EVALUATION OF RENEWABLE ENERGY STRATEGIES IN THE DOMINICAN REPUBLIC

ANGELINES DAIHANA DONASTORG SOSA

B. Eng., MSc., PG Cert.

University of Wolverhampton

Faculty of Science and Engineering

Department of the Built Environment

PhD thesis 2019

Evaluation of renewable energy strategies in the Dominican Republic

Angelines Daihana Donastorg Sosa

B. Eng., MSc., PG Cert.

A thesis submitted in partial fulfilment of the requirements of the University of Wolverhampton for the degree of Doctor of Philosophy (PhD)

October 2019

This work or any part thereof has not previously been presented in any form to the University or to any other body whether for the purposes of assessment, publication or for any other purpose (unless otherwise indicated). Save for any express acknowledgements, references and/or bibliographies cited in the work, and I can confirm that the intellectual content of the work is the result of my own efforts and of no other person.

Signature……………………………………………….

Date……………………………………………………….

ABSTRACT

The Dominican Republic electricity sector has been in crisis for decades, because of the ageing grid system, technical and nontechnical losses and the dependency of around 85% of its electricity from fossil fuel. However, the situation in the Dominican Republic is contradicting; the country has high renewable energy potential for generation, the international support, aid and funds, the willingness of the private sector, and the 57-07 law for incentives for renewable energy projects yet out of 200 renewable projects approved only 4 have been successfully implemented and are in operation. Why did so many projects fail? Why has the country had so difficulties making the transition? Those were some of the questions that drove this research. To answer those questions an exploratory qualitative research was undertaken with a pragmatism ideology at its core, due to the lack of documentation on the subject. The research focused on the energy sector especially electricity from renewable sources. To understand the environment for renewables in the country and lack of success in the area twenty-five key stakeholders representing the renewable sector in the country were chosen and through purpose and snowball sampling were interviewed in a semi-structured manner, as to allow for the participants to express the knowledge they possess. Through the literature review and the content and interpretive structural modelling analysis of the interviews, key drivers, challenges, critical success factors, benefits, financial tools and business model were identified, and their interlinking relationship was discovered. This identification and interconnectivity of the parameters aid in the creation of a successful framework for the implementation of renewable energy projects in the country, that could be used be the private and public sector of the country, the auto producers and local and international investors, which was the aim of the research.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

Through the journey of this research, I have received a great amount of support and assistance. I would first like to thank the Government of the Dominican Republic for sponsoring this research without their support this research would still be a dream.

My most sincere thanks to the supervisory team, Doctor Suresh Renukappa and Doctor Subashinni Suresh, who guided, provided feedback and unwavering support to make this research a reality. Also, guided the writing of this dissertation correctly and provided insightful feedback for its completion.

I thank the University staff and researchers at the Faculty of Science and Engineering of the University of Wolverhampton for their advice and input in the process and during the whole research.

I would like to thank my friends and family for their support, encouragement and understanding nature that help me through a lot of difficult times in this research process.

DEDICATION

This thesis is dedicated to my family and loved ones

and in memory of my parents, Hector Donastorg and Maritza Sosa

and my grandfather Andres Sosa.

LIST OF ACRONYMS AND ABBREVIATIONS

AC: Alternating Current

ADEME: French Environment and Energy Management Agency

AES: AES Corporation Electric power distribution company

BHD Leon: Dominican Mortgage Leon Bank

CDEEE: Dominican state Corporation of electric enterprises

CDM: Clean Development Mechanism

CEPM: Punta Cana-Macao Energetic Consortium

CEPP: Puerto Plata Electricity Company

CNE: National energy commission

CO2: Carbon Dioxide

CPA: Authorized Public Accountant

CRI: Cost Recovery Index

DC: Direct Current

DGII: Directorate General of Internal Taxes

DIF: Diffuse horizontal irradiation [kWh/m2]

DNI: Direct normal irradiation [kWh/m2]

DR: The Dominican Republic

EGEHID: Dominican Hydroelectric Generation Company

EIA: Environmental Impact Study

GDP: Gross domestic Product

GEF: Global Environment Facility

GHG: Green House Gas

GHI: Global horizontal irradiation [kWh/m2]

GPS: Global Positioning System

GTI: Global irradiation for optimally tilted surface [kWh/m2]

GWh: Gigawatt-hour

ICT: Information and Communications Technology

IDB: Interamerican Development Bank

IEA: International Energy Agency

IEC: International Electrotechnical Commission

IFC: International Finance Corporation

INTEC: Santo Domingo Technological Institute

IPI: Real Estate Property Tax

IRENA: International Renewable Energy agency

ISM: Interpretive Structural Modelling

ITC: investment tax credits

KPMG: Klynved Peat Marwick and Goerdeler

kWh: kilowatt-hour

LAC: Latin American and Caribbean Region

LCOE: levelized cost of electricity

MEM: Ministry of Energy and Mines

MIMARENA: Ministry of Environment and Natural Resources

MNES: Multinational Enterprises in the Global Economy

NAMAs: Nationally Appropriate Mitigation Action

NOx: Nitrogen Oxide

ONAPI: Organization in the National Office of Industrial Property

OPTA: Optimum tilt to maximize yearly yield [°]

PPA: Power Purchase Agreement

PTC: Production tax credit

PUCMM: Pontifical Catholic University Mother and Teacher (Pontifica Universidad Católica Madre y Maestra)

PVOUT: Photovoltaic power potential [kWh/kWp]

PWC: PricewaterhouseCoopers

RD$: Dominican Currency Pesos

RE: Renewable Energy

REBM: Renewable Energy Business Models

RNC: National Taxpayer Registry

SENI: National Interconnected Electrical System (Sistema Eléctrico Nacional Interconectado)

SIDS: small-island developing state

UN DESA: United Nations Department of Economic and Social Affairs

UNDP: United Nations Development Programme

UNFCCC: United Nations Framework Convention on Climate Change

USAID: U.S. Agency for International Development

USD: U.S. dollar

UTM: Universal Transverse Mercator Coordinate System

WB: World Bank

WWTP: Waste Water Treatment Plant

RESEARCH OUTPUTS

Journal papers

- Donastorg A., Renukappa, S., and Suresh, S., (under review) An evaluation of Renewable Energy Business Models for Developing Countries: A Critical Review, Renewable & Sustainable Energy Reviews journal, Elsevier publication (Impact factor 7.896).
- Donastorg A., Renukappa, S., and Suresh, S., (under review) Evaluation of CSF for the implementation of renewable energy in the Dominican Republic, Targeted journal: Renewable energy- An International Journal, Elsevier publication (Impact factor 4.068).
- Donastorg A., Renukappa, S., and Suresh, S., (under review) Financing renewable energy projects in the Dominican Republic: An empirical study, Targeted journal: Renewable Energy - An International Journal, Elsevier publication (Impact factor 4.068).

Conference papers

- Donastorg A., Renukappa, S., Suresh, S., and Gross J., (2016) Renewable Energy Business Model for Developing Countries, The 7th World Renewable Energy Technology Congress, August 18-25, New Delhi, India.
- Donastorg A., Renukappa, S., and Suresh, S., (2016) Renewable Energy Business Models for Developing Countries: Case study of the Dominican Republic, International Conference on Water, Energy & Climate Change, WECC-2016, Marrakech, June 1- 4, Morocco.

- Donastorg A., Renukappa, S., and Suresh, S., (2017) Financing renewable energy projects in developing countries: A case study of the Dominican Republic. ICGET second international conference on green energy technology, Rome, Italy, July 2017.
- Donastorg A., Renukappa, S., and Suresh, S., (2017) Evaluation of CSF for the implementation of renewable energy in the Dominican Republic. ICSF Bahrain 2017 (Winner of best sustainable paper)

Poster competition:

Winners of the 2016-2017 University of Wolverhampton poster competition.

Chapter 1 . Introduction

This starting chapter presents the current problem for implementing renewable energy projects in the Dominican Republic. It also presents the research aim, objectives, research questions, the limitations and scope of the research and finally the structure of the dissertation.

1.1 The current problem

It is indisputable that the growing concerns over climate change are provoking a worldwide transformation in the way that governments and industries seek to supply energy while at the same time learning, creating and implementing new measures to aid in minimising greenhouse gas emissions and other environmental impacts.

One of the primary energy policy strategy applied in many countries worldwide is the employment of renewable energy sources (RES). Because energy is one of the leading sectors that fuel global economic activity. Consequently, the expansion in population growths, which is estimated by the United Nations (2017) to be 2.3 billion more people by 2050 compared to 2016, the living standards and demand, that are estimated by McNabb (2019) to increase by 21% by 2030, are interlinked and influence the development of a country.

The decisions made and implemented by countries government for and on the energy sector infrastructure, especially in the investment aspect, would lock the financial strategy at the very least for a few decades. This relates to how efficient the energy sector growth across the economy. The energy sector is directly connected to the sustainability and vibrancy of a countries economy. Any major decision made in the Energy sector will have a ripple effect throughout the economy point and case of the Dominican Republic (DR).

The DR was chosen as a case study for several critical reasons: (1) As the country is the sponsor of this research (2) The DR is the second biggest contributor of CO2 emission in the Caribbean region with 2.214 tonnes per capita per year (Janssens-Maenhout *et al.*, 2017) and (3) The Dominican Republic's electricity generation is over 85% from imported fossil fuels and its derivative, which the country has to import from different places, especially from Venezuela has the two countries have an agreement for this called PETROCARIBE (Latinamerica and the Caribbean economic system, 2015).

However, the renewable energy potential of the Dominican Republic is exponential: the local wind potential is of 100-10000 MW, the tremendous solar potential that ranges from 5 to 7 kilowatt-hours per square meter per day (kWh/m2 /day) throughout most of the country, and approaches 8 kWh/m2 /day in some regions. This potential is more significant than Germany, that has few locations above 3.5 kWh/m2/day, and more than Phoenix, Arizona (USA) famed for its solar potential, that possesses an average of 5.7 kWh/m2/day(International Renewable Energy Agency, 2016).

The Renewable sources of the DR could fulfil the country's energy demand entirely and help create an energy economy and business with the rest of the Caribbean. However, fossil fuel dependency makes the country's economy exceedingly susceptible to global oil price fluxes. That creates an unbalanced trade, while also contributing to pollution and global climate change.

1.2 Aim and objectives of the research

This research aim is to evaluate the status of renewable energy strategies in the Dominican Republic. For developing a strategic framework for renewable energy infrastructure implementation in the Dominican Republic as a possible solution for the energy crisis that the country faces and to improve the development and quality of life of its citizens. To achieve the aim, the following objectives were developed.

1.2.1 Objectives

- To review the literature related to renewable energy sources and infrastructure in general and the Dominican Republic.
- To investigate the critical renewable energy related business models' initiatives that have been or planned to be implemented in the Dominican Republic
- To analyse and document the drivers for the implementation of renewable energy projects in the Dominican Republic.
- To explore the essential renewable energy-related financial tools and policies initiatives that have been or planned to be implemented in the Dominican Republic
- To study and record the challenges of implementing renewable energy projects in the Dominican Republic
- To examine and detail the critical success factors of implementing renewable energy project in the Dominican Republic
- To investigate and document the benefits of implementing renewable energy projects in the Dominican Republic

- To develop and validate a strategic renewable energy management framework for the benefit of Dominican Republic organisations.

1.3 Research questions

1. *What is the status of renewable energy worldwide? In the Dominican Republic?*
2. *What business strategies have been used in the Dominican Republic for the implementation of renewable energy projects?*
3. *What are the key motivations for implementing renewable energy projects in the Dominican Republic?*
4. *What essential financial policies and tools are available for implementing renewable energy projects in the Dominican Republic*
5. *What challenges does the implementation of renewable energy projects face in the Dominican Republic?*
6. *What are the factors that could guarantee the successful implementation of renewable energy projects in the Dominican Republic?*
7. *What are the possible benefits that the Dominican Republic could achieve by implementing renewable energy projects?*
8. *What process could be followed or implemented to guarantee the successful implementation of renewable energy projects in the Dominican Republic?*

   The corresponding research objective and question is explained below in Table 1-1. Linking table of research objectives, question and chapters (RO= research objective, RQ= research question).

Table 1-1. Linking table of research objectives, question and chapters (RO= research objective, RQ= research question)

Objective No.	**Research Objectives**	**Research question No.**	**Research question**	**Chapter**	**Method of analysis**
RO1	To review the literature related to renewable energy sources and infrastructure in general and the Dominican Republic.	**RQ1**	What is the status of renewable energy worldwide? In the Dominican Republic?	**Chapter 2**	**Literature review**
RO2	To investigate the key renewable energy related business models' initiatives that have been or planned to be implemented in the Dominican Republic	**RQ2**	What business strategies are been used in the Dominican Republic for the implementation of renewable energy projects?	**Chapter 4**	**Semi-structure interviews**
RO3	To analyse and document the drivers for the implementation of renewable energy projects in the Dominican Republic.	**RQ3**	What are the key motivations for investing or implementing renewable energy projects in the Dominican Republic?	**Chapter 5**	**Semi-structure interviews**
RO4	To explore the essential renewable energy-related financial tools and policies initiatives that have been or planned to be implemented in the Dominican Republic	**RQ4**	What essential financial policies and tools are available for implementing renewable energy projects in the Dominican Republic	**Chapter 6**	**Semi-structure interviews**
RO5	To study and record the challenges of implementing renewable energy projects in the Dominican Republic	**RQ5**	What challenges does the implementation of renewable energy projects face in the Dominican Republic?	**Chapter 7**	**Semi-structure interviews**
RO6	To examine and detail the critical success factors of implementing renewable energy project in the Dominican Republic	**RQ6**	What are the factors that could guarantee the successful implementation of renewable energy projects in the Dominican Republic	**Chapter 8**	**Semi-structure interviews**
RO7	To investigate and document the benefits of implementing renewable energy projects in the Dominican Republic	**RQ7**	What are the possible benefits that the Dominican Republic could achieve by implementing renewable energy projects?	**Chapter 9**	**Semi-structure interviews**
RO8	To develop and validate a strategic renewable energy management framework for the benefit of Dominican Republic organisations.	**RQ8**	What process could be followed or implemented to guarantee the successful implementation of renewable energy projects in the Dominican Republic?	**Chapter 10**	**Systematic framework creation**

1.4 The methodology of the research

The methodology of this research is grounded in pragmatism as the lack of resources available created the need for an exploratory study. This need led to a qualitative approach as to answer the question and objectives proposed by the researcher (Table 1-1. Linking table of research objectives, question and chapters (RO= research objective, RQ= research question)). Due to challenges in the collection of the data, addressed in chapter 3, both purpose and snowball sampling were used to obtain and collect the documents and interviews of the key stakeholders of the energy sector in the Dominican Republic.

For analysing the data, a content analysis was performed, to correlate the different results an ISM analysis was performed and finally with the results a framework was created for the successful implementation of renewable energy in the Dominican Republic (See Table 1-2. Summary of the methodology of the research).

Table 1-2. Summary of the methodology of the research

Research	**Qualitative research**
Ideology	Pragmatism
Approach to enquiry	Qualitative
The main purpose of the investigation	Exploratory research due to the complexity of renewable energy issues and the paucity of comparable research in the area
Sample technique	Purposive snowball sample
Sample size	25
Sample diversity	Directors, CEO’s Ministers
Data collection method	Semi-structure interviews
Unit of analysis	Energy Industry
Embedded unit of analysis	Individual employee
Method of analysis	Content analysis and Interpretive Structural Modelling
Outcome of analysis	Framework

1.5 Benefits of the research

This study will be of benefit to the public and private sector of the energy infrastructure in the Dominican Republic, more specifically to: auto-producers, private generating companies, public generating companies and the energy distributor. The results of the research will:

- Aid in understanding the implementation process for renewable energy in the Dominican Republic
- Improve the knowledge regarding the essential drivers that promote the implementation of renewable energy projects
- Assist policy and decision makers in understanding the forces that drive the need to change the development strategies towards a sustainable at its core plan.
- Guide organisations to effectively manage the renewable energy project implementation and the challenges that this change brings.
- Improve awareness and education regarding renewable energy projects
- Supply evidence of the benefits that renewable energy projects can provide for a country or organisation.

1.6 Contributions to knowledge

- This research contributes first with this body of work that will be added to the reports and documents available for the study of the Dominican Republic's renewable energy sector. This study can be used as a foundation for futures studies (see future work in Chapter 11).

- The guide for permit solicitation created in this research will aid future investors in the steps to obtain the needs documentation for renewable energy projects in the Dominican Republic
- The discovery of the core drivers for renewable energy business models in the Dominican Republic: (1) Environmental conscience and funds and (2) climate change targets
- The determination of the critical driver for implementation of renewable energy projects in the Dominican Republic: Environmental conscience and funds
- The discovery of the main financial tool for implementation of renewable energy projects in the Dominican Republic: Loans
- Provided the key challenges for the implementation of renewable energy projects in the Dominican Republic: (1) leadership and (2) knowledge of RE
- The extraction of the key critical success factor for the implementation of renewable energy projects in the Dominican Republic: Transparency
- Yielded the critical benefit for implementing renewable energy projects in the Dominican Republic: (1) Environmental and public health and (2) energy independence
- The framework that will aid private, public and international investors in successfully implementing the renewable energy projects in the Dominican Republic.

1.7 Limitation and scope of the research

The research is exploratory nature due to the complexity and lack of literature on renewable energy and the inner workings of the Dominican Republic. Like any research, the limitations are an important part as this identifies the scope and highlights the future work. For this research the limitations were:

- Although the study explains renewable energy in a generalised way, the focus of the research is the Dominican Republic. As such, the framework created is specifically for the Dominican Republic, and some of the components can be globally used. However, the successful implementation will depend on the specific situation of the country it has been implemented on. The energy status of the country will define the drivers, challenges, critical success factors and benefits of the framework.
- Renewable energy is used in 4 distinct areas: Electricity generation, air and water heating/cooling, motor fuel and off-grid urban electricity generation. For this research, the focus is on electricity generation on the grid for urban and rural areas.
- The lack of written information regarding the country's renewable energy infrastructure
- The fact that the research focuses on renewable energy in the Dominican Republic and not one specific renewable energy. This was due, to the lack of information led to the exploration of the sector as to better understand the way the infrastructure work before exploring one renewable energy in more detail.

- The lack of renewable energy projects limited the research to experts from the solar, wind or biomass. While more renewable energies are available in the country, this has not been explored or exploited.
- The interviews were of a limited number as the population of renewable energy experts in the country is very limited
- The study focuses on the energy industry and experts in the area. However, the knowledge that the general population is unknown as research in this area has not been done and did not fall under the scope of this research.

1.8 Structure of the dissertation

The flow of the dissertation was made logically so that the reader can follow along while gaining insight and understanding into firsts: Why the research was done, how the objectives and research questions were achieved and how the framework and conclusions were constructed. The layout is in a logical sequence commencing with the introduction of a chapter and ending with the conclusions and recommendations of the chapter.

The sequence is as follows: Chapter 1 introductions, chapter 2 literature review, chapter 3 methodology, chapter 4-9 discusses the data analysis and describes the way each objective was achieved, chapter 10 is the construction, layout and functionality of the framework, chapter 11 is the conclusions and recommendations while chapter 12 is the bibliography, finally appendix A-C represent the raw data from the interviews and validation.

Chapter 2 . Literature Review on Renewable Energy

2.1 Introduction

In this chapter, an in-depth review of the known literature of renewable energy is presented, making emphasis in the Dominican Republic. The chapter is divided into the critical components of renewable: (1) Definition of renewable energy (2) the known renewable (3) Business strategies of renewable energy (4) the financial policies and tools (5) key drivers for implementation (6) main Challenges and (7) the benefits of renewable energy. The purpose of this literature review is not just to have a thorough understanding of the field of renewable but to also answer the first research objective and question:

"*To review the literature related to renewable energy sources and infrastructure in general and the Dominican Republic."*

"What is the status of renewable energy worldwide? In the Dominican Republic?"

It is an indisputable fact that energy has become an indispensable (essential) human necessity, along with air, water, food and shelter. In addition to the importance of energy is its demand, due to the growth and future growth of the world population.

The world population, as of 2014, of 7.3 billion is projected to range 8.5 billion by 2030 and 9.7 billion in 2050 (United Nations Department of Economic and Social Affairs (UN DESA). 2015) that is 2.4 billion more people compared to 2015. Also, 90% of this increase will be in developing countries alone (World Bank, 2015). Understanding the population growth, the changes, challenges and opportunities that this increase will produce are the keys to designing, implementing and achieving sustainable development in the world (UN DESA, 2015).

The cumulative global emissions of developing countries have always been lower than in developed countries, at 48% and 52%, respectable, from 1850 to 2010 (UN DESA. 2015). However, as Beltramello *et al.* (2013) explain (taking the growth in population into account and projecting the possible emissions for the next 35 years and adding all greenhouse gas (GHG) emissions) the prediction for developing countries is to surpass that of the developed. By 2020, these countries could be responsible for approximately 51%of emission and exponential increase the following years. Hence, somewhere during the current decade, an urgent need to address the sustainability issues in these countries must be established to avoid a larger climate change development.

Billions of new consumers with needs for housing, food, water, clothing, transport but most importantly energy, will be created by the growth of population. However, the future projection of the world situation shows that this current growth could not be sustained, due to the reduction in the availability of natural resources, the environmental deteriorating, climate change and economic difficulties of developing countries (Asif and Muneer, 2007 and Gross, 2015).

The scenarios that the Energy Council (2013) has developed (for the “Business as Usual” projection for 2013-2050) show that the world energy demand will be about 80% higher. Fossil fuels will still account for 85% of the energy mix, and GHG emissions are estimated to rise by 50%, primarily powered by energy use that would create a 70% growth in CO_2 emissions. Also, Ajayi (2011) and Beltramello *et al.* (2013) both suggest that the water demand is projected to increase by 55%, with the electricity sector demands responsible for a significant amount of the surge for 2050 compared to 2013 level.

For this research three global trends were easily identified with simple observation (theme) as the literature itself is already organised in: (1) energy potential, (2) Energy implementation and (3) energy efficiency and (4) energy projection. For this research the focus was placed on energy Implementation. Again, the literature on a global (Bouckaert, Mazauric and Maizi, 2014; Schelly, 2014 and Mondal, Kamp, and Pachova, 2010) based is already clear on the characteristic of implementation of renewable energy which are: (1) Renewable energy strategies or business model for implementation (2) drivers for implementation (3) financial tool available for implementation (4) challenges or barriers for the implementation and (5) the Benefits of implementation of renewable energy projects.

These five characteristics became the themes to identify not just in the literature for the Dominican Republic but also became the guiding areas for the creation of the interview protocol and the themes for the content analysis of the interviews. The following sections will discuss these themes in a global level and then in a smaller scale for the Dominican Republic.

2.2 Overview of the Dominican Republic

The Latin American and Caribbean region is of great importance, it may only have 8.5% of the world population, but it produces 12% of the global emissions. The Dominican Republic is one of the highest CO_2 and GHG emitters of the region and the third largest energy consumer in the Caribbean, after Cuba and Puerto Rico(International Renewable Energy Agency, 2016). This small island located in the Caribbean Sea (see Figure 2-1. The Dominican Republic) possess an area of 48,670 sq. km, a population of 10.18 million people according to the national renewable energy laboratory (2015), with a growing economy of 4.0% per year per the Canadian trade commissioner Service (2018) and an electric energy demand growth of 4%-7.8% per year, with a GDP of 12,800 USD and the energy sector represents 3.4-8% of the GDP according to the national renewable energy laboratory (2015). The DR, due to its strategic location in the equator is in a position of high renewable energy potential, as will be discussed in sections 2.11. Although the Dominican Republic's natural resource endowment is very favourable to expand the use of renewable energy the country is failing to utilize this enormous potential and plans to invest further in coal and natural gas power.

Petroleum-based power plants remain the largest generation source 85% of the energy matrix, fired by costly imported fuel. This high reliance on fossil fuel imports makes the country vulnerable to international oil price shocks, posing an economic burden for homes and businesses. With electricity demand projected to grow at an average of 4-7.8% annually through 2030, these economic costs will likely only worsen in the future (DOE's, 2010).

Figure 2-1. The Dominican Republic Geographic map.

(Source CNE,2019)

The Dominican government is tasked with guiding the transition to a truly sustainable electricity system to ensure simultaneous security of supply, affordability, and environmental integrity. Given the country's projected demand growth and plans to add substantial additional capacity, it must make decisions now that will shape the energy sector for the coming decades.

2.3 The Dominican Republic's Energy Goals

The country's Intended Nationally Determined Contribution (INDC) sets an ambitious national target to reduce the country's GHG emissions by 25% by 2030 compared to the 2010 level (See Table 2-1. Sustainable goals of the DR). Also, the DR has signed numerous international agreements the latest one the Paris accord to increase the installed generation capacity of renewable energy to 25% to 2025. Now the renewable energy installed in the Dominican Republic is 19.5%.

Table 2-1. Sustainable goals of the DR

(source República Dominicana, 2012)

No.	Sustainable Energy Goals of the DR
1	Reduction of Greenhouse Gas emissions by 25% by 2030
2	Reduce fossil fuel import dependency
3	Reduce the local and global impacts of fossil fuel combustion on the environment
4	Increase renewable energy in the power generation mix by 25% by 2025 (Law 57-072)
5	Rural Electrification program with off-grid renewable projects
6	Blackout reduction programme

2.4 Energy Infrastructure

Renewable energy forms part of the energy infrastructure. This infrastructure is formed by the technologies, business models, fossil and renewable portfolio, financial and political laws need to direct and manage the energy flow from generator to distributer to the consumer. In essence as Mondal *et al.* (2016) explains the energy infrastructure could be defined as the interconnection between the demand and supply of energy. Around the world, the energy industry is confronting exceptional but essential change. Fast and widespread technological developments for the generation and dissemination of electricity, has greatly influenced the energy suppliers and consumers.

The generation or production of energy is done by the transformation of primary energy resources (coal, crude oil, nuclear, hydro, gas, renewable) into secondary energy sources (electricity, biomass, petroleum, liquefied petroleum gas). Of these primary sources fossil fuel is used in 85% worldwide (Frankfurt school- United Nations Environment Programme, 2016). Secondary energy sources are referred to as energy carriers. While many ways exist to categorise the entire energy infrastructure, for the purpose of this research the energy infrastructure was divided into:

- Electricity Infrastructure
- Fossil fuel based
- Renewable energy
- Transportation infrastructure fuel

Due to the nature of the research, the focus will be on the electricity infrastructure and not on transportation.

2.5 Electricity Infrastructure

Electricity infrastructure as explained in section 2.4, forms part of the energy infrastructure. The foundation of the electricity infrastructure is the generation, distribution and transition of primary energy sources into energy carriers, specifically electricity.

The electricity sector is composed of the energy source; for this research, this area will focus on renewable energy, the business model and financing of the sector. These components will be further described below on sections 2.6-2.12. This sector possesses three main actors: the generators and distributors that can be government, private or jointly own and the consumers.

2.6 The electricity sector in the Dominican Republic

In the Dominican Republic, the electricity sector represents only 24% of the energy sector (IRENA, 2016). This 24% energy demand is composed of 46% demand from the industrial sector 42% of the residential sector and 11% public and commercial services. The DR's transmission lines connect approximately 92% of the country to the energy grid (See Figure 2-2. Transmission lines), and around 96% of the population has access to electricity. However, of this 96% of the population around 60% receive a proper electricity service.

Due to the high rate of distribution losses, one of the highest rates of distribution losses in the world, at around 32.93% according to the National Energy Commission in the Dominican Republic (2017). These distribution losses create regular shortages, blackouts and grey-outs in the distribution system to the users.

For example, in 2017-2018, 15.07% of the energy demand, went unfulfilled. This 32.93% of distributed losses is divided into technical losses, around 12%, due to technical inefficiencies at generation plants, substations, and transmission lines, which contribute roughly USD 100 million to the electricity sector's deficit, and non-technical losses, around 20.93%, due to electricity theft costing the country an estimated USD 1 billion in 2014—about 1.7% of national GDP—through budgetary transfers to the electricity sector.

Figure 2-2. Transmission lines in the Dominican Republic

(source, CNE, 2019)

The Dominican Republic's reliance on fossil fuels for electricity generation results not only in massive transfers of wealth to other countries for imports but also in high generation costs per unit of electricity. The Dominican Republic is one of the fourteen countries that have a standing agreement with Venezuela called PETROCARIBE or petroleum for the Caribbean, as part of the CARICOM or Caribbean community way to aid one another (Konold *et al.*, 2015). However, this agreement still leaves the Dominican Republic vulnerable to the flux of fossil fuel prices and supply. Also, because electricity prices are not indexed to fuel prices, but rather are set by the government's price cap, distributors sell electricity for a much lower price than is economical.

The electricity infrastructure in the Dominican Republic is divided into: the purchase of the fossil fuel, the division of the fuel between transportation, cooking and electricity, distribution of the energy source to the generators, conversion of the primary energy source into a secondary in this case electricity, transport the energy to the Transmission of electricity enterprise for Dominican Republic (ETED), then to the distribution company and finally to the consumers. To visualise the supply chain that is the energy infrastructure in the DR Figure 2-3. Energy infrastructure in the Dominican Republic based on research. was created.

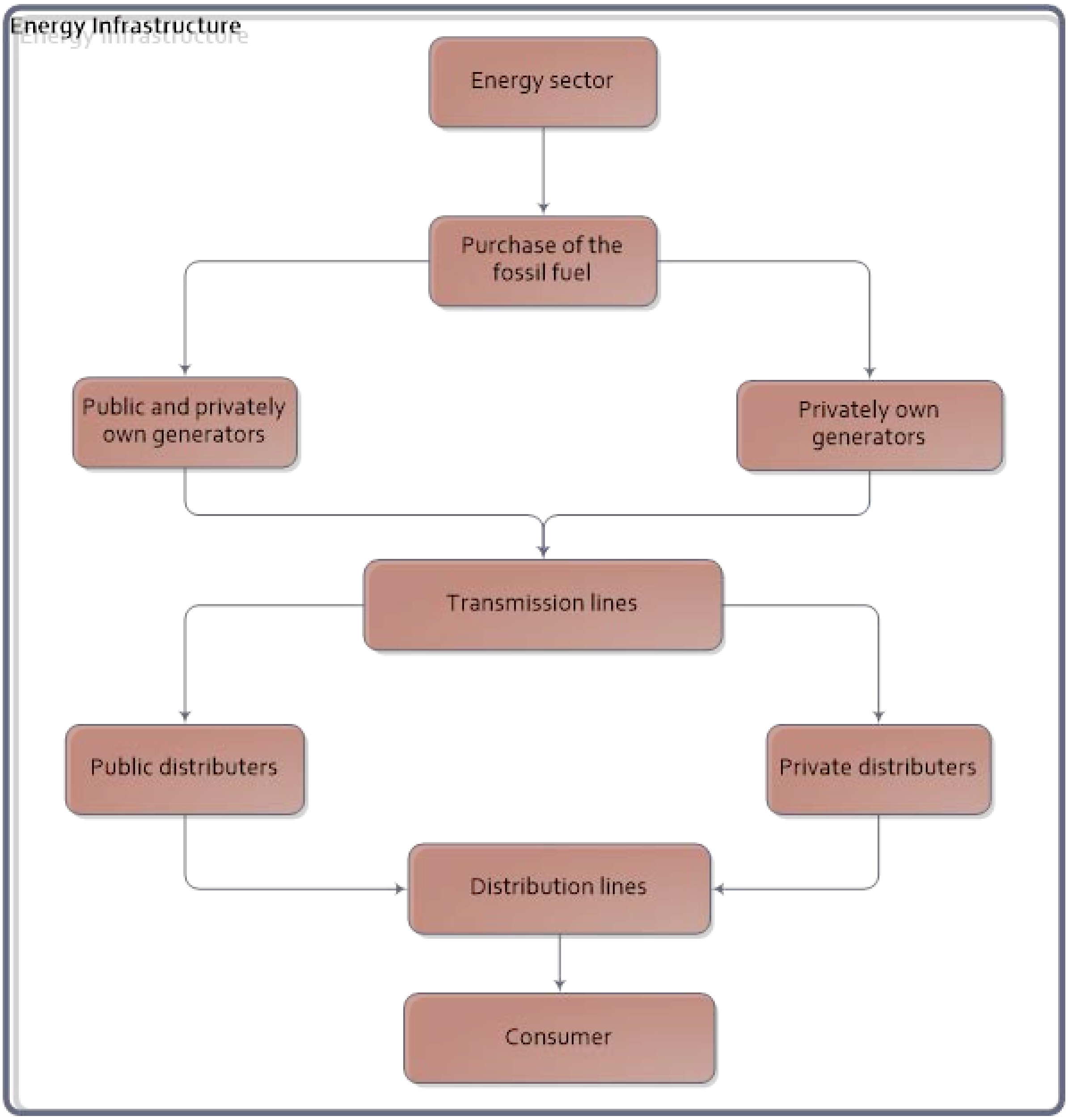


Figure 2-3. Energy infrastructure in the Dominican Republic based on research.

2.6.1 Generators

The generators have the important task of converting the primary source of energy into the secondary in the form of electricity. The Dominican Republic generator system is composed of 58 generators: (1) one solar farm (30MW) (2) one biomass plant (30MW) (3) two wind farms (134.5MW) (4) 24 hydroelectric (608MW) and (5) 30 fossil fuel plants(2832MW) (see Figure 2-4. Dominican Republic's current energy generation map with locations) for a total of generation capacity of 3634.5 MW. This installed capacity is more than enough to satisfy the ±2.0 GWh of peak demand in the Dominican Republic.

However, in the Dominican Republic most of the fossil fuel power plants that provide 85% of the country's electricity generation are several decades old and need greater maintenance or to be replaced altogether. For example, 2013 the government started the construction of a coal thermal power plant to replace two power plants. However, as of 2019, the plant Punta Catalina has not been placed in operations or finished. Although the idea of replacement of the two power plants (ITABO I and ITABO II) that were going out of commission was good, the fact that the business as a usual strategy of the country's government was to replace fossil fuel with fossil fuel, demonstrates the lack of awareness and investment into renewables. Also, the coal power plant cost the country around 2 billion US dollars, with the same amount over 10 wind farms could have been built and operational by 2019 providing over 50% of the electricity demand of the country.

In addition, due to the unreliability of the national grid, many industries and private individuals generate their own electricity using relatively inefficient small-scale fossil fuel-based units and in more recent years, small-scale roof solar units and even small-rooftop wind turbines. This further perpetuates high consumer electricity prices and a dependence on imported oil. This dependency along with a lack of transparency, inadequate transmission lines, underperformance of the generators, frequent power cuts and high consumer electricity prices have resulted in making the electricity sector a national crisis, while at the same time promoting a no pay culture in the population, due to the lack of trust in the energy sector and in the different entities involved (International Renewable Energy Agency, 2016).

Over the past decade, the Government has restructured the sector and made major progress in the technical area. However, improving the poor quality of the power supply, education of the population, transformation to renewable are the most urgent issues that still need to be addressed to put the sector on a sound financial and technical footing. These issues are locked in a vicious circle, as poor quality of service, customer dissatisfaction and high tariffs have induced theft through illegal connections and non-payment of electricity bills by businesses and households, at times with the connivance of staff of the distribution companies. This, in turn, has left the distribution companies without the resources to make the necessary improvements.

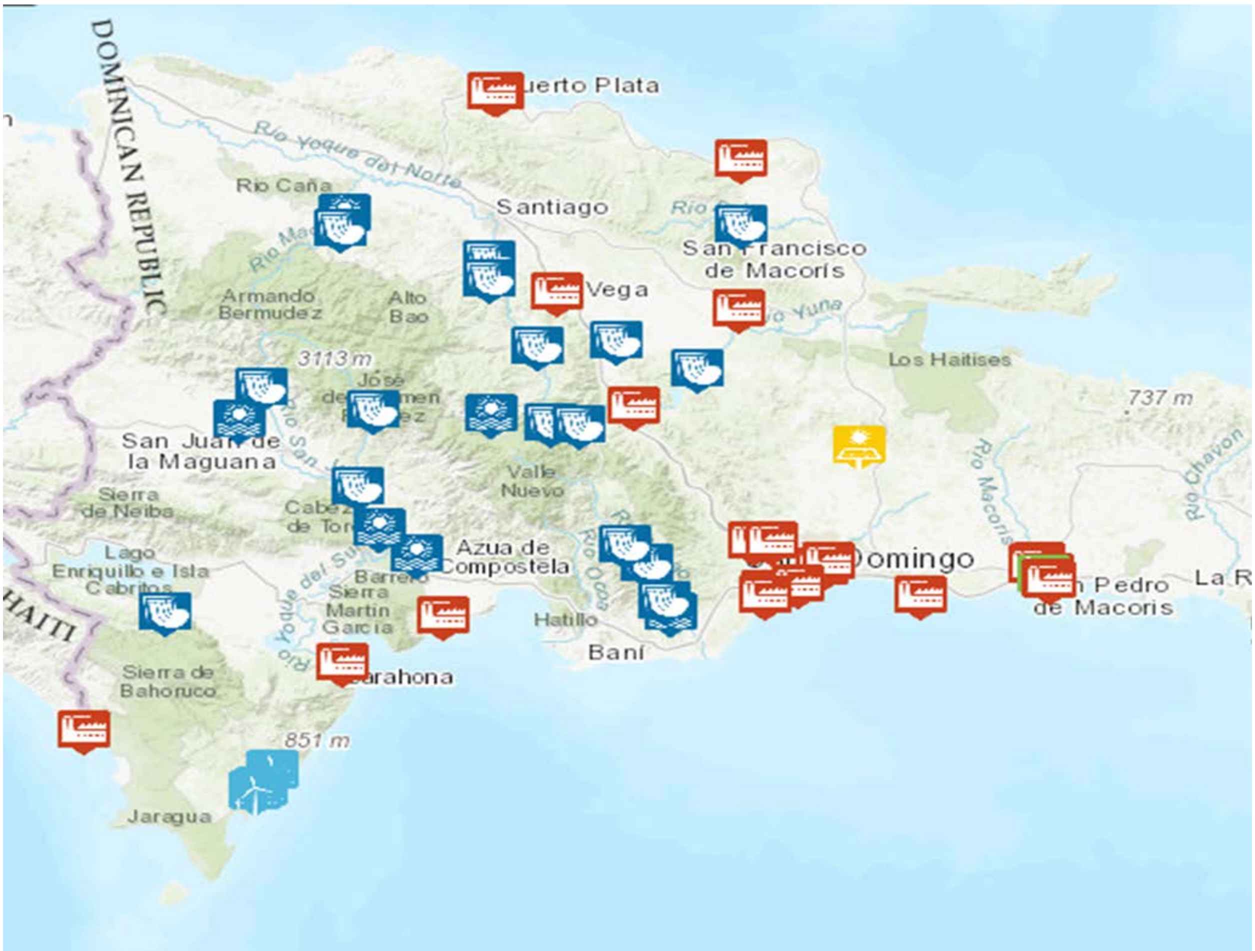


Figure 2-4. Dominican Republic's current energy generation map.

(source CNE,2019)

2.6.2 Distribution

Distribution of the electricity in the Dominican Republic is done by a state own company called Dominican Electricity State Corporation Enterprise or CDEEE(Ochs, 2011). This entity is further divided into three subsidiaries to provide services in the three different regions of the country: EDEnorte or electricity distributor enterprise of the north, EDEsur or electricity distributor of the south and EDEeste for the east. The three EDEs supply electricity to all regulated customers and to a fraction of the 40-50 non-regulated (demand higher than 2 MW) consumers and manage the energy grid for each region(Konold, 2015). The companies each have about one-third of the market, but EdeSur has the most industrial and commercial users, followed by EdeEste, as they divide the Santo Domingo (Capital of the country) market.

The Dominican national electricity grid comprises some 1,657 kilometres of 69 kilovolts (kV) lines and some 1,337 kilometres of 138 kV lines, most of which are in the country's more populated and tourist-oriented areas. The grid also includes a new 345 kV transmission line that spans 160 kilometres between the two largest cities, Santo Domingo and Santiago that helps prepare the country to handle new generation capacity from both fossil and renewable energy projects (National energy commission, 2018). The new line cost just over USD 170 million and is currently being used at only half of its capacity.

In addition to the national grid, there are nine large off-grid systems ranging from 4 to 120 MW in size. The energy matrix according to the National Energy Commission (2016) is comprised of 85% fossil fuel and 15% renewable energy, 12% of which are hydroelectric alone. However as can be seen on Table 2-2. Energy matrix of the Dominican Republic.

(Source, CNE 2010-2016), the tendency of the energy matrix is towards fossil fuel as it is displacing the hydro. In 2015 fossil fuel accounted for 89.91% of the energy matrix. This preference for fossil fuel is evidence of the "business as usual" mentally of the government that needs to be addressed to implement more renewable energy projects.

Table 2-2. Energy matrix of the Dominican Republic.

(Source, CNE 2010-2016)

Energy Matrix of the Dominican Republic					
Resources	2010	2012	2013	2014	2015
Natural gas	9%	24.8%	24.9%	24%	25.92%
Fuel oil no.6	70%	49.1%	33.6%	50%	38.68%
coal	6.2%	12.9%	14.2%	12%	14.03%
hydro	12.4%	10.5%	13.2%	9%	6.26%
Fuel oil no.2	2.2%	2.5%	2.7%	2%	7.59%
wind	0.1%	0.2%	1.7%	1.5%	1.9%
other	12.5%	---	9.7%	1.1%	5.63%

In addition, due to the inadequate connections of the transmission lines, the distribution network suffers from a technical loss of 32% of the energy generated. However, this study has verified the purchase energy by the distributed, and the produced energy by the generators and the losses are greater than 32.93%. According to the report for 2017 by the CDEEE, thanks to the freedom of information act, the purchase of energy for 2017 was of 13.752 GWh, 6.876 times more than the peak demand of the country of ± 2 GWh. In addition, the energy that was charged to the consumer was 9.644.2 GWh, and the paid energy was 9.353 GWh, providing further evidence that the electricity sector is a non-profitable if the country continues the fossil fuel dependency and does not update the system. Given the overall poor status of the network, and the underinvestment in the past, virtually the entire distribution system needs to be rehabilitated.

2.7 Decentralized/Distributed Generation

Decentralisation or distributed generation refers to the production of electricity generated in-situ, meaning in the same place that it will be consume. This can range from as low as a few kW to large MW, depending on size of the consumer (household or industry) (Konold, 2015). Several cities have successfully implemented decentralisation of the energy generation, for example: The Hague in Netherlands, Morris Country in the USA, Berlin in Germany and Stockholm in Sweden (Chmutina and Goodier, 2012).

For the case of the Dominican Republic, Gielen *et al.,* (2016), Konold (2015) and Ochs (2011) agree that distributed generation using renewable energy is a possible solution for the energy crisis of the DR. However, Gielen *et al.,* (2016) only focused on the solar potential for decentralisation and provided a limited projection of the possible applications, accounting for only 8% of the energy demand. This model is insufficient and does not provide a feasible option for the DR. On the contrary, Konold (2015) provided a slightly more complex view of distributed energy by considering both solar and wind. However, Konold (2015) and Ochs (2011) both identified that the DR would face several challenges for the implementation of distributed generation. Some of the challenges are:

- Power Flow reversal: In cases where the power generated is greater than the demand the flow of power can be reversed. This may cause overloads and damage electrical equipment of the system. The DR is already facing voltage regulation issues that have not been resolved.
- Unintentional Island: This is the critical challenge, as this would occur in a system outage, breakers would automatically isolate the section of the grid

that is experiencing the issue. However, a generator that is still providing power to this section could interfere with the isolation command and create longer interruptions of the system.

Other challenges would be: Voltage regulation, harmonic distortion and protection scheme disturbance.

Solutions for these challenges already exist in a passive and active manner to prevent the disconnect of the distributed system. However, the DR would need a clear understanding of the workings of the system, challenges and solutions, currently the country has not displayed such knowledge.

2.8 Electricity Storage

Energy storage systems, including batteries, pumped hydropower, compressed air energy storage, molten salt thermal storage, and hydrogen, can address the intermittency challenge associated with variable renewable energy sources such as solar and wind. These systems store surplus renewable energy generated during periods where production exceeds demand, and then dispatch this energy at times of low renewable generation. Because battery systems are the most mature and widely implemented energy storage technology, they are the most likely option to be implemented in the Dominican Republic in the near term.

There also has been interest in the country in pumped-storage hydro systems, which use excess electricity from power plants during periods of low power demand to pump water uphill to be stored in reservoirs, and then later released as hydropower during periods of high demand. Pumped-storage hydro systems could be paired with solar or wind farms sited near viable waterways. Assessments are needed to determine if there are sites that have potential for pumped-hydro systems and that would minimize the ecological impacts associated with large hydropower development.

2.9 Renewable energy

The agreed upon definition for renewable energy by the Department of the Environment (2010), European Renewable Energy Council (2011) and the International Renewable Energy Agency (2014) is: energy that comes from resources which are replenished naturally on a human timescale such as sunlight, wind, rain, tides, waves, and geothermal heat. Renewable energy is mostly used in four areas: electricity generation, air and water heating/cooling, motor fuels, and rural (off-grid) energy services as a sustainable replacement to the fossil fuel (International renewable energy agency, 2017). In this research, the focus has been in electricity generation on the grid.

2.10 Importance of renewable energy

Climate change continuously affects the foundations of every country and presents a critical challenge to the global community. Especially developing countries as they are more vulnerable to the effects of climate change; due to the evolving social-economic-political climate that they possess. Historically, developing countries have contributed comparatively little to the world's climate crisis. However, according to the (international renewable energy agency and World Bank, 2014) developing-country emissions are increasing, with their combined share of global greenhouse gas output expected to soar in coming decades and surpass developed countries. Unless new approaches are taken to develop low-emissions energy, building, and transport systems, the future of the developing nations is at risk, along with the rest of the world.

The Latin America and Caribbean (LAC) region is already being hit by negative climate change impacts, as evidenced by the bleaching and destruction of coral reefs in the Caribbean, damage to the wetlands in Mexico, more frequent natural disasters in the region, the melting of the Andean glaciers, water shortages, reduced food production, and “unnatural” disasters due to increased storm intensity and rising sea levels (Bull, 2009). Given its vulnerability, mitigating climate change is of paramount importance in the LAC region. Reducing greenhouse gas emissions (GHGs) through improved use of energy and other resources must be part of any climate change mitigation strategy.

Emerging markets, including LAC, represent more than half of the opportunities available for greenhouse gas emission reduction globally. Multitudes of small emitters in these markets could play a critical role in achieving these reductions, using sustainable energy, including renewable energy, energy efficiency and cleaner production (Stein, Ardic and Hommes, 2013).

However, renewable energy is considered a temperamental source, as many environmental factors can affect the generation, such as wind speed, drought, solar intensity, movement, aviary species, the location of the potential resource. These factors affect the perception of renewable energy and create a perception-based risk that provokes fear for developing nations to implement. Regardless of the risk, renewable energy provides many benefits, such as aids in sustainability, aids in reducing CO2 emission and GHG, contributes to the economic growth of a country or entity, create new jobs and its part of the energy independence or energy security (Alrikabi, 2013).

2.11 The Dominican Republic and renewable energy projects

The Dominican Republic like most countries has immense renewable potential. This potential can aid in resolving the decades-long national crisis in the electricity sector that the country possesses. The government has taken steps to address the crisis as the previous section 2.6 explains. In addition, the country as a small island developing state (SIDS) and member of the Alliance of Small Island States (AOSIS) launched along with all the members of AOSIS, in 2009 at the Copenhagen conference, the sustainable energy initiative called SIDS DOCK (International Institute for Sustainable Development, 2009).

This initiative was designed as a docking station to connect the energy sectors in these countries to wider markets for finance, carbon, and sustainable energy sources. SIDS DOCK commits small-island states to work together to develop renewable energy and energy efficiency options and to seek funding from international carbon markets to implement their low-carbon energy strategies. Regarding this initiative, the DR has taken the lead with the percentage of renewable already installed and the financial assistance that it has received from international partners.

The renewable potential and installed capacity in the country is mostly in solar and wind. However, new studies, according to the Ministry of Energy and Mines (2016) are being done to confirm the potential in geothermal, biomass and ocean energy. In

2014 the Government of the Dominican Republic and the Inter-American Development Bank (IDB) signed an agreement for the Geothermal study to be conducted between 2016-2017, in three different areas with theorical potential (the area of Yayas de Viajama near the city of Constanza, the area of Canoa in the province of San Juan and the area of Enriquillo and Pedro Santana in the province of Elias Piña).

However, the results of this study are yet to be publish or made accessible to the public. Another study that was performed on the Dominican Republic was the Hydrokinetic of the Yaque of the north river for the possible generation of energy for the community of Del Paso de la Perra in Manabo in the Province of Jarabacoa, this was done by the Technological Institute of Santo Domingo in 2014. However, this study only evaluated one river and with one hydrokinetic turbine. Due to the lack of resources the study was inclusive and should be performed again in a wider spectrum regarding the different fluvially of the Dominican Republic and the variety of turbines.

Regarding energy projects, the National Energy Commission (CNE) has awarded over 200 permits for renewable energy projects yet only 4 have been developed. Most of the projects have failed due to a combination of lack local financial support, lack of communication between the project's owners/managers and the different government institutions involved and lack of a PPA. These challenges are described in detail on chapter 7.

2.11.1 Energy source

Energy source as the name implies is something that provides useful energy that can be refined or extracted by means of transformation or reaction (Demirel, 2016). Energy sources are divided into primary and secondary energy sources; the difference between them is critical for the balance of energy to count and record the transformation, supply and losses.

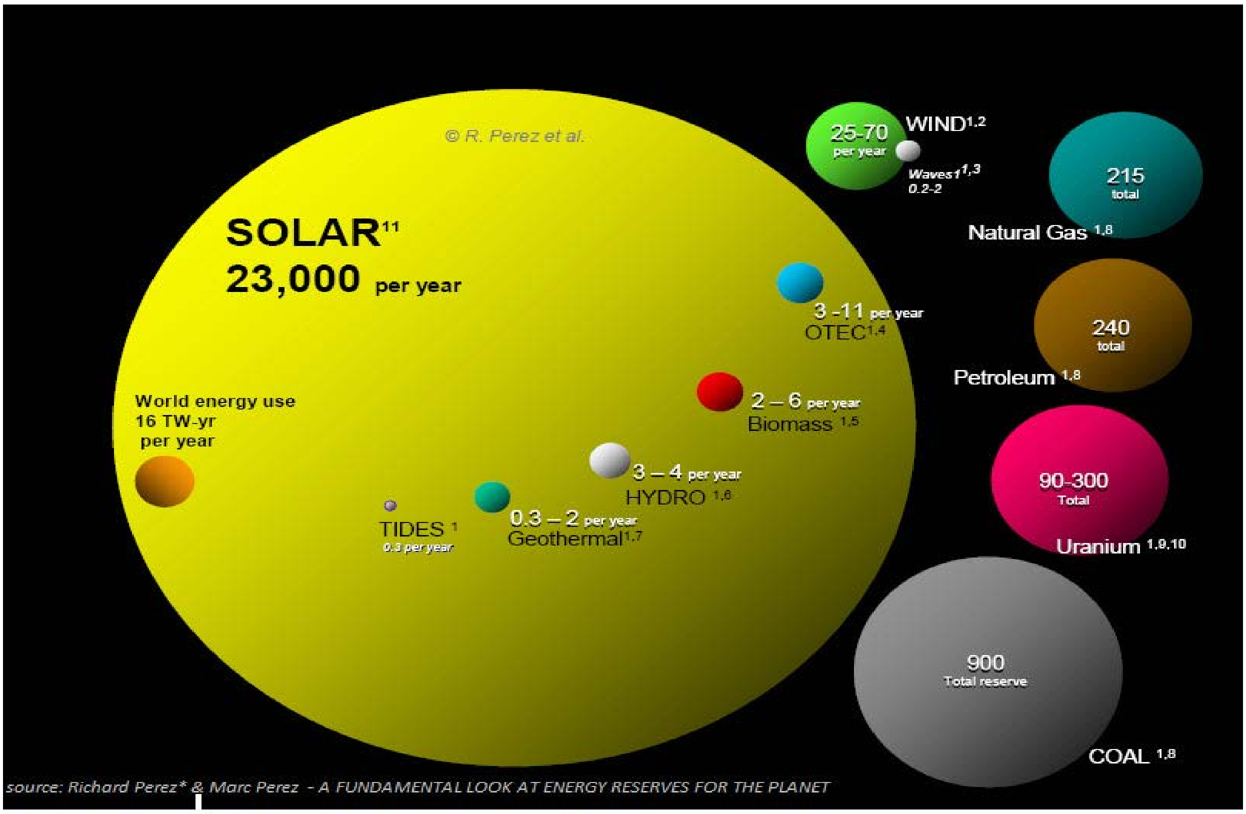
2.11.1.1 *Renewable energy portfolio*

The renewable energy portfolio, not to be confused with the renewable energy portfolio standard, is the description of each energy source that composes the portfolio. This description for this research has been divided into six categories: (1) Energy forecast, (2) Source location, (3) Measurements on site, (4) Management need, (5) Technology available and (6) the available workforce.

2.11.1.2 *Solar Energy*

Per Alrikabi (2013) and Zhang *et al.* (2015) solar energy is power derived from the sun by conversion. This energy falls into two categories: (1) photovoltaic (PV) modules that convert light directly into electricity and (2) concentrating solar thermal power (CSP) systems that convert sunlight into heat energy that is later used to drive an engine, heat water or heat spaces. Solar power can operate at any scale from a household rooftop to a medium-size setting such as resorts and industrial facilities, or as part of a large network of utility-scale PV farms (Warren, 2016).

According to the World Energy Council, (2016), 10% of the total energy that reaches the earth from the sun (60% of the total emitted by the sun) would be four times more energy than the world's electricity generating capacity, around 5,000GW (see



Comparing finite and renewale planetary energy reserves)Terawatt-years).
Total recoverable reserves are shown for the finate resources.

Figure 2-5.Energy sources potential for the world

Figure 2-5, below).

This high potential worldwide and the advance in the technology and cost in solar technology has aided in the rapid adoption of solar energy in many countries. As Closas and Rap (2017) highlight Germany when from 5,877MW to 25,039MW from 2008-2011 and the USA wen from 1,168MW to 5,171MW in the same time period. The benefits of solar are clear (Table 2-3. Characteristics of solar energy) as are the challenges.

Table 2-3. Characteristics of solar energy

(source: IEA and World Bank, 2014)

Solar Energy Characteristics	
Benefits	• Can produce electricity without emitting greenhouse and toxic gases such as CO2 and NOx • Reduces electricity bills • Creates new jobs • Easy and quick installation of any scale • Low maintenance • Diverse use • Continuous research and development technology
Challenges	• Weather dependent • Land requirements • Expensive storage • Some toxic materials and hazardous products used during the manufacturing process
Average Levelized Cost of Energy (LCOE)	• $48.8 cent of a dollar
Levelized tax credit	• $11.1 cent of a dollar
Average Life Cycle	• 25 years
Average Capacity factors	• 29%
Carbon footprint	• 12-24g per kWh

2.11.1.3 *Solar in the Dominican Republic*

Status of Solar as an energy resource in the Dominican Republic is limited. Currently, only one solar plant has been implemented, Monte Plata solar with a capacity of 30 MW, and the second farm is under construction in the province of Monte Cristi and is set to be active by the mid to end of 2019. However, the potential of the country in solar energy is exponential according to the International Renewable Energy Agency (2016) the solar potential of the country could account for 3 TWh of energy for the country more than enough to cover the growing demand. Global horizontal irradiance, or GHI, ranges from 5 to 7 kilowatt-hours per square meter per day (kWh/m2/day) throughout most of the country (See Figure 2-6. Dominican Republic's Solar potential) and approaches 8 kWh/m2/day in some regions.

By comparison, Germany, which has nearly half of the world's installed solar PV capacity, has few locations with a GHI above 3.5 kWh/m2/day, and Phoenix, Arizona, a city in the U.S. southwest famed for its solar potential, has an average GHI of 5.7 kWh/m2/day. However, the studies (PWC, 2014; Konold *et al.*, 2015; Guerrero-Liquet *et al.*, 2016 and International Renewable Energy Agency, 2016.) that show this potential is based on outdated data (Elliott, 2001) and the studies for the solar potential should be re-done with new technologies.

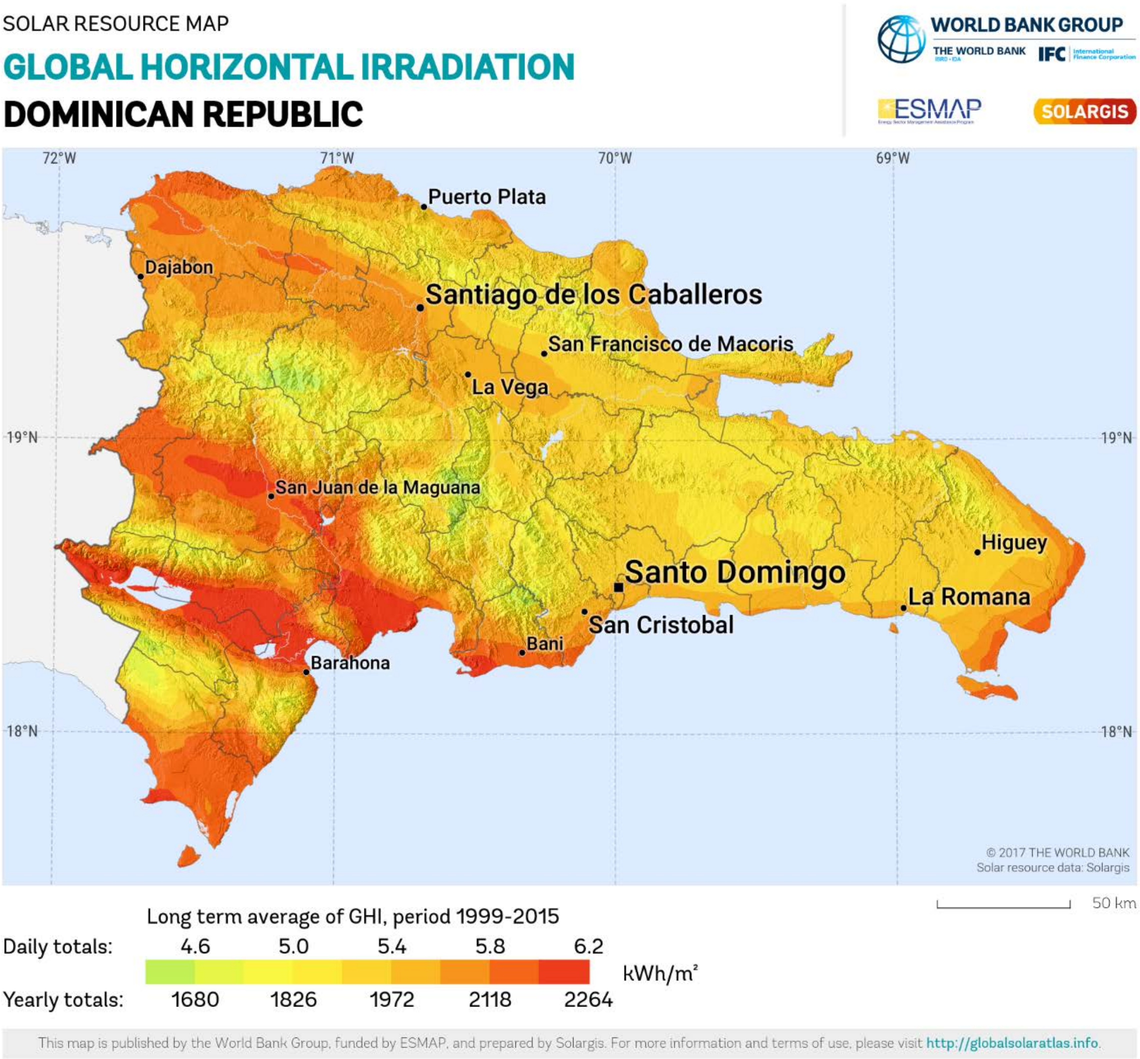


Figure 2-6. Dominican Republic's Solar potential

(source, Global Solar Atlas, World Bank Group, 2019)

2.11.1.4 *Wind Energy*

Wind energy is, in essence, a byproduct of the sun, as Alrikabi (2013) explains the uneven warming of the earth by the sun and the difference in this heating creates an atmospheric convection system from the stratosphere to the surface. This convection system possesses wind speeds of over 160km/h specifically in high altitudes. However, these speeds are not constant must be monitored for a period to calculate a usable average for exploitation.

Outside of hydropower, the wind has been by far the most successful renewable electricity source worldwide, with 318 GW of wind capacity installed globally by the end of 2013. In some markets, the costs of wind power are estimated at 4–7 cents per kWh in attractive locations, making it fully competitive with fossil fuels (Mbzibain *et al.*, 2013. Arnette, 2017). Although turbines come in many sizes, wind power is used mostly for the centralised utility-scale generation, but innovations for smaller-scale generation make decentralised wind energy an increasingly viable option(Mbzibain *et al.*, 2013).

Small-scale (50–100 kW) wind-diesel hybrid systems are growing in the Caribbean, and a U.S.-funded project in Dominica aims to demonstrate the viability of wind generation facilities of under 250 kW in the region(Auth *et al.*, 2013). Wind turbines can provide on-site electricity generation for large electricity consumers such as a factory or a farm. Unlike traditional on-site thermal generators, however, the wind is intermittent and cannot be started up at will. Connecting these turbines to the grid can increase the value of the electricity significantly, as landowners can sell excess power (Table 2-4. Characteristics of Wind Energy).

Table 2-4. Characteristics of Wind Energy

(source IEA and World Bank, 2014; Treyer and Bauer, 2016)

Characteristics of Wind Energy	
Benefits of wind energy	• Low cost of generation • Creates jobs • Aids in the growth of the economy • Multiple uses for the land of installation • No greenhouse gas emission
Challenges	• Weather and location • Connectivity to the grid • Noise pollution • Bird endangerment
Average Levelized Cost of Energy (LCOE)	• $42.8 cent of a dollar for onshore • $117.9 cent of a dollar for offshore
Levelized tax credit	• $6.1 cent of a dollar for onshore • $11.5 cent of a dollar for offshore
Average Life Cycle	• 25 years
Average Capacity factors	• 44-45%
Carbon footprint	• 11-14g Per kWh

2.11.1.5 *Wind energy in the Dominican Republic*

The wind potential of the Dominican Republic is good, according to Ochs, *et al.* (2011) the average is over 7 meters per second at an 80 meter above sea level, with several locations reaching 8 meters per second (see Figure 2-7. Dominican

Republic's wind potential). The Dominican Republic currently has three commercial-scale wind farms in operation. The first is Quilvio Cabrera, an 8.25 MW installation that was built in 2011 and is in the province of Pedernales in the southwest of the country. On a neighbouring piece of land is the Los Cocos Wind Farm, which consists of two phases: Phase 1, completed in 2011, comprises 33.5 MW, and Phase II, completed in 2013, raised the installed capacity to 77 MW. however, integration with the grid has not been easy, as grid operators struggle with voltage regulation.

A third wind park, Larimar, in the province of Barahona just to the north of Quilvio Cabrera and Los Cocos, came online in 2016 with an installed capacity of 49.5 MW(International Renewable Energy Agency, 2016). These two provinces are home to the country's strongest wind potential. Although, these projects have been successful others have not been able to get off the ground. For example, the Parques eolicos del Caribe or PECASA development was projected to be a USD127 million investment for a 50MW wind farm.

However, financing issues and disagreements with the distribution company (state-owned) have placed the project on "indefinite hold"(Ochs, *.et al* 2011). The same can be said about the Matafongo wind farm from the Dominican wind group it was planned for 2005 with an estimated investment of USD 68.9 million. However, it ran into the same issues with lack of local financial support and governmental discord (International Renewable Energy Agency, 2016). Both projects are considered a failed project.

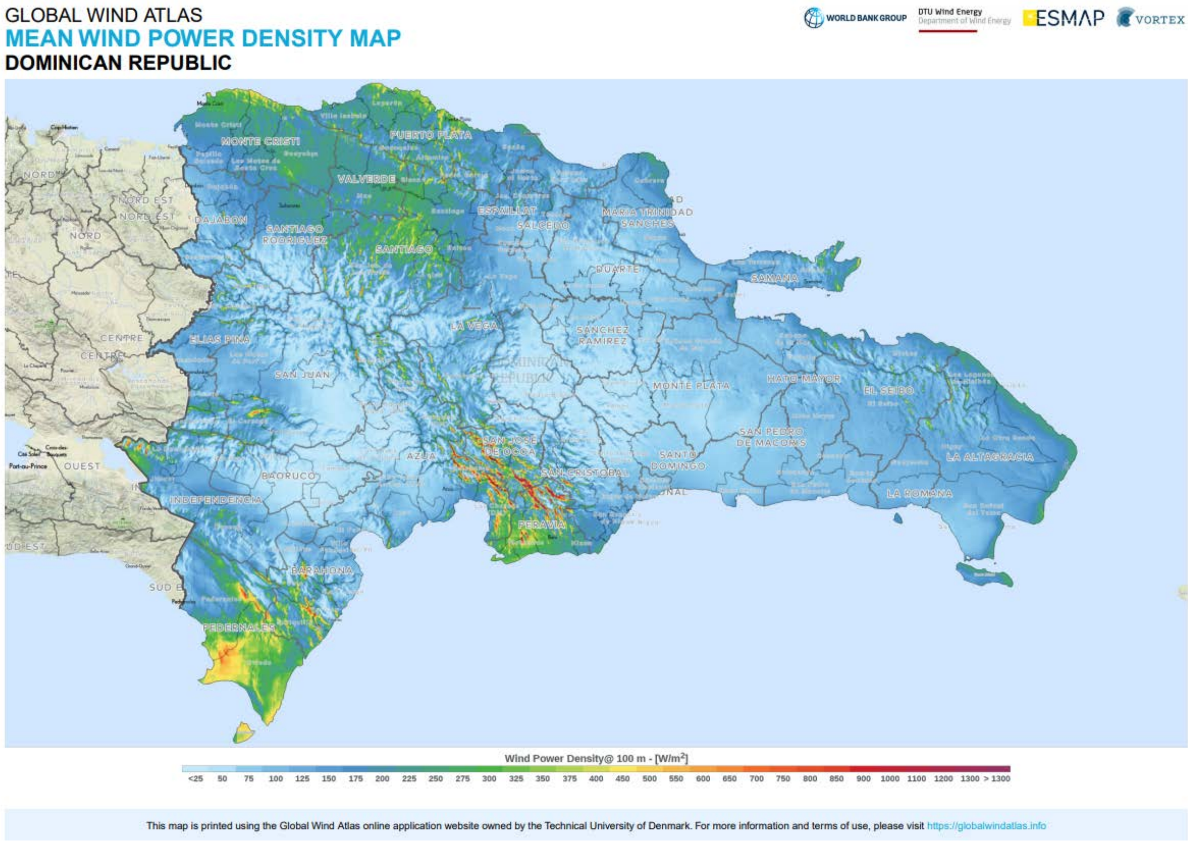


Figure 2-7. Dominican Republic's wind potential

(Global Wind Atlas, World Bank Group, 2019)

2.11.1.6 *Bio-Energy*

Biomass energy sources are based on the carbon cycle of organic material which energy is extracted from either by cellulosic or anaerobic methods (International energy agency and World Bank, 2014). Some of the most used biomass sources are:

- Wood: Timber, sawdust

- Crops: corn core and husk, straw, rice husks, sugar cane bagasse, palm husk, coconut shells
- Algae

The benefits and challenges can be seen in Table 2-5. Characteristics of biomass.

Table 2-5. Characteristics of biomass

(source IEA and World Bank, 2014; International Renewable Energy Agency (IRENA), 2018)

Characteristics of Biomass	
Benefits of biomass	• Domestic resource • Waste management • Simple combustion technologies
Challenges	• Transportation and connection to the grid complications • Emissions of NOx and Sox
Average Levelized Cost of Energy (LCOE)	• $92.1 cent of a dollar
Levelized tax credit	• $0.00
Average Life Cycle	• 30 years
Average Capacity factors	• 83%
Carbon footprint	• 43 g per kWh

2.11.1.7 *Bioenergy in the Dominican Republic*

Bioenergy is not a new concept in the Dominican Republic as many companies, especially the sugarcane production has been using the cogeneration of biomass to boost their operations for over 30 years(Konold, 2015). For example, the plantation Cristobal Colon, located in San Pedro de Macoris, produces some 30,000 tons of sugarcane bagasse annually. The facility's owner, the Vicini group, uses some of this feedstock to turn a 7 MW turbine on-site and to supply all its own electricity needs, although it never uses the generator to full capacity. Another example is, plantation Barahona has 6 MW of installed capacity and can power itself completely with its own bagasse feedstocks.

Likewise, Plantation Porvenir, also located in San Pedro de Macoris, powers itself with its own bagasse stocks. Plantation Central Romana, the largest sugar company on the island, is owned by the Fanjul Corp. and produces some 12,000 tons of sugar a day. With an installed capacity of around 54 MW, half of its bagasse goes to generating its own electricity, while the rest is used to make furfural, a liquid aldehyde used for a variety of industrial applications.

The company uses fuel oil to supply any supplemental electricity it needs. However, a proper study has not been done in the Dominican Republic, but due to the countries production in rice, coconut, sugar, corn, palm an estimate of the potential was done by the ISA university in Santiago (in-country study in 2012, see Table 2-6. Estimated sugarcane bagasse potential in the Dominican Republic) based on this it was concluded that around 535GWh of energy could be produced and stored. The study also suggests that sugarcane bagasse, if used to its full potential with high-efficiency technology, could fuel up to 4% of the country's electricity generation, back in 2012 (see Table 2-2. Energy matrix of the Dominican Republic.).

Table 2-6. Estimated sugarcane bagasse potential in the Dominican Republic

(source Ochs, 2011; Konold, 2015)

Estimated Sugarcane Bagasse Potential in the Dominican Republic				
Unused Bagasse	Cogeneration Efficiency	Potential Annual Generation	Estimated Installation Capacity	The share of National Electricity Production in 2012
1.05 million tons	kWh per ton 370-510	GWh 388.5-535.5	MW 88.7-122.3	percent 2.9- 4.0

2.11.1.8 *Hydropower*

Hydro-energy is defined by the World Energy Council (2016) as the energy derived from moving water, usually from a dam, river or ocean. Large hydropower comprises most of the global renewable power generation and accounts for more than 16% of the world's electricity production. See Table 2-7. Benefits and challenges of Hydro-power.

Table 2-7. Benefits and challenges of Hydro-power

*(*source IEA and World Bank, 2014; International Renewable Energy Agency (IRENA), 2018)

Characteristics of Hydro-Power	
Benefits of hydro-power	• Eliminates fuel • Little air pollution • Longer life cycle

	• Low operation cost
Challenges	• High capital expenditure (CAPEX) • Land occupation • Relocation of population and fauna • Destruction of ecosystems
Average Levelized Cost of Energy (LCOE)	• \$39.1 cent of a dollar
Levelized tax credit	• \$0.00
Average Life Cycle	• 50-100 years
Average Capacity factors	• 75%
Carbon footprint	• 7g per kWh

2.11.1.9 *Hydroelectric in the Dominican Republic*

Hydropower generation in the Dominican Republic ranges from as low as 65 MW in the dry season to as high as 180 MW in the wet season, with a capacity factor of 15–25%. The country's total installed capacity is 608 MW, but the size of on-grid plants varies widely, from 0.1 MW to 98 MW (International Renewable Energy Agency, 2016). However, as can be seen in Table 2-2. Energy matrix of the Dominican Republic.

(Source, CNE 2010-2016), the use of the hydroelectric is in decline in the Dominican Republic part is due because two hydro plants, located in Angostura and Valdesia, are used exclusively to relieve blackouts, and the rest are only included in the energy matrix as a last result.

The energy sector in the DR suffers from blackouts due to the inadequacy of fossil fuel power generating plants and the high cost of the tariff along with technical and non-technical issues that have plagued the country for years. The paradoxical matter is that the DR has a renewable energy potential to not only supply its energy demand but to aid in supplying energy to neighbouring countries.

2.11.1.10 *Marine energy*

Marine energy is produced by the movement of the waves or tidal of the sea or rivers. This energy is divided into wave energy, tidal energy or underwater energy (Alrikabi, 2013). Systems to harvest electrical power from ocean waves have recently been gaining momentum as a viable technology. The potential for this technology is considered promising. The world's first commercial tidal power station was installed in 2007 in the narrows of Strangford Lough in Ireland. Although the generator is powerful enough to power a thousand homes, the turbine has a minimal environmental impact, as it is almost entirely submerged, and the rotors pose no danger to wildlife as they turn quite slowly. (see Table 2-8. Characteristics of marine energy).

Table 2-8. Characteristics of marine energy

*(*source Alrikabi, 2013; Cicea *et al.*, 2014)

Characteristics of Marine Energy	
Benefits of marine energy	• Turbine similar to the ones used for wind energy • Because water is roughly 1,000 times denser than air, the systems

	can produce roughly 1,000 times more energy than wind using water moving with the same flow speed as the air. • Needed depth is 2 m, and the minimum needed speed is 2m/s^2 • Poses no danger to wildlife
Challenges	• The high cost of installation • The high cost of technology • Still at an initial stage of development and implementation
Average Levelized Cost of Energy (LCOE)	• $85-109 cent of a dollar
Levelized tax credit	• 5-10%
Average Life Cycle	• 20 years
Average Capacity factors	• 59%
Carbon footprint	• 4-8g per kWh

2.11.1.11 *Marine energy in the Dominican Republic*

In theory, wave and tidal energy have significant potential in island countries like the Dominican Republic, yet technology costs remain too high for commercial-scale development. Despite this, the newly formed Ministry of Energy and Mines, with the assistance of the Development Bank of Latin America (CAF) is conducting a study for seawater air cooling (SWAC) and ocean thermal energy conversion (OTEC) potential in Dominican waters to supply air conditioning and electricity generation.

Among the factors to be considered when developing marine energy projects are the corrosion of equipment in seawater, coexistence with other human uses of coastal waters such as fishing and recreation, grid connection obstacles, and potentially significant ecosystem disturbances (Ochs *et al.* 2011). Despite the current barriers, maritime power could become cost-competitive as technologies mature and may play an important role in small-island states that have extensive coastal territories. The Dominican Republic currently has no marine technology facilities.

2.11.1.12 *Geothermal Energy*

Geothermal energy is the heat originating from the original formation of the planet, from radioactive decay of minerals, from volcanic activity, and from solar energy absorbed at the surface. This energy stored in the Earth can be used to generate electricity or to provide heating and cooling services. Good geothermal resources can contribute significantly to a region's electricity portfolio. (see Table 2-9. Characteristics of geothermal energy).

Table 2-9. Characteristics of geothermal energy

*(*source International Renewable Energy Agency (IRENA), 2014 and IRENA, 2018)

Characteristics of Geothermal Energy	
Benefits of geothermal energy	• Baseload source of energy • Reliability • High efficiency • Little system maintenance Lower GHG emission
• **Challenges**	• Need for reservoirs with very high temperatures near the Earth's

	surface. • Possibility of depletion • High investment and technology cost • Land requirement
Average Levelized Cost of Energy (LCOE)	• $39.4 cent of a dollar
Levelized tax credit	• $2.50 cent of a dollar
Average Life Cycle	• 30 years
Average Capacity factors	• 90%
Carbon footprint	• 11.3-47 g per kWh

2.11.1.13 *Geothermal in the Dominican Republic*

Geothermal is a mature technology that can provide a significant share of generation in countries with strong resources. While it appears unlikely that the Dominican Republic has enough potential to develop geothermal power, as it does not have a thermal source as a volcano, a study to explore the theoretical potential should be carried out to discard or not the option.

2.11.2 Business Models for RE

As explain in section 2.4 the energy infrastructure is organised by the technologies, business models, fossil and renewable portfolio, financial and political laws need to direct and manage the energy flow from generator to distributer to the consumer. In this section the renewable energy business models are addressed.

2.11.3 RE business models for developing countries

The fluctuation of energy prices is a vital issue that encourages companies into seeking a new market for alternative renewable energy sources (Richter, 2013). Along with the increasing of the impact of GHG emissions caused by the current fossil fuels energy markets among others.

The renewable energy business model (REBM) can significantly impact the shift to renewable energy systems. These new energy business models can augment the use of local natural resources (Pavie *et al.*, 2013). Therefore, aid in reducing environmental issues, such as the contribution of the said country to climate change. Also, REBM can assist with the growth in productivity, energy efficiency and offer a new market for economic growth (Lorek and Spangenberg, 2014 and World Bank, 2015). Although the market for green energy and services is expanding, the development, growth and implementation of REBM are stumps by a range of barriers that englobe the Company’s current business model (Internal barrier) and the Countries laws and regulations (External Barrier). These can be addressed by a well-designed and executed REBM and the correct creation and implementation of policies.

New renewable energy technologies are more likely to be adopted and distributed when they can be fitted with pre-existing business models. On the other hand, high and transformative technologies are sophisticated and have connections and dependencies with many components of the business model. Therefore, cannot be quickly adopted and circulated (Tsai *et al.*, 2017).

New sustainable business models are at present emerging, and some examples of these are green product/process-based models, waste regeneration systems, alternative energy-based systems, efficiency optimisation by Information and Communications Technology (ICT), functional sales and management services, innovative financing schemes, sustainable mobility systems, industrial symbiosis, and green neighbourhoods and cities (Table 2-10. New sustainable business models).

Some of these, such as: eco-cities and industrial symbiosis, focus on the greening of an entire system and can, therefore, be considered as systemic innovations. Others, such as: energy saving companies and models based on efficiency optimisation through ICT, are focused on more incremental changes. Others, such as: cradle-to-cradle business models, take a life-cycle approach aiming for a society based on recycling and zero waste.

While in developed countries this transition mainly entails a structural change towards a resource-efficient, knowledge-based economy, in many developing countries, green growth requires strategies that contribute significantly to the objectives of development and poverty reduction.

Solutions such as pollution control, cleaner production, eco-efficiency measures, and eco-design and green products are often applied by business. They are powerful tools to improve efficiency, as they can be introduced within existing production, process or business systems, without changing the underlying "technological regime". Such solutions are also relatively easy to manage, as they often involve few actors, and are often fast and relatively cheap to implement because they involve only a product or a process and not a whole system. Therefore, they can generate results relatively quickly, having enabled substantial environmental improvements over recent decades, and thus contributing to a relative decoupling of economic growth from environmental pressure (OECD, 2011b).

Radical and systemic innovations are highly complex as they often involve many actors and a range of technological and non-technological changes in organisational and institutional arrangements. One of the imperatives for these innovations is that both suppliers and consumers should embrace social and cultural changes and adopt new values and behaviour.

The components of business include strategic decisions on customer segmentation, products and services and models typically associated value to offer. business, development, trade and other partners. resources to create, and channels to deliver value and underlying cost structure and revenue streams to ensure the financial viability of the business. A business model can also be considered as a holistic approach towards explaining how firms conduct business (Zott *et al.*, 2010).

A background literature review includes empirical studies that analyse and summarise several cases studies, as well as others based on single cases of eco-innovations and business models. The literature sustainability benefits, the role of enabling review below focuses on value creation and capture, technologies and infrastructure, corporate governance and strategy, the role of policy, barriers and drivers and systemic changes.

2.11.3.1 ***Types of Renewable Business models***

As Noailly and Smeets (2013) emphasize, business models are rarely created with environmental sustainability values at its core, even though that business community has been increasingly recognising the challenges posed by the diminishing of natural resources and climate change. However, these challenges are usually included in marketing strategies but are not always incorporated into the foundation of a company’s Business Plan (strategy and operations). Generating value is the core reason for this as every business plan are centred around profit gain. Also, according to Sandberg, Klockars and Wilen (2019), many companies believe that environmental sustainability is more of a challenge that generates unnecessary cost, instead of a key source of value creation both for the business and the customer, which is at the heart of any business model.

The need to alter the traditional economic models and approaches that government and businesses have been using has been exposed by the current economic crisis and by several researchers, Gross (2015) and Noailly and Smeets (2015) to name a few. Governments around the world are gradually pursuing more innovative ways to increase the economic activity, and at the same time find solutions to the global environmental challenges such as the shortage of natural resources climate change and increasing environmental challenges.

Table 2-10. New sustainable business models

(Source Qin *et al.*, 2017; Ringel, 2017)

New Sustainable business models	Waste Regeneration
	Alternative energy-based
	ICT optimisation
	Green neighbourhoods and cities
	Industrial Symbiosis
	Functional sales and management
	Innovative financing schemes

As already stated in section 2.9 developing countries are responsible for most of the increase in population and GHG emission, making them the greatest potential climate change contributors. It is only logical that the focus of the latest investigation is on preventing these scenarios from happening. This section will concentrate on a business model as a possible solution to guide these countries towards a renewable energy system or a potential energy-based economy for the sustainability of the countries themselves.

Product-service systems (PSS) based models

Functional sales are a generic model with common characteristics for all service-based business models focusing on providing the function and benefits of the product instead of the physical product as such. Instead of paying for the product per se, a consumer pays for the function of the product. The service provider controls the use-phase of the product. This creates an incentive to improve the output yield and to extend the life-span of the product by making the product more durable, reducing the need for spare parts, making it more energy efficient and improving the maintenance of the product (FORA, 2010).

Energy service companies (ESCO) provide energy-efficiency-related and other value-added services and assume performance risk for their project or product. Their compensation and profits are tied to energy efficiency improvements and savings.

Life-Cycle Models

Cradle to Cradle (C2C) based business models centre on a holistic design and production paradigm and strived for a society that produces no waste and recycles everything. The concept is based on a bio-inspired approach to the design of products and systems where nature is seen as a closed loop production system with solar energy as the only external input. It stimulates innovation through the development of new products with a competitive edge (FORA, 2010).

ICT Solutions

ICT solution-based models provide a wide range of solutions for energy and resource use control, the establishment of smart grids and cloud computing. ICT is also an important part of many novel technologies and systems solutions like industrial ecosystems namely incentive models that create incentives for customers to use resources more efficiently, and life-cycle models, that focus on the greening of a companies' value chain.

2.11.3.2 *Renewable Business models' examples*

The case studies presented in Table 2-11. Renewable Business Models .) Has been classifyed by the country, classification (Heating or Electricity), Business Plan and financial plan used for the implementation of each of the case studies analysed.

Table 2-11. Renewable Business Models examples

Renewable Business Models Case Studies					
Case Studies	**Country (Region)**	**Classification (Heating/Electricity)**	**Business Plan**	**Financial**	**Reference**
The Oujé-Bougoumou Biomass District Heating Facility	Quebec, Canada	Heating	Innovative financing schemes	Revolving fund and grants	Seymour, S., 2016. Assessing community forest resources to determine potential for biomass district heating in one rural and one remote First Nation of Northwestern Ontario (Doctoral dissertation).
The Industry Power Project in Raskat, Himachal Pradesh	Raskat, India	Energy	Alternative Energy-Based	MNES/UNDP/GEF initiative	ADEME/ Energie-Cités. (2005). Planning for Small Hydro Himachal Pradesh
Rural Electrification Program	Chile	Energy	Alternative Energy-Based	Government subsidies	Nasirov, S., Silva, C. and Agostini, C., 2015. Investors' perspectives on barriers to the deployment of renewable energy sources in Chile. Energies, 8(5), pp.3794-3814.
The Middelgrunden Wind Turbine Cooperative, Copenhagen Harbor	Denmark	Energy	Innovative financing schemes	Sale of shares in the project	Brimmo, A.T., Sodiq, A., Sofela, S. and Kolo, I., (2017). Sustainable energy development in Nigeria: Wind, hydropower, geothermal and nuclear (Vol. 1). Renewable and Sustainable Energy Reviews, 74, pp.474-490.
EcoCentroGen: The Low-Carbon Distributed Energy Utility	Central America	energy	Alternative energy based	Government funding	Madriz-Vargas, R., Bruce, A. and Watt, M., 2018. The future of Community Renewable Energy for electricity access in rural Central America. Energy research & social science, 35, pp.118-131.
The SunBridge Wind Power Project	Canada	Energy	Innovative financing schemes	50/50 partnership between Suncor and Enbridge, Inc.	Mulvihill, P., Winfield, M. and Etcheverry, J., (2013). Strategic environmental assessment and advanced renewable energy in Ontario: moving forward or blowing in the wind? Journal of Environmental Assessment Policy and Management, 15(02), p.1340006.
The Erie Shores Wind Farm	Ontario, Canada	Energy	Efficient optimization by ICT	Non-recourse long-term debt and equity bridge financing	Winfield, M. and Dolter, B., 2014. Energy, economic and environmental discourses and their policy impact: The case of Ontario's Green Energy and Green Economy Act. Energy Policy, 68, pp.423-435.
Solar Energy Farms	China	Energy	Alternative Energy-Based	Government subsidies	Bhattacharya, M., Paramati, S.R., Ozturk, I. and Bhattacharya, S., 2016. The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. Applied Energy, 162, pp.733-741.

The Business models researched, represent the new trends and major success and failures in the innovation of the business models in developed and developing countries. Although this is not a significant sample of all the energy projects in the world, it can be inferred that a possible pattern appears between the different strategies in both actors. In developed countries, a larger range of business plans focusing on different financial tools and strategies along with the inclusion of new technologies and software are the new normal while in developed countries the struggle still exists to change to renewable energies.

However, even among developed countries, a vast leap exists for example in Canada (Winfield and Dolter, 2014 and Seymore, 2016) and Denmark (Brimmo *et al.*, 2017.) the success of the renewable projects is due to the community's demand for Renewable Energy. Therefore, forcing the existing fossil fuel enterprises to change to renewable sources to feed the growing demand. While in the UK (Martin, 2011.) is the initiative of the business, going further than the government regulations demand, that has a guarantee the change to a more sustainable business plan.

However, all are possible because the government in each has created and sustain a Renewable Energy Market, which is a key factor or element in the success of any sustainable business plan. Some of the key elements in any Renewable energy business plan are (1) Regulatory Policies of the country, (2) Financing Plan, (3) Consumer-Company Interaction, (4) Platform and Technology and (5) Stability and knowledge. Also, the government and policies are an integral part of the success of any business plan. The government cannot be the only actor in the design, development and implementation of Renewable Energy Business models as can be seen in India (ADEME/ Energie-Cités, 2005), Chile (Nasirov, Silva and Agostini, 2015) and China (Bhattacharya, 2016).

The government is the main actor in developing countries, due to the economic situation, and the social-political underdevelopment (Corruption, illiteracy and more) of these countries. The failure of the projects is almost guaranteed; for example, China (Bhattacharya, 2016). The government created and implemented policies for the subsidies of renewable technology. However, the transformation to a renewable economy cannot be solely based on policies the creation of a renewable energy market is essential.

Also, the lack of disseminating of the green and renewable information to the population has resulted in the failure of its venture into renewable solar energy farms and so far, have been unsuccessful in converting the existing fossil fuel enterprises to a more sustainable path. As a result, the situation has contributed to increasing the previously excessive pollution (smog and waste) in the country to alarming levels.

Developed countries show different internal arrangements for financing the renewable sector from 50/50 business projects to the consumers financing a cooperative or revolving fund to guarantee that the change in renewable energy is a reality. While developing countries do not have this versatility as the struggle to support the existing energy system places a strain in the already delicate economic situation of any developing country.

Also, to the difficult economic situation, with the lack of control on the growth of population in these countries and the increase of energy demands the government in these and many countries be forced to rely on international loans and co-operatives to aid in the development and decrease the strain that such projects demand.

Benefits of new business models

Financial, environmental and reputational benefits are a critical element of any business model, especially for renewable business plans. As illustrated by Beltramello *et al.* (2013), Gross (2015) and Del Rio (2015), new renewable business models tend to generate incentives to maintain environmental improvements in the long-term. For example: Functional sales and management services models generate incentives to decrease energy expenses that can be invested to increase the sustainable efficiency of the model or business.

Also, Alternative Energy-Based Models create incentives for the decreased use of waste as an alternative energy source. This model can be a link and used along with an Innovative financing schemes business model to generate incentives for the design of the energy product to improve the durability and quality of the service provided and diminish the life-cycle cost. Also, this will aid in the reduction of the energy product volumes and the connected need for resources.

However, Mulvihill, Winfield and Etcheverry, (2013), Bhattacharya, 2016 and Madriz-Vargas, Bruce and Watt (2018) agree that the sustainable benefits that the renewable business plans will generate will depend greatly on the manner in which the renewable energy market is developed and implemented, along with the government policies and financial aids and subsidies.

The adoption of more sustainable business models along with renewable energy technology and sources provides a range of benefits. Many researchers (Mulvihill, Winfield and Etcheverry, 2013; Noailly and Smeets 2013; Beltramello *et al.* 2013; Gross 2015; Del Rio 2015, Bhattacharya, 2016 and Madriz-Vargas, Bruce and Watt 2018) suggest that the benefits of any renewable energy business plan can be divided into two groups: (1) Short-term benefits and (2) long-term benefits. Also, Madriz-Vargas, Bruce and Watt (2018) have further classified depending on the actors (Company or country) that are involved in the renewable energy project and whom it directly benefits. Some of the benefits that a renewable business plan can generate are:

- an increase in comfort or reputation gains,
- full energy cost savings,
- fiscal advantages and investment subsidies
- reducing material or energy use.
- reducing the CO2 footprint of the company.
- reducing water and waste pollution,
- economic growth with the new markets,
- improved savings of resources,
- cuts in associated cost,
- savings on the import/export substitution of crude oil and refined products among others (Mulvihill, Winfield and Etcheverry, 2013).

Also, it adds value to companies and reinforces the competitiveness in this new sustainable market. However, as Del Río (2015) highlights, some actors, regardless of the increase in benefits, especially the revenue, are immovable in the fossil fuel mentality that has caused climate change. Also, these lack the vision or leadership to transform to a new renewable business model.

As Del Rio (2015) and Bhattacharya (2016) agree many barriers or obstacles will emerge when transforming to any new business plan, in developing countries more than other, However, as the great Bucchianeri once said:

> *"Well, if it can be thought, it can be done, a problem can be overcome,"*

Barriers

The case studies point to some key barriers to the emergence and growth of new business models. Beltramello *et al.* (2013) classify these obstacles in two: (1) Internal and (2) External, based on the scale of repercussion that the barrier presents (Company or country). However, Schelly (2014) divides the barriers that sustainable business models encounter in three: (1) Design, (2) transition and (3) Implementation barriers. This division shall depend on when in the life cycle of the project the impediments emerge. For this research a combination of both classifications shall be used as barriers in developing countries can emerge at any time and by internal or external to that purpose Table 2-12. Classification by Design, Transition, Implementation, Internal or External of barriers for new Renewable Energy Business Plans) has been created to understand better.

Table 2-12. Classification by Design, Transition, Implementation, Internal or External of barriers for new Renewable Energy Business Plans based on study.

Classification	Barrier	Internal	External
Design	Traditional Mindset	x	
	Lack of Competent personal	x	x
	Lack of Knowledge in Renewable and Sustainable subject	x	x
	Leadership	x	x
	Lack of Vision and Resources	x	x
	Lack of market	x	
Transition	Cost	x	
	Financial Risk	x	
	Bank loans or programs	x	
Implementation	Lack of integration of the Renewable business plan	x	
	Policies, Regulations and Law		x
	Lack of Market Demand		x
	Green Practices		x

The research reveals that many of the barriers occur simultaneously internally and externally, during the design and implementation phases of any project, due to the critical aspect of each. In Table 2-13. Renewable energy business model for developing countries) and Table 2-12. Classification by Design, Transition, Implementation, Internal or External of barriers for new Renewable Energy Business Plans) the drivers for each of the barriers can be seen. Also, this might help identify more clearly the possible solutions and steps to counter-act the obstacles in the different phases and actors before they develop.

The most important of this barrier, according to KPMG Global Energy Institute (2011), Gross (2015) and Schelly (2014) is the lack of market demand. Which reduces the incentives for businesses to develop an innovative business plan and the implementation of renewable energy technologies, sources. Also, it reduces the capacity of these companies to gauge innovation in this subject. Other essential barriers consist of lack of knowledge and human resources, limited access to the necessary financial resources, as well as obstacles resulting from government policies themselves (perverse incentives due to fossil fuel subsidies).

Internal Barriers

Internal barriers include: (1) a traditional mindset among producers and providers, (2) a lack of competencies, (3) knowledge of sustainability issues (4) an insufficient number of reference cases (5) a lack of knowledge of possibilities on the part of higher management (6) a lack of integration between divisions in companies, for example: a division that develops a product and the people that develop the services or separation between organisational bodies for investment and the operation in organisations (7) increased development and production costs (8) insufficient R&D capabilities (Schelly, 2014 and Bouckaert, Mazauric and Maïzi, 2014). Many organisations do not have the necessary vision and resources to incur certain costs, such as implementation costs, in return for uncertain benefits, such as reduced risks and revenue growth.

External Barriers

External barriers include a lack of market-pull due to the limitations of environmental tax legislation, the lack of green public procurement practices, as well as old fashioned routines and red-tape due to regulators and public procurement staff, lack of regulation and general government support for change, lack of capital for initial investment and for deployment of eco-innovations, which is often due to the fact that projects are perceived to be risky, or there is a lack of knowledge amongst stakeholders about the economic benefits of green growth (Zheng, Hu, Wang and Wen, 2014; Schelly, 2014 and Bouckaert, Mazauric and Maïzi, 2014).

Access to finance appears to be particularly crucial. Confino (2011) notes the importance of the investment community to the promotion of company innovation. Investors effectively control developments in businesses and therefore their reluctance to support radical or sustainability-oriented changes is a serious barrier to the introduction of eco-innovations into ongoing business activities. Finally, the adoption of eco-innovation is heavily dependent on consumers' attitudes (Meenakshisundaram and Shankar, 2010 and Zheng, Hu, Wang and Wen, 2014). For example, consumers who are accustomed to the luxury provided by large, petrol engine-powered automobiles and their various features and functions, may not be impressed by electric cars or less luxurious cars offered by car-sharing schemes

The business model for implementation of renewable energy business model has evolved from business as usual to having environmental conscience at its core. However, the challenges for developing nations still exist, taking the barrier and drivers identified in this section, key drivers, barriers and obstacles for implementation were identified in Table 2-13. Renewable energy business model for developing countries. Once the barrier was identified the recurring and specific obstacle was also identified in each example studied in this section. The areas for drivers and barriers are generalised while the obstacles appear regardless of if the barrier is internal of the organization or external.

Table 2-13. Renewable energy business model for developing countries based on study

Renewable Energy Business Model for Developing Countries			
Key Drivers	**Key Barriers**		**Obstacles to Implementation (Recurring)**
	Internal	***External***	
Renewable Market Creation	Current Business Plan	Laws	Lack of Market Demand
Availability of Raw Renewable Energy Source (RRES)	Knowledge	Knowledge	Lack of Human Resources and Technologies to utilize the RRES
Climate Change issue	Investment cost, Budgets and Financial Plans	Regulations	Lack of understanding and general knowledge of the renewable subject
Financial Gain and Investment	Initiatives	Incentives	Lack of offers or alternatives options for energy (Monopoly)
International investment and interest	Organizational Structure and Leadership	Fossil Fuel Dependency	Lack of interest and corruption in the government
		Loans (Bank Entities)	Lack of financial guarantee

2.12 Financing RE projects

2.12.1 Financing RE projects in developing countries

Until recently Renewable Energy (RE) investments were treated in the same manner as any other investment, yet RE investments possess certain characteristics that require a high level of understanding, some of the key aspects are:

- **The feasibility of the investment (This depends on the policy and regulations and the impact on the economy that such measures can have)**
- **The durability and real implementation of any subsidies, grants, tradable certificates or tax credits**
- **Basic financial analysis**

The governments of many developing countries have embarked on the path to low-carbon development to create and increase energy access, economic opportunities and to reduce carbon emissions. However, because of scarce public funding and investments, the international community and the private sector engagement will play a major role.

The RE markets is a 19-26 Trillion dollar investment opportunity, estimated by International Renewable Energy Agency (2017). The renewable energy industry faces a rapidly increasing opportunity and challenge to grow the business and financial strategies to exploit this investment properly. Current and ongoing cost reductions in renewable power generation technologies can aid developing countries in achieving national and international energy and emissions policy goals, in energy security and reliability and affordable energy. along with promoting access to electricity for all at a lower cost than traditional sources.

As Germany, Costa Rica and many more countries have demonstrated. Through the use of Biomass, hydropower, geothermal, solar and onshore wind power for Electricity that shows competitively levelling cost of RE compared to fossil fuel-fired power generation. Being solar, the most impressive of this Levelized cost of electricity (LCOE) for RE. Solar energy cost generation alone has halved just between 2010 and 2014. Technology enhancements, occurring simultaneity as the reduction in the installed costs of RE sources have augmented the competitiveness of Renewable Energy in the energy market to be equal, and in some cases the LCOE of some RE, like offshore wind even lower than for fossil fuels.

Table 2-14. New Characteristics in Renewable Energy Financing

(source Shrimali *et al.*, 2017; Lyu and Shi, 2018)

New Characteristics in Renewable Energy Financing		
Cost Reduction	Policy Support	New & Improved Technology
New & improved renewable Systems	Investment	Research and investment
Higher investment	Sustainable goals	Development

The global investment for renewable energy has been exponentially increasing over the years. Due, in part, to the new financial characteristics, that have been implemented in current years (Table 2-14. New Characteristics in Renewable Energy Financing). The amount of money committed to renewables projects has risen, according to some studies (Bella *et al.,* 2015; International Renewable Energy Agency, 2016 and Qin *et al.*, 2017.) 5% in 2015, a record high of $285.9 billion, in contrast other researchers (Ferroukhi *et al.*, 2016; Walz and Shoemaker, 2017 and Lyu and Shi, 2018.) highlight that the investment had drop down 18% in 2016. Along with this record high, 2015 is also the year where investment in renewables in developing countries surpassed that in developed countries. Were, China, India, Brazil, South Africa, Mexico, Chile, Morocco, Uruguay, the Philippines, Pakistan and Honduras, together invested over $156 billion in renewable energy investments. developed countries invested only $130 billion.

Meanwhile, renewables projects possess attractive advantages for developing countries, such as, the built time, wind farms can take from nine to twelve months, solar parks in three-to-six months, compared to fossil fuel (coal and gas plants) that can take several years to be completed, not to disregard the long time that nuclear energy takes to install. Along with the high competitiveness of renewable in current energy markets. However, even with all this improvement policy support for renewables remains fickle in the Latin American and Caribbean region (LAC), especially in the Dominican Republic.

This study compares the main funding mechanisms employed by governments, institutions and businesses to finance renewable energy development programs or projects: feed-in tariffs, tax incentives, and tradable green certificates. in addition to new support mechanisms that have appeared in later years: co-operative funds, hybrid Bonds revolving fund, Tax equity loans, loan loss reserve and crowdfunding.

2.12.1.1 *Cost of renewable energy projects*

A fundamental concept to understanding the economic competitiveness of any energy project is the real costs of the project versus the benefit achieved throughout its life cycle, regardless if it is fossil or renewable (PWC, 2015). This concept is the foundation for many investments decisions because it is based on the capital cost, fuel cost and financial costs of the project. These cost at the same time are based on the sum of the cost over the lifetime of the project over the sum of the electrical energy produced over that lifetime (Ferroukhi *et al.*, 2016).

This is subjective to the access to precise, comparable, dependable and current information on the actual costs and life cycle operation of renewable energy technologies and projects. The financial instruments can be created, design and implemented by the private or public sector. As these encompasses the government and non-government own enterprises.

- **Private sector**

The government of many developing countries has taken measures to commit and ensure a reduction of carbon emission. For this purpose, renewable energy transformation steps have been taken. However, the financial struggles that many developing countries face is, in some cases, and almost impossible challenge. The private sector engagement is a necessity rather than an option, as this sector can facilitate and aid in the renewable energy investment with strong benefits not just for the country but the non-government businesses as well.

As Jenkins and Miguel Guevara (2014) explains an appropriate financial and political framework for the cooperation of the private sector in renewable energy projects its necessary. Also, the risk and perceive risk must be address as to attain the engagement of this sector fully. However, as International renewable energy Agency (2014) and Nawaz-ul-Huda, et al. (2017) highlight, developing countries use public and concessional resources to attain the aid of the private sector, even though this does not fully address the different challenges or the risk that the private sector experiences. On the other hand, Aslani and Mohaghar (2013), International energy agency and World Bank (2014) and Hossain, Hossain and Uddin (2017) point out that the use of these instruments to engage the private sector has the dual benefit of being more sustainable and minimising the instability that this could bring to the industry. while augmenting the competitiveness of the renewable energy market.

- **Public sector**

Many developing countries have embarked on a renewable energy transformation, due to the agreement and international commitment to reducing global emission, in addition to creating economic opportunities and increasing energy access of the population. however, most developing countries lack the financial means to achieve this.

However, as many researchers have shown (Town and Paulo, 2009; Zierler, Wehrmeyer and Murphy, 2017; and Hoffman *et al.*, 2017.) policymakers in developing countries tend to implement a particular financing instrument (Tax incentives, Loans and more) without, in most cases, analysing which instrument or combination of tools would be most effective for the project or country at the time. Affordability is one of the critical challenges that developing countries faced when implementing renewable energy.

Also, the standard process for any energy projects, be it finance by the public or private sector, is first obtaining a power purchase agreement (PPA) or through "yieldco". Although, according to many new researchers (Lee and Huh, 2017; and Kahia, Aïssa and Lanouar, 2017), this is also changing along with the funding sources. The new trends that have already been used in 2015 by:

- The UK (Simcock, Willis and Capener, 2016) demonstrated winning bids at 11% below the agreed for onshore wind and offshore a 14% and 18% below the officially set price.
- In South Africa (European Investment Bank, 2011) auctions awarded contracts to onshore wind at 41% less in local currency terms than the first auctions.
- Germany (Dvořǐk et al., 2017) the second PV auction in 2015 awarded contracts 7.5% below the previous feed-in tariff level. These auctions allow developed and especially developing countries to offer the generation agreement of energy for keen and in some cases, very reduce prices compared to the traditional PPA. Allowing for the tariff prices to diminish and the competitiveness of the market, particularly the RE, to flourish.

2.12.1.2 *Investment sources*

Traditionally renewable energy (RE) projects had two methods of obtaining funds:

- Borrowing from a bank (Loan). However, Banking institutions will focus on the repayment of the debt and not on the return of the transaction (Cerqueiro, Ongena and Roszbach, 2016). In such cases, due to the emphasis of the banks, the return for such ventures tends to be smaller than in other funding methods.

- Through equity capital (selling stakes or shares in the business, among others). Equity capital has greater expected returns due to the level of risk that is taken. In some cases, some companies might expect between a 25-35% of return, due to the perceived risk versus the real risk (Lyu and Shi, 2018). Also, stakeholders place greater pressure and expectations on RE projects than traditional financial institutions do. Other ways to finance through equity is by “on balance sheet” funds (from funds drawn internally, treasury department), this is usually done by the utility companies as part of a corporate RE strategy. However, the specific role played by equity may change over the lifecycle of the RE project as it is refinanced, depending on existing and new actors that would like to benefit from the project. See Table 2-15. Key Features of Traditional Funding for RE.

Per (Lyu and Shi, 2018), equity funding is a popular option. As of 2015 financing of RE projects through utility-scale for wind farms and solar parks was of $199 billion in comparison to the 188 billion of the previous year, showing a 6% increase in a years’ time. In general, the growth in equity funding in RE in 2015 was between 5.8-12% over previous years, in areas such as roof-top solar projects, reinvestment of equity and acquisition activities.

According to Mark (2013), International energy agency and World Bank (2014) and Hossain, Hossain and Uddin (2017), an important difference between this two methods are also, in which RE projects they are utilised. Loans are usually applied to RE projects with traditional and proven technology and approaches, while equity is used more for new and innovative RE technology projects and methods. In some countries, local financing options are plentiful. in others, they are few and far between. Other innovations in the funding of RE projects come from Europe. Since

2012 new inflation-linked notes have appeared as a way for organisations to access the return flows of RE project, specifically the wind and solar.

Table 2-15. Key Features of Traditional Funding for RE based on research

Key Features of Traditional Funding for RE		
	Equity	**Loans**
Source of Funding	A wide range of sources (Insurance companies, pension funds, mutual funds, Stock Market, Real State and more)	Financial Institutions (Banks)
Target	New Technologies, Methods and Markets	Mature Technology and markets
Risk	Low-Medium-High (Depending on the source of funding)	Low risk
Return time	3-10 years (Depending on the RE project and on the Equity that is funded)	2-5 years (Depending on the specific terms of the Loan)
Types	Venture Capital, Private Equity and Funds	Personal, Commercial, Small business and more
Return	Low- Medium-High	Low
Benefits	Diversity Liquidity Public Trading transparency of the market price	Money guarantee None involvement in the RE project by the banks Accessibility and options Tax Benefits

- **Traditional Financial Trends for renewable energy**

Traditional finance as (Lyu and Shi, 2018) highlight is the character, collateral , capital and capacity of securing a line of credit or loan through a financial institution. For renewable energy the traditional finance is based in financial policies: (1) Feed-in-tariff, (2) incentives and in a financial tool usually loans.

- **Feed in Tarif**

The Feed-in Tariff (FIT) is an energy-supply policy or agreement that is the base of supporting the development of new renewable energy power generation, especially in developing countries. Since FIT contract provides a guarantee of payment (dollars per kilowatt-hour, $/kWh) for the full power generated and is a long-term period agreement (between 15-20 months usually), this will vary depending on levelized cost, the renewable technology type (Wind, solar, hydroelectric, etc.), project size, quality, strength and availability of the resource, the PPA and (or) other project/contract/agreement-specific variables. However, not just developing countries implement FIT, according to researchers Cory *et al.* (2009), Couture *et al.* (2010), Cicea *et al.* (2014), and many more, over 40 countries implement FIT policies.

This policy is attributed to the reason, per World Bank and CIF (2012) and Ng and Tao (2016), of the success of the renewable energy markets in German and Spain. Other possible benefits of properly designed FITs are that it is more cost-effective than standards renewable energy portfolios; also, this makes FIT's more competitive in the general energy market.

- **Tax Incentives**

Taxes and Incentives for Renewable Energy are created and implemented to aid in the communication of the government's policies, programs and plans for the development of renewable energy to the energy companies, investors and other entities (Lee and Zhong, 2015). Based on that definition and the studies of NREL (2017) Congressional Research Services (2018) and EIA Independent statistics and analysis (2019) the key features that a tax incentives should have was built as can be seen in Table 2-16. Key features of Tax Incentives (Production tax credit, PTC and investment tax credits, ITC).

As the incentives are part of policy regulated by the government it makes them easy to implement, especially because the levelised cost of electricity does not need to be calculated to uptain the percentage of incentive. This is decided by the government at whatever range better suits the needs or goals of the nation.

Table 2-16. Key features of Tax Incentives (Production tax credit, PTC and investment tax credits, ITC)

(source Chien Bong *et al.*, 2017; International Renewable Energy Agency (IRENA), 2018)

Key features of Tax Incentives (Production tax credit, PTC and investment tax credits, ITC)	
Improve funding for renewable energy technologies	Encourage, increase and improve renewable energy market adoption
Job creation in the renewable energy sector	Encouragement of public investment in renewable energy
Increase R&D in local renewable energy technology	Create and encourage renewable energy education and training programs

- **Loans**

Loans are a financial tool (agreement between the actors) implemented in most case by banks as a means of providing finance or capital for companies, investors or individuals to support normal business or project operations (Eib, 2012). For this, the financial institution will conduct an assessment of the company's financial strength and stability of the project projections and returns, and debt is calculated priced accordingly to the market at the time with a return period and interest rate calculated and agreed upon in the contract. Also, these agreement place few restrictions on how the company can use the funds, provided certain general conditions be met.

- **New Financial Trends**

As technology advances, so do the applications in different fields. Finance is no different, the new technologies have brought innovative ways of financing projects from providing social interaction of raising money with crowd-founding to certificates based on the renewable energy generated.

- **Green Bonds or certificates**

A bond is a loan or better known as a debt investment that is based on a coupon (fixed or variable interest rate) of an investors loan to an entity (typically corporate or governmental) for a fixed period (Ng and Tao, 2016). In renewable energy, bonds are better known as green bonds, which are any variety of bonds that the incomes will be solely used to finance (re-finance) in full or partly a new and existing renewable energy project. It is often used to raise money to fund an acquisition or a new development. (Table 2-17. Different types of Green Bonds)

Table 2-17. Different types of Green Bonds

(source Abolhosseini and Heshmati, 2014; Ng and Tao, 2016)

Different types of Green Bonds
Green Use of Proceeds Bond
Green Use of Proceeds Revenue Bond
Green Use of Proceeds Project Bond
Green Use of Proceeds Securitized Bond
Pure Play
Hybrid Bond
Other types will appear as the renewable energy market matures

Co-operative funds

A cooperative fund or trust is a self-governing alliance of people that have united voluntarily to fulfil a common economic, social and (or) cultural need(s) through a jointly and democratically owned and controlled business (MacArthur, 2017).

Crowdfunding

Crowdfunding is an alternative finance form that has become a popular financing tool in the last couple of years. This tool allows a project, an organisation or a company to gain its funds from the general and global public using open calls on the internet, on a dedicated and detailed web page and platform. This is a result of the developments of the information and communication technology (ICT), the increased use and popularity of social networks and the rapid advance and use of interactive technology. Crowdfunding can indeed be defined as an 'economic superstructure' of social networks and crowdsourcing (Caneva and Alonso, 2018).

- **Risk and Return**

An important area of understanding any finance and investment subject is a risk and return. The purpose of any business is at its core the generation of income. In this same way, financial institutions are based on the return of the investment versus the risk that has or will be undertaken(Lyu and Shi, 2018). This is a directly proportionate higher risk of investment equals a greater return. The RE sector utilises finance from across the entire risk-reward spectrum (See Table 2-18. Different Risks of investing in RE).

Table 2-18. Different Risks of investing in RE

(source Dos Santos Alves; Soares de Souza, 2014; Abolhosseini and Heshmati, 2014; Lyu and Shi, 2018)

Different Risks of investing in RE	
Country	Governed by the stability, status, seriousness and transparency of the government, it is the legal system, business practices and links to the risk encore by currency.
Economic	Depends on the inflation and future projection of the currency, local financial regulation, market growth and GDP
Financial	Based on the coupons or interest rates, refinement of agreements or projects, insurance of business, projects and companies along with asset liquidation and shares in the company
Currency	Subject to the exchange rate fluctuation, currency controls, devaluation, currency flow
Political	Influenced by the changes in the legal framework, directly link to the countries risk. However, more dependent on the policies and implementation of them.
Security	Refers to the asset insurance and robust legal framework in correspond to the ownership and operations of a project
Perceived	Based on the popular perception and social knowledge of the actors involved in the project and financing. Influenced by a subjective understanding of the individuals based on past cases or projects.

2.12.2 The financial state of the electricity sector in the Dominican Republic

The financial stability of the Dominican electricity sector is threatened by four major factors. First, high technical and non-technical losses continue to account for significant lost revenue, leading to an average 60% cash recovery rate for state-owned distribution companies (International Renewable Energy Agency, 2016).

Second, electricity rates set by the government remain below what is needed for generators to recover their costs, creating the need for government support to cover the revenue gap between distributors and generators and preventing funds from being reinvested in new infrastructure.

Third, the reliance on expensive imported fuels has led to a high cost of generation and to a significant increase in foreign debt. Fourth, the lack of participation of the financial entities in the energy market. To increase the financial stability of the national electricity sector, efforts should be made to address these four critical areas.

As of 2015, the PETROCARIBE (Latinamerica and the Caribbean economic system, 2015) agreement was renegotiated between the two nations due to the situation in Venezuela and the extreme debt that it was creating in the Dominican Republic. In response to this renegotiation, the Dominican Republic has been able to pay according to the National Energy Commission in the Dominican Republic (2018), 98% of the debt. This debt represented 25% of the external non-financial public debt of the whole country.

This debt repayment represents progress for the financial sector of the Dominican Republic. However, the financing for the implementation of renewable energy projects will require the collusion of the public and private sector with the aid of the international community.

However, several barriers exist in the country:

1) The government did not define a clear and concrete investment market for renewable energy. The renewable energy was added to the existing market with a minimal adaptation, described in the 57-07 law (See section 2.10.4.7 of this chapter)
2) The financial entities were not considered for the development of the renewable energy law or market.
3) No security from the government other than the Power purchase agreement (PPA).
4) The high-interest rates and risk that the country possesses in the financial sector.
5) Many banks in the Dominican Republic are still building their lending capacities, as this is a new unfamiliar product (renewable energy)

6) The access only to hard loans continues to impede project development as well. (See chapter 6 for a more in-depth review of financing in the DR)

Banco Hipotecario Dominicano Leon (BHD Leon, Dominican Mortgage Leon Bank) and Popular Dominican banks in 2017 made a leap of faith and created a pool of banks to finance the first generator biomass plant in the country. In doing so, not only does it emulate the private domestic financing in the country, but it hopefully sets an example to follow for the rest of the financial entities in the country (Popular bank, 2018). The lessons learned from this finance should be capture, use and store to scale up and expand the bank's lending portfolio and encourage and guide the financial sector into similar loans or methods for renewable energy projects.

Furthermore, certain public financing mechanisms, such as the Dominican sustainable energy fund and Petrocaribe, have not been leveraged to support renewable energy and energy efficiency as designed. These funds could play a significant role in mobilizing the domestic financing needed for project deployment. International financing also must be used to scale up renewable energy development. The Dominican Republic is a leading Caribbean nation in accessing international climate finance.

Support from mechanisms like the Global Environmental Facility (GEF) (both for large and small-scale projects) and the Clean Development Mechanism (CDM) should continue to play a role in providing financing to renewable energy projects. Domestic capacity should continue to be developed to allow the country to benefit from new mechanisms such as Nationally Appropriate Mitigation Action (NAMAs), where it has emerged as an early participant, as additional international funding becomes available.

The renewable energy sector remains a policy-driven market(Konold, 2015). As such, many barriers to financing projects can be overcome through the development and implementation of well-designed policy mechanisms.

Despite certain opportunities for reforms in the financial sector, a thorough scaling up of renewable energy financing will depend on policymakers creating the enabling framework to allow investments to take place. Financial actors and policymakers must communicate to ensure that these specific needs are addressed during the policymaking process. The financing of renewable energy is described in detail in chapter 6.

However, certain economic sectors do have reliable access to financing. In the hotel and tourism industry access to financing should not pose a barrier to energy efficiency and renewable energy investment. Here, the lack of sustainable energy investment is more a matter of the need for education, outreach, and capacity building regarding the benefits and opportunities of climate finance, as well as the will to implement energy upgrades.

2.12.3 Laws for renewable energy in the Dominican Republic

In 2007 to fulfil the international agreements and the national goals that the country had set regarding sustainability and alternative energy source, the DR created, approved and enacted law 57-07 on the incentives for renewable energy. This law contained the strategy of the government to implement renewable energy in the country. The main objectives were: (a) to increase the diversity of energy sources (b) reduce dependence on imported fossil fuels (c) stimulate private investment in renewable energy (d) ensure that private investments comply with rules and regulations (e) mitigate the negative environmental impacts of fossil fuel generation (f) promote social community investment in renewable energy projects (g) contribute to decentralization of power and bio-fuel production to increase the market competition and (h) contribute to the achievement of goals of the National Energetic Plan, especially those related to renewable energy.

The scope of the law was centred in small-medium scale wind, solar and biomass and the possibility of ocean energy. The strategy of the government was to attract investor by proposing a several appealing incentives, such as: 75% tax credit from the investment of self-producers, exemption from import duties on necessary renewable energy equipment, exemption from income tax until 2020, and many more (57-07 Law of renewable energy of the DR). Despite the attractive environment that this law proposes many of the policies that the law proposed such as the Feed-in-tariff prices have never been implemented in the country.

A list of the policies that have been enacted by the government of the DR can be seen in Table 2-19. Renewable policies in the Dominican Republic (2018). In 2012 with the change in government and the fact that since 2007 only one renewable energy project had been successfully implemented, the government decided to reform the law and cut the incentives.

As a result, the interest in the investment of renewable energy has been diminished. Also, with the creation of the Ministry of Energy and Mines it has become unclear what entity oversees renewable as the law 57-07 created the National Energy Commission to administer the law, however, with a ministry for energy in existence the process has become muddled and complicated, as both entities claim the power over renewables.

Table 2-19. Renewable policies in the Dominican Republic (2018) based on research.

Policy Name	Policy Mechanism	Status	Governing Law
The Dominican Republic Corporate and Income Tax Exemption	Tax-based Mechanism	Repealed	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07 Dominican Republic Law 253-12
The Dominican Republic Clean Energy Fund	Equity Finance Mechanism	Repealed	Dominican Republic Law 112-2000 on Hydrocarbon Regulation Dominican Republic Law 253-12
Dominican Republic Feed-in Tariff	Feed-in tariff or premium	Lapsed/not enacted	Dominican Republic application regulation of the law No. 57-07 Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
The Dominican Republic Import Duty Exemption	Tax-based Mechanism	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
The Dominican Republic Clean Energy Investment Tax Credit	Tax-based Mechanism	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07 Dominican Republic Law 253-12
Dominican Republic Exemption from Tax on Transfer of Industrialized Goods and Services (ITBIS)	Tax-based Mechanism	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
The Dominican Republic Renewable Energy Dispatch Priority	Utility regulation	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
The Dominican Republic Net Metering	Net metering	In force	Dominican Republic Net Metering Regulation Dominican Republic Net Metering
The Dominican Republic Renewable Energy Tax Incentives	Tax-based Mechanism	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Law 253-12
Dominican Republic External Financing Tax Reduction	Tax-based Mechanism	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
Dominican Republic Biofuel Tax Regime	Tax-based Mechanism	In force	Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
The Dominican Republic Renewable Energy Mandate	Energy target	In force	Dominican Republic application regulation of the law No. 57-07 Dominican Republic Law 57-07 on Incentives for Renewable Energy Dominican Republic Decree 202-08 regulating Law 57-07
The Dominican Republic 2030 Emissions Reduction	Emission reduction target	In force	Dominican Republic Intended Nationally Determined Contribution

Target			
The Dominican Republic Renewable Energy Tax Incentives	Tax-based Mechanism	In force	Dominican Republic Law 253-12 Dominican Republic Law 57-07 on Incentives for Renewable Energy

This 57-07 law of renewable energy in the DR is based on several Spanish laws regarding renewable energy: 40-1994 and 54-1997 energy law of Spain, the 1994 Costa Rican renewable energy policy and the 1990 German law on FIT. The Dominican renewable energy law has many similarities with the Spanish, Costa Rican and

From the Spanish law it has: (1) The initial RE installation potential is of 50MW. (2) The sale of renewable energy will be a fix tariff based on the electricity tariff, installed potential and the installation type. (3) the creation of a national energy plan. From the Costa Rican policy: It has the exemptions in the import tax for renewable energy equipment. From the German Law: the FIT schemes were adopted into the law and the prices for the renewable energy were estimated instead of calculated. However, the energy law of the DR was created in 2007 yet it is based on old and outdated laws from the 1990's. The need to re-evaluate and update the Dominican law is urgent.

2.12.3.1 ***Net Metering Program***

In July 2011, CNE launched a net metering program in the wake of other initiatives to promote renewable energy, the fiscal incentives contained in Law 57-07. A net metering scheme allows consumers to reduce their monthly utility bill by supplanting electricity consumption from the grid with power generated from their own renewable sources such as solar PV. Any surplus electricity that the user generates can be sold back to grid operators at a set price.

In the Dominican Republic, the program was originally designed for solar PV generation. By the end of 2014, solar PV remained the dominant source of generation under the net metering program. Most net metering clients remain small electricity producers. Almost two-thirds, or 333 of the 519 net metering customers, have systems smaller than 10 kW. Additionally, 68% of the clients (352) are residential, while the remaining 167 clients are commercial.

However, while the average generating capacity of a net metering system was 10.2 kW in July 2012, that figure had more than doubled to 23.7 kW by the end of 2014. Only 3 clients had a capacity of over 25 kW in July 2012, but that figure jumped to 76 clients by the end of 2014. The net metering program's growth has been remarkable since mid-2011. The program's average monthly growth is 25%, and the total generating capacity is now about 12.3 MW. Nevertheless, there remains significant potential for expanding the program to additional electricity customers.

The Dominican Republic has very strong renewable energy resources that have the potential to generate enough electricity to meet the country's growing power demand. Successfully integrating new renewable power into the national electricity system, however, requires a strong and functioning grid. The management challenges related to electricity transmission and distribution on the grid are different for centralized versus decentralized generation.

2.13 Critical review about the drivers for implementing RE in the DR based on the literature

The main forces in the Dominican Republic are:

- Returns: The wind farm Los Cocos a year after installation (2012), had a capacity factor of about 30%, above the level deemed necessary for a commercial project to be economical. In addition, contrary to most countries (Petrova, 2016) in the Dominican Republic the wind farms are a local tourist attraction creating extra revenue from tours and sightseeing stops.
- The electricity sector is a decades-long crisis that both represents a driving force and a challenge for the implementation of renewable energy.
- International pressure from the different signed agreements and the different groups that the country belongs too (CARICOM, SIDS, UN, Paris accord, Cop21)
- Health and wellbeing for the population, since this is a national crisis, it affects the different pillars of the nation, from food and water to health and education
- Environmental concerns, the LAC region is already being hit by climate change with the increase of natural disasters.
- Energy security, as the country, is vulnerable to the fluctuating fossil fuel prices.

2.14 Critical Review about the challenges for the implementation of RE in the DR based on the literature

The challenges in the Dominican Republic for the implementation of renewable energy are:

- The decades-long national crisis has created distrust in the population in the energy sector (Konold, 2015).
- The implementation of some of the renewable sources is highly expensive:

- o Wave and tidal energy technology are expensive (as explained in section 2.10.4)

- The absence of appropriate renewable energy infrastructure makes the absorption or implementation of renewables difficult. For example, biomass, most agricultural areas that have significant biomass potential are not located near power lines. Moreover, there is little experience with (and expertise in) mixing different types of biomass to make fuel, which is important if biomass power is to be distributed domestically (Konold, 2015 and International Renewable Energy Agency, 2016). Another major obstacle is that sources of biomass are seasonal: for example, sugarcane is normally produced for only half the year, meaning that substitute fuels are needed if power plants relying on bagasse are to run year-round or storage for renewable energy needs to implement. Finally, a pricing mechanism needs to be in place for biomass feedstock. Although many sources of biomass have the benefit of not being usable for other purposes, this does not mean that their collection and distribution will be free. More focus needs to be placed on how to properly price biomass feedstocks so that farmers or private biomass waste collectors have an incentive to capitalize on this low-hanging energy opportunity.

- Load shedding, or deliberately suspending electricity service for a period, is a major issue in the Dominican Republic (Konold, 2015). Not only does it lead to poor service, but it exacerbates the electricity theft that has left the country's power sector in debt by lowering the quality and value of electricity services in the country and making consumers more willing to steal electricity. Load shedding in the Dominican Republic is more a factor of customer non-payment and electricity theft across all income levels, and therefore distribution management and payment problem, and a shortage of supply (International Renewable Energy Agency, 2016). Distributors may purposefully ask for less generation than they know the grid demands, asking for only what they know they will recover in terms of expenses. Distribution companies then transfer any outstanding debt owed to the generators to CDEEE, which may go months without paying it. As a result, generators have been known to impose what is locally known as “financial blackouts” or “grey-outs” refusing to provide electricity until outstanding debts have been at least partially paid.

2.15 Discussion regarding the benefits of implementing RE in the DR based on the literature.

- The implementation of renewable could serve as a catalyst for many struggling industries.
- The country would save more than USD 30 billion in imported fuel costs, create 12,500 new jobs, save up to 137 million tons of greenhouse gas emissions, and reduce negative health effects from local pollution by implementing more renewable energy.

2.16 Summary of the Literature review

This chapter answers the research objective one:

“To review the literature related to renewable energy sources and infrastructure in general and the Dominican Republic.”

And the research question one:

"What is the status of renewable energy worldwide? In the Dominican Republic?".

Renewable energy has been adopted globally as a solution to the climate change issue. The world council (2016) has projected that for 2030 the developing countries will not only have the greatest population but will be the greatest CO_2 emitters, so it is only logical that a plan to prevent the growth of GHG emission and the effects of climate change be prepared. Point and case of the Dominican Republic, an island on the Caribbean that has one of the fastest growing economies but also one of the three highest CO_2 emitters of the Latin American and Caribbean region.

The Dominican Republic has exponential potential for renewables, especially wind, solar and biomass. Few studies exist in the area of renewables for the Dominican Republic and the focus of the majority of them is the potential along with highlighting that the exploitation of just one renewable energy would be enough for the country to cover the energy demand (Konold, 2015). However, the Dominican Republic suffers from a decades-long energy crisis in the electric sector, due to inadequate electricity infrastructure (old fossil fuel generators, inadequate lines of transmission, technical and non-technical losses in distribution, lack of trust in the sector by the consumers, dependency in fossil fuel) that has created a business as usual mentality for the actors involved in the sector. In many countries, renewable development is promoted by the government in the DR is the opposite the private sector has been using renewable energy for cogeneration for over 30 years. In the area of biomass the plantations have been using the sugarcane bagasse as an energy source for years (Ochs., *et al,.* 2011).

In the solar, the international company from Germany was the one to successfully installed the only solar plant in the country with 30 MW. In the wind, the 3 wind farms have been done without local financial support or government support. The DR has the potential but lacks the leadership and interest for follow through from the public sector. This chapter has explored the known literature and has aided in the identification of the themes for the data to be collected. Also, this chapter creates a path for the how and why the data is collected in DR, which will be presented in the next chapter.

Chapter 3 . Methodology

3.1 Introduction

This chapter is a systematic and critical review of the research process undertaken for the present study. The chapter is divided into three parts: (1) the ideology and its selection (2) the research method and (3) the data collection and analysis process. This division was done to enhance the understanding and reasoning of the methodology used for the different components of the research, such as the literature review, the philosophy the study is based on, the development of the research questionnaire, the data analysis, the creation and validation of the framework.

3.2 Research Overview

This research was focused on developing an objective and systematic approach to the implementation of renewable energies in the Dominican Republic. The research focused on a qualitative exploration of the energy sector in the Dominican Republic. This qualitative exploration was based on a pragmatic approach due to the complexity and lack of knowledge resources in the area (see Table 3-1. Resources available for Dominican Republic research).

To fulfil this approach an in-depth systematic and critical literature review was conducted of the status of global renewable energy (Chapter 2) as to be able to access the situation in the Dominican Republic and evaluate the existing energy sector strategies for renewable energy. From the literature review, a series of drivers, challenges, critical success factors were identified and documented. This identification assisted in the creation of the semi-structured interviews, as it highlighted what areas of knowledge need to be expanded in the Dominican Republic energy sector.

Once the questionnaire was created, it was obvious that the stakeholders to be interviewed had to be seniors in the field, so a purposed sample method was selected. Based on the knowledge need the following profile was created:

Senior Experts Representatives:

- Experience in the RE area (Technological, generation, Legal, financial, public and private sector)
- Knowledge in RE subjects
- At least five years of experience in the RE area

Based on the profile, 25 individuals were identified in the Dominican Republic, ranging from directors of departments, directors of projects, CEO's of companies, lawyers in the renewable area, managers and ministers. Although a purpose sample was implied a more accurate description would be purposive snowball sampling, as the energy sector is the Dominican Republic is in crisis, the interviewees were hard to agree to the interview.

However, once one accepted and when through the 30-90-minute-long interview and signed the confidentiality and anonymous paperwork, in true snowball (and Dominican way), aided in contacting the rest of the interviewees. As in the Dominican Republic, a personal reference or word of mouth has more weight than a request for a study. The collection of data started with a pilot study of 10 stakeholders.

However, it was quickly discovered that sample saturation was being reached and the pilot study became the main study. While and once the data was collected the transcripts were performed. Due to the complexity of the Dominican language and the use of regional and Dominican specific slang a transcript agent was not used. Instead, the researcher did the translations from Dominican Spanish to English, as to avoid mistranslations or miscommunications of what was said.

With the transcripts correctly translated, the next step was the analysis that was done through Nvivo, software that allowed for an easier content analysis of the data. The analysis identified new drivers, challenges, critical success factors and benefits for the Dominican Republic. To reconcile the findings from the literature to the ones from the interview an Interpretive Structural Modelling (ISM) analysis was performed. With all the results aligned, a systematic framework was selected and constructed for the Dominican Republic.

The benefits of the study are not just the creation of a framework that the country did not possess, but the body of the study (Literature review) contributes in expanding the need knowledge of the country while highlighting other areas for further research.

3.3 Steps of the research

3.3.1 Research ideology

All research is driven by the researchers' ideology in combination with the strategy as can be seen in Figure 3-1. Research design typology conceptual overview. Ideology is evidence driven continuous line from the left through positivism and pragmatism in the middle towards constructivism on the right (Kothari, Kumar and Uusitalo, 2014). The decision of what ideology to use will depend on the purpose of the research. For Positivism the data is an undisputable fact, for pragmatism, the interpretations of the researcher are the objectives of the study, and for constructivism, the views and opinions of the study participants are the important information.

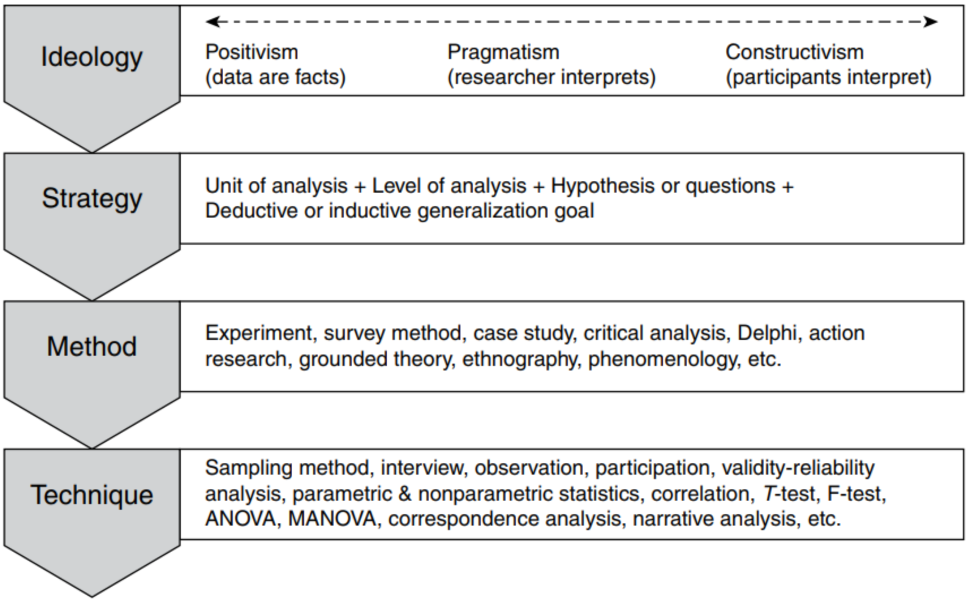


Figure 3-1. Research design typology conceptual overview.

(Source Kenneth D. Strang, 2015)

3.3.2 Determination of a research Ideology

As the literature review in chapter 2 demonstrated this study is exploratory in nature due to the lack of information available regarding the renewable energy implementation in the Dominican Republic (see Table 3-1. Resources available for Dominican Republic research).

Due to this lack of resources and that as the information of the participants would be fragmented and lacking a positivism or constructivism ideology was not possible. This led to the conclusion that the only possible ideology would be pragmatism as the lack of available knowledge the newest of the subject in the country would need to be exploring to form a cohesive theory and technique and to be able to add this compilation to knowledge.

Table 3-1. Resources available for Dominican Republic research

(research based)

No.	Title	Author	year	Type of publication
1	Wind Energy Resource Atlas of The Dominican Republic	NREL	2001	Report
2	Plan Energético Nacional – National Energy Plan	CNE	2010	Report
3	Dossier Energético República Dominicana (Energy dossier of the Dominican Republic)	BID	2013	Report
4	Aspectos Regulatorios y Tarifarios -Caso Republica Dominicana	OLADE	2013	Report
5	Harnessing the Dominican Republic's Sustainable Energy Resources	WORLDWATCH INSTITUTE	2015	Report
6	Climate Change Legislation In Dominican Republic An Excerpt From The 2015 Global Climate Legislation Study A Review of Climate Change Legislation In 99 Countries	Michal Nachmany, Sam Fankhauser, Jana Davidová, Nick Kingsmill, Tucker Landesman, Hitomi Roppongi, Philip Schleifer, Joana Setzer, Amelia Sharman, C. Stolle Singleton,	2015	Report

		Jayaraj Sundaresan and Terry Townshend		
7	El Futuro Del Sector Eléctrico en la República Dominicana (The Future of the electric sector in the Dominican Republic)	FUNGLODE	2015	Report
8	Energy Snapshot Dominican Republic	NREL	2015	Report
9	Renewable Energy Prospects: Dominican Republic	IRENA	November 2016	Report
10	Decision-Making for Risk Management In Sustainable Renewable Energy Facilities: A Case Study in the Dominican Republic	Guido C. Guerrero-Liquet, Juan Miguel Sánchez-Lozano, María Socorro García-Cascales María Teresa Lamata and José Luis Verdegay	2016	Paper
11	Boletin (Internal reports)	CNE	2017	Report
12	Renewables 2018 Global Status Report	REN21	2018	Report

3.3.3 Pragmatism Ideology

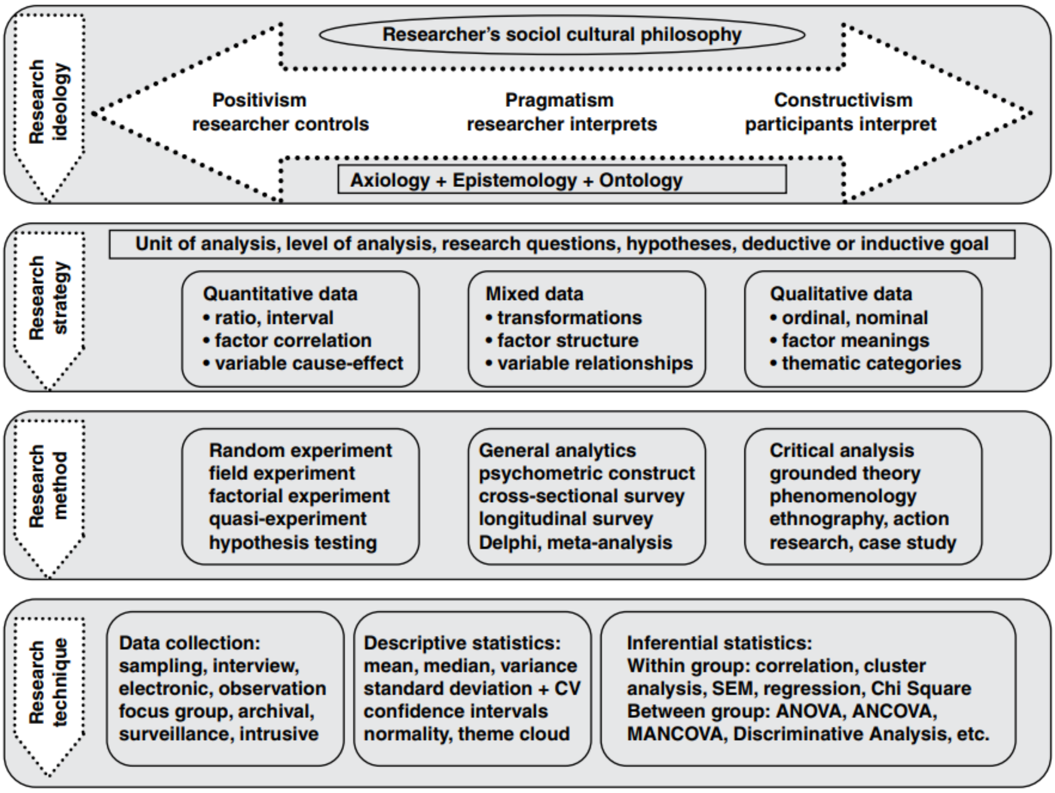


Figure 3-2. Research design typology full model

(Source Strang, 2015)

Pragmatism research ideology accepts concepts to be relevant only if they support action (Strang, 2015, chapter 4). Pragmatics:

"Recognise that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities."

At the same time, there is an occasional need for seasoned researchers to "modify their philosophical assumptions over time and move to a new position on the continuum". The modified philosophical assumptions are adapted by pragmatic researchers, who usually happen to be experienced researchers.

According to pragmatism research philosophy, the research question is the most important determinant of the research philosophy. Pragmatics can combine both, positivist and interpretivism positions within the scope of single research according to the nature of the research question (see Figure 3-2. Research design typology full model).

Unlike positivism and interpretivism research philosophies, pragmatism research philosophy can integrate more than one research approaches and research strategies within the same study. Moreover, studies with pragmatism research philosophy can integrate the use of multiple research methods such as qualitative, quantitative and action research methods.

This ideology aided in the research as an out of the box solutions to problems that aroused during the study had to be reached.

Once an ideology is selected a method of application of the ideology must also be implemented. In the positivism usually equates to quantitative method and constructivism equates to qualitative. In the case of pragmatism, both qualitative and quantitative can be implemented. The next logical step was to decide which method would better suit the aim and objectives of the study.

3.3.4 Qualitative, quantitative and mixed methodology

Strang (2015) and Creswell (2018) both explain that any empirical study beginnings with a literature review and includes data collection of some type without which there would be no scholarly research. However, the data collection requires the appropriate protocol and technique to achieve the proposed aim and objective. Three main research techniques or methodology are the most commonly use: quantitative, qualitative and mixed.

Quantitative methodology is used when the aim of the study is to quantify a situation, phenomenon, problem or event and the data collection method and analysis is design to discover the magnitude of the variation. Contrary to qualitative studies which aim to describe, explore a situation, problem or event through qualitative measurement scale to analyse the variation of the issue(s) without quantifying it.

A mixed method as the name indicates uses both quantitative and qualitative techniques to fulfil the aim. Although the research process is the same in all the methods, they differentiate in terms of the underpinned philosophy, the method of data collection, analysis and research findings communication style.

Due to the underpinned ideology chosen for this research, a qualitative methodology was selected to better fulfil the aim. As a quantitative and mixed method could not have been applied due to the lack of quantifiable parameters.

3.3.4.1 *Qualitative Research*

Qualitative research methodologies are those scientific approaches that attempt to create or construct meaning or knowledge. Qualitative research method follows a developing flow as the different steps evolve as the research matures. The focus of qualitative method is complex and broad, it's based on discovering, description, understanding and shared interpretation as it's mostly based on open-ended interview question and analysis that allow patterns to form and aid in the formation of a theory or phenomenon.

The basic characteristics of qualitative methods describe the aim of this study, as it is an exploration into the energy sector in the Dominican Republic, therefore making the choice of the method to use as qualitative (see Table 3-2. Characteristics of Qualitative method

(Source Kynga¨s, 2007; Strang, 2015 and Creswell, *2018)*).

Table 3-2. Characteristics of Qualitative method

(Source Kynga¨s, 2007; Strang, 2015 and Creswell, 2018)

Characteristics of qualitative method	**Description**
Natural environment	The qualitative method usually collects the data in the field of research, as their behaviour and mannerisms in their environment are just as important as verbal communication. Individuals are not interviewed or brought to a lab.
Researcher is the key instrument or tool	Qualitative researcher is responsible for gathering the documents that will aid in the creation of the questionnaire. The reliance on premade questionnaires or other instruments is not usually done.
Multiple resources for data	Qualitative research does not rely on one single

	data source. This method tends to gather interviews, observations, documents, audio-visual materials, and more.
Inductive and deductive data analysis	Qualitative research works both inductively, as the researchers first built patterns, themes, categories by organising the data collected and then deductively as the need for more or additional evidence for each theme is evaluated.
Participants meaning	The whole process is for the researcher to understand the knowledge that the participants represent for the research and not what the researcher can bring to the study.
Emergent Design	Qualitative research is a continuous loop or flow. It cannot be a rigid design as parts of the process may change as the data is collected or analysed. These shifts indicate that the research is achieving deeper understanding.
Reflectivity	The background of the interviewees and research may shape the direction of the study
Holistic account	Qualitative research tries to paint a bigger picture of the situation. However, this description is not necessarily a linear model of cause and effect is more the collision of different factors, parameters and viewpoints.

3.4 Research Data

There is no one definition for research data. Strang (2015) defines data as the factual recording of materials necessary to validate a research theory and findings and accepted by the scientific community. On the other hand, Creswell (2018) defines research data as a collection of information for producing original research and results. For this research, the data will be defined as a database of information for collecting, classifying, documenting, creating and analysing to create new knowledge.

Research data like the methodology can be quantitative or qualitative. For this research as a qualitative approach has already been selected a qualitative data collection and analysis was chosen.

3.4.1 Data for qualitative

Per Creswell (2018) qualitative data needs a different approach than quantitative methods of data. Although, as explain before the two methods have similarities due to the use of the scientific method, qualitative data are reliant on text, documents, images, interviews, opinions, perspectives.

As McCusker and Gunaydin (2015) the foundation of qualitative research is to purposefully select the individual participants or environment that will best aid in answering the aim and objectives of the research. This indicates that random sampling or many participants are not the best course of action.

3.4.1.1 *Steps in data selection*

First step: per Archibald and Faculty (2015) and Strang (2015) for samples related to qualitative methods and especially for research dealing with renewable is to identify what environment or sector is being targeted. For this research, the environment chosen is the energy sector. The second step is the decision on the type of data to be collected, for qualitative method several types of data exist:

- Qualitative Observations: These are open-ended observations taken in the field during the interviews with the participants. (This is implemented more in social studies where the behaviour of the participants is relevant to the aim of the study)
- Qualitative interviews: These are a few unstructured, semi-structured and open-ended questions with the intent of extracting the views, opinions and knowledge of the participants. These interviews can be:
    - Face to face
    - Telephone

- Focus group
- E-mail
- Social media (Skype or WhatsApp)

- Qualitative documents: During the research process, the research may collect relevant documents, such as newspapers, official reports, diaries, journals, and more. With the objective to broaden the knowledge base of the study. These can be:
  - Private documents
  - Public documents
- Qualitative audio-visual and digital materials: This is creative data that may be pictures, videos, websites, emails, social media and more.

Because of the nature of this research and the already discuss lack of information and complexity, the data that was selected was: Qualitative interviews and documents (see Table 3-3 for the advantages and disadvantages of the data type selected).

Table 3-3. Qualitative data selected with advantages and disadvantages

(source Strang, 2015; Archibald and Faculty, 2015 and Creswell, 2018)

Qualitative type	**Sub-types**	**Advantages**	**Disadvantages**
Interviews	Face to face	Participants feel more comfortable than by phone or email. The researcher can add reactive questions. The participants can make observations regarding the flow and understanding of the questionnaire.	Researcher's presence may influence the participants. Not all participants are articulate or perspective when face-to-face. Time-consuming. Coordination of the dates and times for interviews can be difficult.

			Transcribing can be long, time-consuming and complex, due to the different languages.
Documents	Public internal and external	Unobtrusive access to the information. Data that the interviewees consider important. Written evidence	Copyright protected Time-consuming to the lack of digitalisation or location of documents Language transcribing Incomplete information The authenticity of the documents

Of the different types of data, this research was based on interviews and documents, as the observations of the participants and audio-visual materials are not relevant or affects the aims of the research. The third step is to identify the recruitment strategy to be implemented. Recruitment can be a difficult step as it involves the wiliness of the individuals to participate or to lend their knowledge to the research. This was particularly difficult in the Dominican Republic.

The strategy for the Dominican Republic was done in two stages: First, an email request was created, and the second phase was creating an over the phone script in case the emails were not answered. However, the recruitment strategy is not implemented until the questionnaire, and the selection of the individuals is made. The fourth step is to analyse the themes identified in the literature review and determine how many participants are needed.

The decision on the number of participants is especially difficult in the qualitative method as the literature has a variety of perspectives, per Creswell (2018) the individuals can be from three to ten. On the other hand, Archibald and Faculty (2015) highlight that 20-30 participants are better. However, the literature does indicate that the importance in the qualitative method is not the number, but the quality of data that could be collected and that data saturation can be achievable with the number of participants selected. Because of data saturation, it is recommended that a pilot study be conducted first to verify the flow of the proposed questionnaire and the confirmation of the selected themes and environment.

The fifth step is to decide on the recording method for the data collection. As per Creswell (2018), this is the creation of a protocol, whether for observations or for interviews. The protocol will dictate the procedure(s) of the data collection. This can cover the recording strategy (field notes, audio recordings, video recordings). Creswell (2018) recommends and Strang (2015) agree that field notes should always be taken regardless of audio or video taken at the same time.

Both (Strang, 2015 and Creswell, 2018) indicate that the research protocol should:

- Be about two pages in length,
- The number of questions should be between 5 and 10 questions as to not overwhelm the participant.
- The research should have a printed copy of the questions and space to make notes on them.
- To prepare for the interview, the research must know the question from memory as to appear prepare before the participant.

The sixth step is the decision of the analysis of the data. Since the analysis is segmentation and understanding of the data collected and finally the last steps are the interpretation and validation of the data. (Table 3-4. Data selection steps)

Table 3-4. Data selection steps

No.	Steps for Data selection	Description
1	Environment	The energy sector in the Dominican Republic
2	Data type	Interviews and documents (see Table 3-3. Qualitative data selected with advantages and disadvantages)
3	Recruitment strategy	Appointments for interviews were made; contact was done through email and phone calls.
4	Sample size Sample type	25 interviewees Purpose and snowball sample
5	Record method	Field notes and audio records
6	Analysis	Content analysis and ISM
7	Interpretation	Framework
	Validation	Triangulation, member reviewed and reflective commentary

- **First step, environment**

As defined in section 3.4.1.1 the first step is the selection of the environment of the research. Since the aim of the study is:

"To evaluate the status of renewable energy strategies in the Dominican Republic."

Therefore, the environment of the research is the energy sector in the Dominican Republic, more specifically renewable energy.

- **The second step, Datatype**

The decision on the type of data to be collected will be dictated by the aim and objectives of the research and the available information. In this research since the available resources were so limited, two data types where chosen, document internal and external and interviews of critical stakeholders as to create a better picture of the renewable energy sector in the Dominican Republic.

Documents

As can be seen in Table 3-1. Resources available for Dominican Republic research (research based). The list of available documents is very small and reliant on reports from international agencies. The researcher while conducting the interviews in the Dominican Republic also collected a series of internal documents from different organizations: from the national commission of energy, from the distributor, from different generation plants, and many more organizations to create a better understanding of the sector and to validate the themes created in the data analysis.

Interviews

Interviews are a type of research data collection that involves conducting a series of theme-related question to an individual or a group with the purpose of recording and documenting the knowledge, views and ideas regarding a phenomenon, situation, or issue. Three different types of interviews are implemented in the qualitative method (Carter *et al.*, 2014; Barakabitze, Fue and Sanga, 2017):

- Structured interviews: this consist of several pre-determined questions that all interviewees answer in the same order, making the data analysis easier by being able to compare different answers to the same questions.
- Unstructured interviews flow like a normal conversation as no prepared question are made. However, specific themes are predetermined and selected for the interview.
- Semi-structured interviews: is a combination of structured interviews as predetermine questions are created with a selected theme at its core and

unstructured as additional questions might be asked during the interview process either to clarify a question or to expand in a specific topic.

For the foundation of this research, semi-structured interviews were selected as the possibility of collecting in-depth information was greater with this type of interview. In addition, it allowed for greater control of the interview flow and provided time for improvised questions. However, it did increase the initially proposed time frame of the interviews from 20 minutes to an average of 45 minutes with some interviews lasting as long as 90 minutes or as little as 30 minutes. For the interview, a protocol was created (see Appendix A). The protocol took into consideration (1) the fact that the research had to remain impartial as to not create a bias in the participants (2) the interviews were to be conducted in the participants offices where they could be more relaxed and open to the interview (3) the reassurance that the participants name and in some case the position in the company would remain anonymous and that once the research was done the recordings and transcripts would be destroyed (see Appendix A for protocol).

The questionnaire was created based on the themes identified from the literature review of renewable energy globally and from the limited documents from the Dominican Republic (See Table 3-5. Themes and questions created for research interviews.).

Table 3-5. Themes and questions created for research interviews.

Theme	Question	Improve question at interview (Sample)
Introductory	Please describe your position and functions in the organisation? (relevance to the organisation)	N/A
Status of the sector	Based on your role, what would you consider as a renewable energy project in the DR? Considering your position, at what stage of development would you believe the renewable energy market in the DR is at? could you please elaborate, based on your role and responsibilities, on the laws and regulations that govern and support the renewable energy projects in the DR?	what measures can be taken to improve the renewable energy market? Are the laws in place enough, do they serve the purpose? Is the renewable energy legal framework applicable or is it more theoretical?
Business models	About the institution that you belong to, What Renewable Energy project have been designed, involved and/or implemented by this institution or company? Considering your position, what would you consider is the renewable energy focus of the business/institution/government of the DR? (e.g., solar, wind, water, etc.) moreover, what energy business plan or strategy would you consider is being implemented by the enterprise/institution/government in the DR? What do you believe, in relation to your position, are the main reasons that the DR has not fully exploited the renewable energy sources in the country?	Has the organization changed its views in regard to renewable energy? Has the organization changed the business model to better accommodate renewables? Why or Why not has the DR not used the renewable potential that it possesses?
Drivers	What renewable energy aims, goals or motivation does the institution/ company that you belong to have, and which goals have been or will be achieved? Can you describe in accordance with your position, the drivers that have motivated the DR to invest/implement in renewable energy	which drivers have been, or do you consider are/will be the most important ones? Do you believe the aims or goals of the country/organization are

	projects/initiatives?	enough? Are they achievable?
Challenges	Given your role and responsibility, kindly explain what do you considered have been the challenges that the DR companies/institutions/government faced or will face by implementing renewable energy initiatives/projects?	Of these challenges which ones do you consider more important? Do you believe that renewable energy could overcome these challenges with proper leadership?
Finance	Regarding your station could please provided what financial support and tools do you believe that a renewable energy project/initiate needs in the DR?	How would you evaluate the current financial tools available in DR for renewable energy projects?
Benefits	Can you elaborate based on your position on the benefits and possible benefits that renewable energy projects bring or could bring to the institution/Company/country?	Which benefit do you believe is more important?

Ethical Considerations

Ethical considerations are an important part of the research. As this research is qualitative and based on interviews, the interaction between the participants and the researcher can be ethically challenging. Therefore, the ethical standards of the University of Wolverhampton have been followed and following the ethics protocol of Bellini (2017) the next ethics concerns were respected:

- Consent for the interviews obtained in writing from each participant
- Each participant was shown respect regardless of if they participated or decided to recuse themselves from the research.
- Privacy protection was ensured, with the database of the interviews been password protected and located in an external hard drive only
- Confidentiality was assured and has been kept
- Anonymity was assured

- The participants were brief on the research before the interview, explaining the aim and objectives, as to provide transparency to the research
- The fact that the research is funded by a government entity was disclosed to all the participants

- **The third step, recruitment strategy**

Archibald and Faculty (2015) explain that often researchers tend to overestimate the willingness and availability of the participants while underestimating the time and resources required for participant recruitment. These assumptions make the recruitment one of the most challenging, time-consuming and intensive resource is the recruitment of participants.

Taking this into account and factoring in the local knowledge of the research regarding coordination and communication in the Dominican Republic, direct recruitment of potential study participants was chosen and carried out by email and phone call in Spanish (Table 3-6. Recruitment drafts have the English version of the email draft and phone call). For the email, a draft of an appointment for a research interview was created, and a script for the phone call appointment was made.

Table 3-6. Recruitment drafts

Recruitment strategy	description
Email	Good day, My name is Angelines Donastorg. I am a PhD student at the University of Wolverhampton in England. I am investigating renewable energy in the DR, and I would like, if you can, to ask you to participate in a brief interview (about 20 minutes of your time) at a convenient date and time for you (or by Skype), the interviewed questionnaire will be referring to the electricity sector in the DR and more in specifically on renewable energy.. I am looking forward to your response. My most cordial greeting. Sincerely,
Phone	A good day is this the office of …I would like to make an appoint with…My name is Angelines Donastorg; I am a PhD student at the University of Wolverhampton

	in England. What date and time are available for a 20-minute interview regarding the renewable energy sector in the DR for research purposes. That will be fine Thank you for your time

Once the drafts were created, the participant needs to be identified.

- **Fourth step. Sample size and criteria**

As many researchers (Archibald and Faculty, 2015; Strang, 2015 and Creswell, 2018.) explain the qualitative method do not have a set sample size; the quality of the sample is the important parameter. Based on this parameter and on the information that renewable energy law was created in 2007, and the first renewable energy generator (wind farm) was built in 2011 and in the period that the data collection was to be done (2016) only two wind farms, one solar farm and one biomass plant were operating in the Dominican Republic. The researcher created a profile:

- Description of Critical criteria of interviewees.
  - o Senior Experts Representatives
  - o Experience in the RE area (Technological, generation, Legal, financial, public and private sector)
  - o Knowledge in RE subjects
  - o At least five years of experience in the RE area

Based on the profile and the knowledge of the generators and law in the Dominican Republic a list obtained with twenty-five names of the stakeholders involved (Table 3-7. Classification of Interviewees for the implementation of RE projects in DR.): in (1) the law creation and implementation, (2) Wind, solar and biomass projects design, construction, maintenance, funding, operation and (3) financial entities involved in the market.

This meant that the sample was purposive as only a limited amount of people in the Dominican Republic possess the knowledge and fit the parameters and making the embed unit of analysis the individual employee. Once the list was obtained the drafts were edited for everyone, the response from the participants took weeks, and even the phone calls were either never answered or redirected to another department.

After four weeks of sending and resending the emails, 10 participants agree to the interview, and since the researcher was out of the country, a trip was programmed around the dates that the participants had selected.

Table 3-7. Classification of Interviewees for the implementation of RE projects in DR.

Classification of Interviewees for the implementation of RE projects in DR.	
Participants	No. of interviewees
CEO's (Including Ministers)	7
Directors	11
Managers	7
Total	25

- **Fifth step. Recording the data**

Recording of the data is critical as it will serve as evidence of the research data collection. For this research field notes and audio recordings were performed. As Creswell (2018) highlights one type of recording is not enough; a backup is essential. The semi-structured interviews were recorded and transcribed in Spanish first and then translated to English. Due to the peculiar, idiosyncratic qualities of the Dominican Language and the use of colloquial words, the research made the decision of not employing a translating or transcribing agent and doing the translations and transcribing alone as a native of the Dominican Republic this would avoid the misalignment of words or phrases local to the Dominican Republic.

3.4.2 Pilot Study

Yoder, et al., (2019) define a pilot study as “a small study to test research protocols, data collection instruments, sample recruitment strategies and other research techniques in preparation for a larger study”. As can be seen in section 3.4.1 the data protocol collection had been created, and 10 out of 25 participants had agreed to the interview. This sample became the pilot study to test the in-depth semi-structured interviews created.

However, once the pilot study began it became apparent that the purposive sample technique alone would not be enough, as several of the participants were difficult to pinpoint even after appointments had been made. So, a purposive and snowball sample was implemented:

- Purposive sample or judgment or subjective: Black (2010) defines purposive sample as a qualitative sample technique in which the participants are chosen based on the judgement of the researcher. (see Figure 3-3. Purposive sample) This type of sampling is time-cost effective, and due to the limited population, that fit the profile was the only sample technique available. However, this method does suffer from a possible high level of bias, as it is based on the judgment of the researcher.

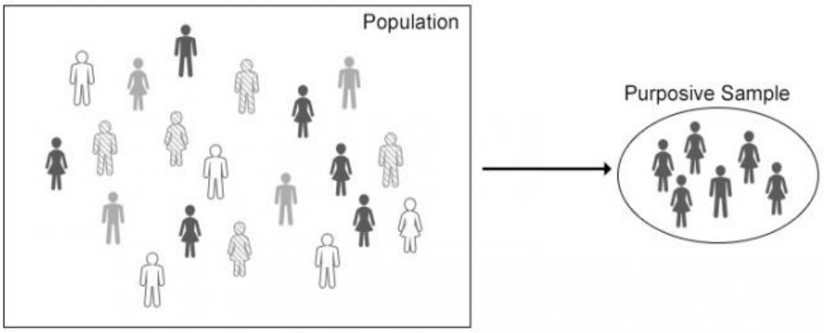


Figure 3-3. Purposive sample

(Source, Black, 2010)

- Snowball sampling or chain-referral sampling is a qualitative sampling technique implemented when the parameters need to fulfil the aim and objectives of research are difficult or rare to find. The technique is based on participants nominating or referring other potential participants to the study (Emerson, 2015).

However, for this research a purposive sample had already been identified, the difficulty was in the participant's willingness to sit down for the interview. This is where snowball sampling aided the research. Once the first participant had been interviewed and understanding the difficulties in contacting or arranging an appointment with the other participants, the first interviewed offered to contact the other participants in the list.

Also, this demonstrated that all 25 knew each other and each confirmed that the members on the list were the only ones that fit the parameter or profile described in section 3.4.1.1.

3.4.3 Main study

Once the pilot study was conducted it became clear, that the protocol's flow and themes were correct as data saturation had been achieved even before completing the 10 participants interviews. So, taking advantage that the participants were willing to continue the purposive and snowball sampling the missing 15 participants were contacted and interviewed. Two of the participants had to be interviewed via Skype as they were in remote locations for work.

3.4.4 Sixth step. Analysis of the collected data

The focus of analysis of the collected data is to segment and break it into parts that can be understood and interpreted. The analysis was a simultaneous process as the data collection, translations and transcripts was performed at the same time (Figure 3-4. Content analysis process for research.). The first step in the analysis is to sort the data that was collected. As Creswell (2018) highlights the data categorization can be done through theme analysis or content analysis.

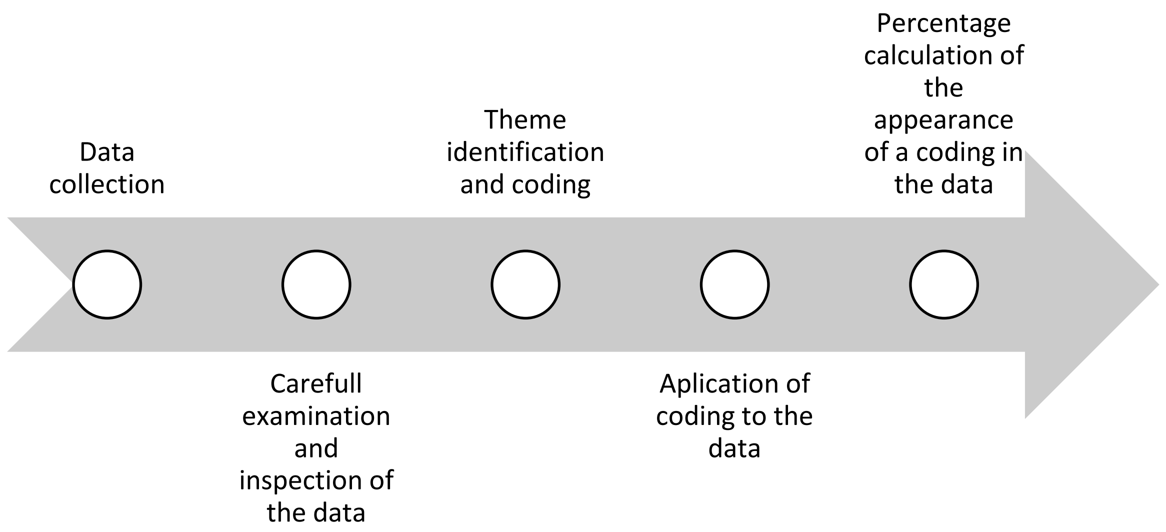


Figure 3-4. Content analysis process for research.

This theme method or thematic analysis according to Braun and Clarke (2012) consists of identifying patterns in the data. Thematic analysis can be done in an inductive, deductive or mixed method. An inductive approach is driven by the content in the data, meaning that the mapping of the information closely resembles the data itself. While a deductive approach, the researcher already knows what themes to look for in the data and has a map or coding ready(Braun, & Clarke, 2012).

Content analysis can be applied to documents, interviews, videos. The foundation of the method is the replication and validity of the inferences from the data to the context, with the purpose of providing new knowledge or insights. Meaning that a coding system is created, a group of themes or words that will be identified in the text and quantified to see the which theme is more important than others by the times it is mention(Kynga¨s, 2007).

3.4.5 Content analysis performed

The focus of content analysis is to achieve an in-depth knowledge of the data collected. Also, as Elo *et al.,* (2014) explains content analysis is a methods of analysis documents in a systematic and replicable manner. As this research is exploratory in nature the content analysis was used for the understanding of the literature review and the interviews.

- Steps for content analysis
- The first step in content analysis is the understanding of document. To be able to do this the researcher had to read and re-read the documents and interviews several times.
- The second step is the decision on what is to be coded. According to Krippendorff (2018) the coding will depend on the objectives of the research, the labelling or coding in content analysis is done to highlight meaningful patterns. In qualitative these objectives coding could be done in a deductive manner, meaning the researcher already knows what to look for in the documents or transcripts, or in an inductive manner where the data stir the coding towards new information, repeat information, information stated by participants as important, and more.

  However, for this research, a deductive approach was used for the analysis, as the themes had been identified in the literature review. Although new themes were discovered in an inductive way (critical success factors) while the analysis took place, the majority was done in a deductive manner. This method can be done by hand or by software. Due to the time frame and complexity of the data collected for this research.

The content analysis and coding of the information were performed with the Nvivo software by QSR International. Nvivo is a qualitative data analysis software that aids in the storage, organization, categorization and analysis of text, videos, social media and more.

- Interviews: First the interviews were coded to fulfil the anonymous clause in the ethics and protocol forms that were agreed with the participants. Each interview was coded as:
    - Energy interview # = EI#, for example, energy interview one equals to EI1

- The data from the interviews were carefully inspected and read, and themes were carefully identified, and then coding was applied. In the Nvivo software (QSR International) the settings were set for content analysis by phrase. Due to the nature of the Dominican language many of the participants tended to speak about several subjects at the same time and to leave incomplete sentences before starting the next one, further evidence of why a translator was not used. This led to the phrase analysis as it provided more context of what the speaker was referring too than a word analysis as can be seen on Figure 3-5. Example of the coding done in Nvivo for one parameter.

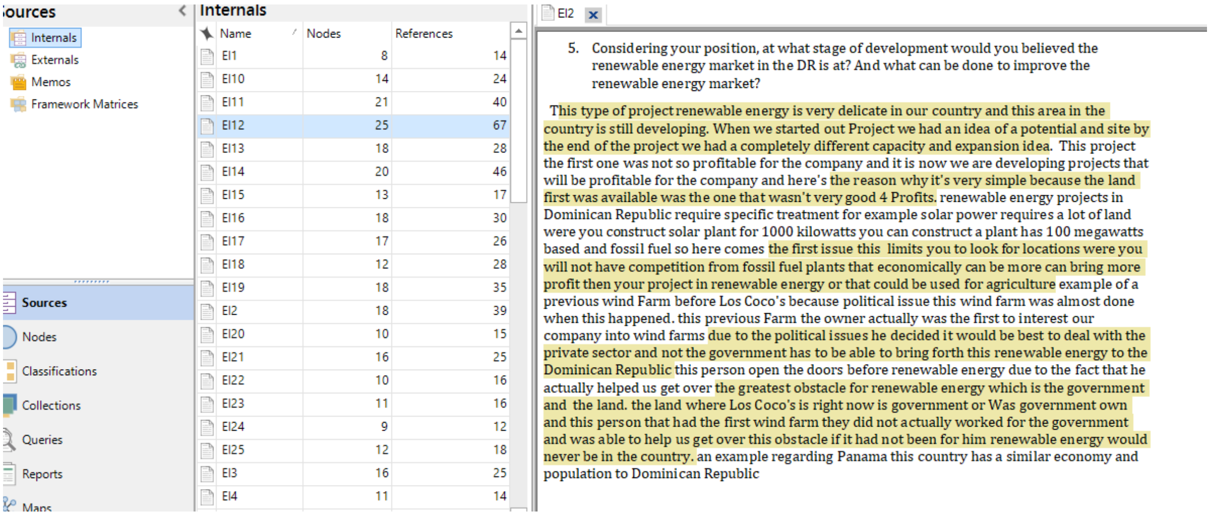


Figure 3-5. Example of the coding done in Nvivo for one parameter.

- Statistically estimation of the proportion of the patterns or coding in the documents and the relationship and correlation of the themes. This can be seen in the tables at the beginning of chapters: 4-9. The tables represent the number of interviews that had knowledge regarding the theme and the knowledge found in the limited documents of the Dominican Republic.

3.4.6 ISM

Interpretive Structural Modelling is the tested and proven methodology to understand and design the structure of a complex problem. It is a tool which is used to establish the relationship between the variables affecting an issue or problem. Identification of the factors acting as a obstacles through literature review and expert opinion, development of contextual relationship between the variables, development of structural self-interaction matrix (SSIM) then formation of reachability matrix ,partition of reachability matrix into different levels, graphical representation of relationship developed among the factors explained in reachability matrix ,check for inconsistencies and subsequent modification are the main steps which that are followed in ISM modelling (Sushil, 2012). For this research ISM was used to find the relationship between the data from the literature review and the data analysis from the interviews and documents.

3.4.7 SSIM Matrix

Experts from the industry and academia are consulted in identifying the nature of the contextual relationship among the factors. The following four symbols are used to denote the direction of relationship between two factors (i and j): (a)V if factor i will influence factor j (b) A if factor j will influence factor i (c) X if factors i and j will influence each other (d) O If factors i and j are unrelated.

3.4.8 Reachability matrix

The reachability matrix is created from the SSIM. Symbols V, A, X or O of the SSIM are replaced by 1s or 0s to create reachability matrix. Following rules are followed: (a) If the (i, j) position of SSIM is V, then the (i, j) position of the reachability matrix becomes 1 and the (j, i) position becomes 0. (b) If the (i, j) position of the SSIM is A, then the (i, j) position of the reachability matrix becomes 0 and the (j, i) position becomes 1. (c) If the (i, j) position of SSIM is X, then the (i, j) position of the reachability matrix becomes 1 and the (j, i) position becomes 1. (d) If the (i, j) position of the SSIM is O, then the (i, j) position of the reachability matrix becomes 0 and the (j, i) position becomes 0 (Sushil, 2012; and Attri, Dev and Sharma, 2013)

3.4.9 Level partitions

With the help of the reachability matrix, reachability set, and antecedent sets are generated for each factor. The reachability set contains the factor itself and the factors which influence it, whereas the antecedent set contains the factor itself and the other factors which impact it. The intersection set for each factor contains the common factors between the reachability set and the antecedent set. A factor is put on the top level if reachability and intersection sets are the same (Sushil, 2012; and Attri, Dev, and Sharma, 2013).

3.4.10 ISM based Model

ISM model is developed with the help of level partition table and digraph. A digraph is the graphical representation of the factors and their interdependence in the form of nodes and edges, and it is drawn with the help of level partition table. Finally, a digraph is changed to ISM model by substituting nodes of the factors with statements (Sushil, 2012; and Attri, Dev and Sharma, 2013).

3.4.11 Advantages and disadvantages of the analysis performed

- The focus of this research is the implementation of renewable energy projects in the DR. For that purpose, first, a theme analysis was performed in a global scale as to identify the critical areas of implementation. This analysis provided the flexibility need to understand the immense quantities of data available for renewable energy implementation and provided the need context that the researcher needs to narrow down the documents. However, the consistency in the theme was a challenge as the flexibility of the theme analysis can be a double edge sword providing a greater scope than need and time consumption having to re-do the analysis to continue to narrow down.

For the analysis of the data a content analysis was performed even though the analysis is time consuming it allows for a statically relationship and correlation to be created between the themes or coding. However, the content analysis of the documents and transcripts provided areas without a direct relation or correlation, so an ISM was selected to bring these results together and to be able to create a graphical view point of the results. See Table 3-8. Advantages and disadvantages of the data analysis methods.

Table 3-8. Advantages and disadvantages of the data analysis methods

(Source Sushil, 2012; Attri, Dev and Sharma, 2013)

Method	Advantages	Disadvantages
Theme	Flexible approach Provides a rich, detailed and complex account of the data Is an accessible and easy to understand the analysis Aids in summarizing large quantities of data	The flexibility can lead to inconsistency and lack of coherency in the themes When compared to other methods the literature on thematic analysis is lacking
Content	Can handle large quantities of data Can corroborate evidence Quantifies texts meaning Highly reliable Can be based on imagines, words or sounds	Time-consuming Is subject to error Is inherently reductive
ISM	Shows interrelations between elements in accordance with importance Can be use in a complex situation Can be used for qualitative or quantitative Enables to map the process of a phenomenon by building a structural model	Time-consuming Errors in the coding carry over Can produce a complex matrix for analysis

3.5 Seventh step. Framework Development

Once the data analysis is done, the last step is to interpret the analysis in a manner that answers the aim and objectives of the research. Interpretation as Creswell (2018) highlights involves several processes: synthesizing the findings, comparing them to the theory, discussion the reliability of the results.

For this study the chosen interpretation was a Framework, as it allows for a structured way of summarizing and comparing the results, the validation part of this step will be described in Section 6 below. As Grant (2014) and Adom, Hussein and Joe (2018) define a framework as the supporting structure of research study theory. Several types of framework exist:

3.5.1 Theoretical Frameworks

Grant (2014) describes the theoretical framework as one of the most important, difficult but not impossible parts of research. A theoretical framework is a guide from which to build the study, and it contains the underlining theory that the research reasoning is based on. The theoretical framework will be affected by the data collection as any relevant data, and the findings will be used to modify or extend the theory.

In a qualitative method, the theoretical framework can emerge as the data is analysed, as a having a theoretical framework from the beginning can keep the researcher from forcing preconceptions on the findings.

3.5.2 Practical Frameworks

This kind of framework as Betancourt *et al.,* (2016) explain is not based in formal theory but on the cumulative knowledge practices or stakeholders in a specific area, and its often focus on the viewpoints of the practitioners. A practical framework guides research based on the experience of participants.

3.5.3 Conceptual Frameworks

A conceptual framework is a foundation structure for research that is not focused on one theory or concept (Agyem, 2018). A conceptual framework aids in summarising the findings from the literature and the data collection. This summary can be a model or conceptual framework which represents an integrated way of presenting a problem or situation.

3.5.4 Framework constructed for this research

Due to the complexity of this study and of the data collected a conceptual model was chosen as the best way to represent the summary of the findings regarding the theory and the data collected from the documents and interviews. See chapter 10 for the framework creation and different levels.

3.6 Reliability and validity of the research method and design

Although validation of findings is done throughout the study, this section will describe the steps that the research took to ensure the accuracy and credibility of the results.

3.6.1 Validation

Validation does not carry the same connotations in qualitative research as it does in quantitative research. nor is it a companion of reliability or generalizability. Qualitative validity means that the researcher checks for the accuracy of the findings by employing certain procedures, while qualitative reliability indicates that the researcher’s approach is consistent across different researchers and different projects.

According with Creswell (2018) eight qualitative validity methods exist: (1) triangulate (2) member checking (3) rich, thick description (4) clarify the bias (5) Present negative or discrepant information (6) spend prolonged time in the field (7) Peer debriefing and (8) external auditor. However, just one method is not enough as Creswell (2018), and Strang (2015) both agree that at least two must be employed by the researcher to ensure accuracy and reliability. For validating this research, the following methods were identified and implemented.

- Triangulate: This method consists in examining evidence from different data sources: Interviews, documents, journals, reports, and if themes, perspectives, views converge from the different sources then this adds validity to the study.

  For this study triangulation was achieved while doing the data analysis as the literature review is the first part, the analysis of the interviews and documents is the second and the third is the ISM analysis done to both the literature and the interviews to discover the interconnection of the previous two.

- Member checking: The foundation of this method is to present to the participants of the study a summary or specific critical part of the research and capturing their viewpoint on the accuracy. This method can be achieved through interviews, focus groups that will result not just on the validity but can expand or modify the evaluated and presented results. For this study a focus group protocol was design (see Appendix B) where participants of the study that had been identify as trendsetters were selected to present a brief presentation of the research findings and the framework model created and asking them five simple questions to ascertain the agreement or disagreement of the participants with the result of the study.

  The participants chosen represented the public, private and academic areas of the energy sector of the Dominican Republic. Anticipating the lack of response base on the experience from the data collection, ten participants were chosen when the targeted audience was 3. Invitations were sent out through email, phone and Skype, all ten participants responded in the affirmative and date, location and time were set in the Dominican Republic between the participants and the researcher.

  However, on the date accorded only 2 participants showed, one from the public and one from the private/academic sector, the focus group was performed, and the responses were recorded with field notes and audio recordings. The other participants were contacted again and two more agreed to meet, and as a result, two individual interviews were conducted and recorded with field notes and audio recordings. (see Chapter 10 for the analysis of the validation and the responses of the participants).

- Peer debriefing: This method is used to enhance the accuracy, as this involves the participation of a peer debriefer. The job of the peer is to review and ask questions to ensure that the information resonates with people other than the researcher. In the University of Wolverhampton, the doctoral college has arranged for the researchers to present their work yearly as to validate the work in a peer debriefing in several ways:

  By presentations to an audience of students and academics, poster presentation regarding the research to the public. This strategy allows the research to see gaps in the research and to have fresh input on the topic discussion.

3.7 Challenges in a reflective way

The researcher faced numerous challenges in the undertaking of this research related to the research data selection, collection and analysis:

- The interviews were the biggest challenge. Due to the nature of the researcher the participants profile was very specific making the targeted population small (25). The actual interviews were difficult to acquire due to the lack of response or follow through of many interviewees. To counter the lack of successful appointments a snowball sample method had to be implemented to acquire the targeted persons.

Since the 25 interviewees seem to know each other, they continued to referrer the researcher to the next person and even going so far as to send presentation emails to aid in arranging the interviews. The researcher was aware that this would be a difficult step as Dominicans tend to value more a personal reference than a University letter. Also, due to the lack of experience of the researcher interviews tended to last longer than necessary or to refocus the interviewee back on the subject at hand took more time than necessary, interviewees tended to go on tangents and extracting the necessary information was in some cases difficult.

- During the interviews the research quickly realised that a transcription and translating agency would not be applicable for the research. Due to axiomatic and colloquial terminologies of the Dominican Republic. Therefore, the transcribing process was longer and more complex, as first the interviews had to be transcribed in Spanish and then translated to english without losing the raw information. In this process, the researcher made the mistake of transcribing everything the interviewees said to assure that no information was lost.
- The selection of the method of analysis was a challenge for the research as first a confusion between theme and content analysis created the need for a more in-depth review of the methods. Also, the lack of documentation created the need to analyse the documents as to be able to apply context and identify the themes discovered in the theme analysis of the global literature.

The analysis of the results provided difficulties as areas were unrelated, so the decision to implement a third method was though about for a long time and research before coming to the conclusion that the best method for the researchers skills to implement would be ISM, as it would allow for all the results to be linked and as a added benefit a graphical view could be created.

- The raw information was complex, but the themes were easy to identify. However, many of the interviewees tended to answer several questions in one, making the theme and categorization harder to analysed. Also, the lack of experience of the researcher made the analysis longer as some of the key areas that the participants highlighted could belong to several of the categories. So, the researcher had to do a more in-depth review of the methodology and of renewable energy as to properly divide the information.
- These challenges were typically addressed through extensive study, discussions with colleagues, presentations of the research in conferences and university activities, and constant discussion and support from the supervisory team.

3.8 Summary

The qualitative methodology employed in this study was selected due to the exploratory nature of the research with a pragmatism underpinned at its core to provide the flexibility need to apply an array of data collection and analysis if need. This exploration was performed on the energy sector in the Dominican Republic, to be more specific the renewable energy sector for the generation of electricity.

To be able to analysis this environment a purpose sample of 25 critical stakeholders were identified and contacted by email and phone. However, due to the fickle nature of the Dominican population a further sampling technique had to be implemented, snowball sampling. The snowball sampling was performed in a purpose manner as the 25 individuals were still the target, yet each interviewer provided the need contact and personal recommendation to be able to interview the following targeted individual. The interviews were conducted in a semi-structure manner, as a protocol was created based on themes identified in the literature. This semi-structure interviews created a direction for the conversation but allowed the flexibility for the participants to speak more freely regarding the themes. Therefore, providing more in-depth knowledge and data for analysis. Along with the interviews, local and internal documents were collected.

Simultaneously with the interviews, the translations and transcript were performed by the research as the idiosyncrasy of the Dominican speech made the task unable to be outsource. Once the interviews, translations and transcripts had been done, the content analysis was performed with the Nvivo software. However, some of the results were mismatch with the literature and therefore an ISM analysis to discover the interconnections between the literature and the interviews was performed. Also, the ISM provided a graphical model and the core parameter of each theme. With the interconnections, the core parameters and the graphical model a framework was built for the implementation of renewable energy projects in the DR and validated with several methods as to ensure the quality and reliability of the research conducted (Table 3-9. Summary of the methodology).

Table 3-9. Summary of the methodology

Ideology	**Pragmatism**

Methodology			Qualitative
Data	No.	Steps for Data selection	Description
	1	Environment	The energy sector in the Dominican Republic
	2	Data type	Interviews and documents (see Table 3-3. Qualitative data selected with advantages and disadvantages)
	3	Recruitment strategy	Appointments for interviews were made; contact was done through email and phone calls.
	4	Sample size Sample type	25 interviewees, purpose snowball sample
	5	Record method	Field notes and audio records
	6	Analysis	Content analysis and ISM
	7	Interpretation	Framework
		Validation	Triangulation, member reviewed and peer debriefing

This chapter provided the guide on how the research was conducted and the reasoning behind the selection of the methods implemented and provides an understanding on how the next chapters were built.

Chapter 4 . Business Models for RE Implementation in the DR

4.1 Introduction

This chapter discusses the traditional and new trends in business models for the implementation of renewable energy in developing countries, specifically for the Dominican Republic. The results are grounded in the findings of the qualitative research methodology discussed in Chapter 3, based on a critical and systematic review of the known literature, different countries case studies and on the thorough analysis of 25 key stakeholders' interviews of the energy sector in the Dominican Republic.

For a better understanding of the business models in the renewable energy area, first this research explains the new and traditional trends worldwide in section 4.2 below, and second, it focuses on the models used in the Dominican Republic in section 4.2.3 below.

The reason for the generalized view and then a focused view in the Dominican Republic is to be able to properly and objectively evaluate the status and the models used in the Dominican Republic as to answer the second research question: "*What business strategies are been used in the Dominican Republic for the implementation of renewable energy projects?"* and at the same time fulling the second research objective*: "To investigate the key renewable energy related business models' initiatives that have been or planned to be implemented in the Dominican Republic"*.

4.2 The Dominican Republic

4.2.1 Background

The Dominican Republic (DR) is primed to become a major proving ground for the viability of renewable energy in the Caribbean region (Ochs *et al.*, 2011). Although it still has major issues to address, some of the key challenges in the DR, are the high cost of electricity, generation peaked facilities, and a distribution system with major energy loss (32.93%) alone with instabilities in the power flow quality (International Renewable Energy Agency, 2016).

Due to inadequate infrastructure and interruptions from natural disasters. Also, the DR's electricity sector is dominated by fossil fuels, with oil (46%), natural gas (25%), and coal (14%) accounting for 85% of the country's power generation. In response to this, the government has made the international compromise to start the transition from a fossil fuel dependent economy to a renewable energy infrastructure by 2025 with a goal of 25% renewable sources in the generation of electricity (Auth *et al.*, 2013 and International Renewable Energy Agency, 2016) and as one of the interviewee explains (EI22):

"*Our goals are to fulfil the agreement in COP21 and our own national strategic plan for 2030, that we need to reach a 25% of RE in our generation matrix, and we are going to fulfil this even ahead of schedule."*.

The tremendous solar potential of the DR (ranges from 5 to 7 kilowatt-hours per square meter per day (kWh/m2 /day) throughout most of the country, and approaches 8 kWh/m2 /day in some regions (Comisión Nacional de Energía, 2015). It is greater than Germany, that has few locations above 3.5 kWh/m2/day, and more than Phoenix, Arizona (USA) famed for its solar potential, that possesses an average of 5.7 kWh/m2/day. The Renewable sources of the DR could fulfil the country's energy demand entirely and help create an energy economy and business with the rest of the Caribbean. This represents for business a great opportunity for investing in solar and wind development of 100-1000 Mw in the DR, as 56% of the interviewed stakeholders agree on:

“Financially speaking it is good business; it is very rentable.” And “Business opportunity, DR is a stepping stone for other countries.”

The government in an effort to promote investment in the area and reach the internationally agreed goal of 25% of renewable energy installed in the country by 2025 created financial incentives. This goal creates possible support mechanisms to advance the exploitation of renewable energy sources, which can and should be further improved. However, the political framework for the development of renewable energy that exists in the country’s government is insufficient, as 92% of the stakeholder's highlight:

“The law 57-07 is an excellent law of the region. However, we need to keep legislating, and we need to support better the law as it is still very abstract; some point depends on how you interpret them, they are not very clear, and we need more government support.”

This is where a REBM can assist by supplementing some of the needs that the legal framework does not cover or does not explain in an understandable manner.

4.2.2 Current Business Practices regarding Energy

Barriers to broad sustainable energy development in the Dominican Republic include the risk perception of project investments, underdeveloped domestic financial markets and institutions, structural problems within the electricity sector, and the weak financial condition of the national government.

4.2.3 REBM case study

REBM researched in this study, represent the new trends and major feat and failures in the innovation of the energy business models across the world. It is understandable that these case studies do not represent a significant sample of all the energy projects in the world. However, these can aid in the inference that different pattern appears between the various strategies and the actors.

In Developed countries, a larger range of business plans focusing on different financial tools, the inclusion of the consumer in the different levels of the new strategies along with the insertion of new technologies and software are the norm. As can be seen in the Danish Energy Business Model that has shown that through persistent and active energy policy with ambitious renewable energy goals, enhanced energy efficiency, consumer participation and support for technical innovation and industrial development, it is possible to sustain significant economic growth and a high standard of living, while reducing fossil fuel dependency and mitigating climate change.

In contrast, the German REBM shows that with the change in tariff approach and the equalizing of the renewable energy price to that of the fossil fuel, is a successful combination for the transformation to a more sustainable economy.

Canada is a prime example of how the community injunction with the government can create a renewable market need that forces the existing business to adapt to a REBM to supply and create revenue from this requisite. While in developed countries the struggle still exists to change to renewable energies. With a few exceptions as the case of Costa Rica. However, even among developed countries, a vast leap exists in different strategies for example, in Canada (Martin, 2011) and Denmark (Ajayi *et al.,* 2011) case study, the success of the renewable projects is due to the community's demand for Renewable Energy.

Therefore, compelling the current fossil fuel enterprises to change to renewable sources to feed the growing demand. While in the UK (Martin, 2011) and US (International Renewable Energy Agency, 2015) is the REBM is implemented by the initiative of the Business, achieving beyond the government regulations demand. This strategy has guaranteed a change to more sustainable energy business.

However, all case studies, have several similarities: the government in each have created and sustain a (1) Renewable Energy Market, which is a key factor or element in the success of any sustainable business plan, (2) Regulatory Policies for the energy infrastructure, (3) Financing Plan (tax exceptions, subsidies and more). Some other similarities are in the REBM of the businesses themselves as are: (1) Consumer-Company Interaction, (2) New Platform and induction of new Renewable energy Technology and software, for a more efficient supply chain and monitoring and (3) Stability and knowledge in the REBM to be implemented by all actors.

The government and policies are an integral part of the success of any business plan as can be seen in the developed countries. This institution cannot be the only actor in the design, development and implementation of Renewable Energy

Business models. as can be seen in the DR (Ochs, 2011), India (ADEME, 2005), Chile (Nasirov, Silva and Agostini, 2015) and China (Bhattacharya *et al.*, 2016).

The government is the main actor in developing countries, due to the economic situation, and the social-political underdevelopment (Corruption, illiteracy and more) of these countries. The failure of the projects is almost guaranteed. for example, China (Bhattacharya *et al.*, 2016) the government created and implemented policies for the subsidies of renewable technology. However, the transformation to a renewable economy cannot be solely based on policies the creation of a renewable energy market is essential. Also, the lack of disseminating of the green and renewable information to the population has resulted in the failure of its venture into renewable solar energy farms and so far, have been unsuccessful in converting the existing fossil fuel enterprises to a more sustainable path.

As a result, the situation has contributed to increasing the previously excessive pollution (smog and waste) in the country to alarming levels. The DR faces a similar issue, several policies have been created for tax exemption and renewable energy subsidies, yet the renewable market has not been nurtured, and so far, the only actors to profit from this are the private industries and lone homeowners. As one interviewed highlight:

“the first thing to aid in developing the renewable energy market is a better legal framework.”

Considering the different case studies and how they relate to the DR an initial framework has been developed, as seen in Table 4-1. REBM for DR this summarizes the challenges, drivers and possible solutions that could aid in transforming the DR into the renewable energy beacon for the Caribbean.

Table 4-1. REBM for DR based on research

REBM for DR (based on findings)			
Renewable Energy Business Model for the Dominican Republic			
	Key Barriers		**Obstacles to Implementation (Recurring)**
Key Drivers	***Internal***	***External***	
Renewable Market Creation	Current fossil fuel-based Business Plan	Laws	Lack of Market Demand
Availability of Raw Renewable Energy Source (RRES)	Knowledge and willingness	Knowledge, government disposition	Lack of Human Resources and Technologies to utilize the RRES
Climate Change issue	Investment cost, Budgets and Financial Plans	Regulations, lack of continuity	Lack of understanding and general knowledge of the renewable subject
Financial Gain and Investment	Initiatives	Incentives	Lack of offers or alternatives options for energy (Monopoly)
International investment and interest	Organizational Structure and Leadership	Fossil Fuel Dependency	Lack of interest and corruption in the government
		Loans (Bank Entities)	Lack of financial guarantee
Job creation	Lack of interest	Fossil fuel agreement	Lack of prepare personal and outsource labour
Educational growth	Lack of continuity	Lack of understanding	Lack of continuity and unnecessary government agreement with 3 parties

As can be seen in Table 4-1. REBM for DR the country has a long way to go for the transformation to a REBM. However, the energy potential and economic possibility exist, the World Bank has since 1985 been financing projects in the DR, specifical energy. With the right policies and support, using technologies available today, the potential of renewables in the DR energy mix can be transformed, the same way that Costa Rica, achieved the 99% renewable energy goal. Despite, all the challenges that the DR faces it still maintains one the 15th place in the World Banks ranking for easy business investment.

For the last two years, the Dominican Republic has been developing new energy efficiency legislation. This creates the support mechanisms to incentivize renewable energy sources with comprehensive tax credits, a possible feed-in-tariff, and the creation of a fund for renewables. In addition, this will be the bases for the renewable energy market as was the case of Canada (Winfield and Dolter, 2014).

4.2.4 Challenges of and for the Dominican Republic

Although sources and limited policies exist in the DR that has helped in lowering the price of the wind and solar energy generation, a market for renewable energy has barely been created, and it has not been correctly developed. As 92% of the interviewed agreed that:

"The market is initiating. the market has just taken the first step, and this is due to lack of local interest."

The developing of this market faces several important challenges, especially in the economic respect (Ochs, *et al.*, 2011. Gardner, 2015. Ferroukhi *et al.*, 2016 and International Renewable Energy Agency, 2016). The Dominican Republic lacks the diversity in the financial tools to support and maintain the renewable energy market as 84% of the stakeholders explain:

"in the country, there are no specific financial tools for RE, banks will provide you with a loan, but it is a personal loan based on other guarantees and logically for you to buy solar technologies."

Along with this lack of diversity, the Dominican Republic also has subsidies for the feed-in-tariff, utilities currently lack the capital to pay for the tariff and have limitations in passing the price on to consumers because of high transmission and distribution losses (International Renewable Energy Agency, 2016). As well as the lack of awareness of the benefits of the renewable energy market and business model, along with periodical governmental changes, inconsistent law implementation, and lack of accountability in guaranteeing that the funds are utilized as mandated pose barriers to implementation of any renewable energy business plan in the DR.

4.2.5 Drivers of Renewable Business plan for the DR

The DR could become a beacon for the Caribbean in the Renewable Energy infrastructure. As Costa Rica has become for Central America with its 99% energy production from Renewable Energy.

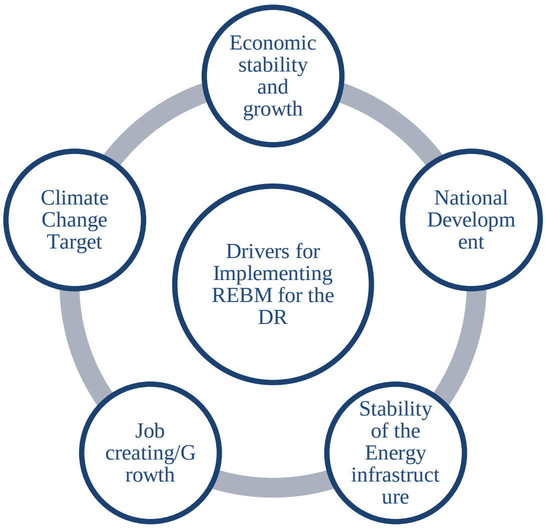


Figure 4-1. Drivers for Implementing REBM for the DR, based on research

This could represent a driver not just for the sustainability of the energy infrastructure in the DR but for the further development of the country. Fig 4-1 Shows the main drivers for the DR in the change to a Renewable Energy Business Model (Comisión Nacional de Energía, 2012; Gardner, 2015; Ferroukhi *et al.*, 2016; International Renewable Energy Agency, 2016). These drivers were identified from the content analysis of the case studies and literature review.

However, from the interviews of the stakeholders several, similar and different, drivers for the implementation of renewable energy business models were found (see chapter 5 for a more in-depth view into these drivers). A comparison between the two can be seen in Table 4-2. Comparison of drivers from literature and interviews below. The drivers have been organized from the most important to the least:

Table 4-2. Comparison of drivers from literature and interviews

No.	**The driver from case study and literature**	**%** **N=12 documents**	**No.**	**Driver from Interviews**	**%** **N=25 interviews**
1	Economic stability and growth	85%	1	Business opportunity	56%
2	National Development	57%	2	Business and renewable energy reputation	40%
3	Stability of the Energy infrastructure	39%	3	Financial returns	36%
4	Job-creating/Growth	10%	4	International aid and recognition	24%
5	Climate Change Target	7.5%	5	Environmental conscience and recognition	12%
			6	Energy diversity	8%

4.2.6 ISM analysis and modelling

As can be seen on Table 4-2. Comparison of drivers from literature and interviews some of the drivers do not match or fall under the same category. To find the inter-relationship between all the drivers an at the same time validate the data an Interpretive Structural Modelling was conducted.

The first step like content analysis is to code the data. In the ISM case each driver is given an alphanumeric code as can be seen on Table 4-3. Coding for ISM drivers for business models shows the list of Driver for business models while Table 4-4. SSIM matrix for drivers of business models shows the SSIM matrix developed for the relationship of between each driver.

Table 4-3. Coding for ISM drivers for business models

Coding	Drivers Business models
F1	Economic stability and growth
F2	National Development Plan
F3	Stability of the Energy infrastructure
F4	Job-creating/Growth
F5	Climate Change Target
F6	Business opportunity
F7	Business and renewable energy reputation
F8	Financial returns
F9	International aid and recognition
F10	Environmental conscience and recognition
F11	Energy diversity

The SSIM matrix is an origin and destination matrix. The start in on the column to the left and the end is the row on the top. The letters represent direct or lack of relationship between the parameters: x= that both parameters affect each other, for example the economic stability and growth affects the national development plan while the national development plan can affect and create changes in the economic stability. The affects that the parameters have on each other can be negative or positive. V= indicates that only the origin influences the destination and not the other around or mutual. A= indicates that the destination impacts the origin and O means that no affect is in place. These values are performed by the researcher and group of peers.

Table 4-4. SSIM matrix for drivers of business models

i/j	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
F1	-	X	V	X	O	X	V	X	V	O	O
F2	-	-	X	X	A	V	V	X	X	X	X
F3	-	-	-	V	X	X	V	X	X	A	V
F4	-	-	-	-	A	A	A	X	X	A	A
F5	-	-	-	-	-	X	V	O	V	X	V
F6	-	-	-	-	-	-	X	X	X	A	A
F7	-	-	-	-	-	-	-	X	X	A	A
F8	-	-	-	-	-	-	-	-	X	A	A
F9	-	-	-	-	-	-	-	-	-	A	X
F10	-	-	-	-	-	-	-	-	-	-	X
F11	-	-	-	-	-	-	-	-	-	-	-

The reachability matrix converts the relationship or lack of into a binary table to create a set of relationships to be interpret by the levels of partitions (See Chapter 2 for a more in-depth description of the method).

Table 4-5. Reachability matrix for business models

i/j	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
F1	1	1	1	1	0	1	1	1	1	0	0
F2	1	1	1	1	0	1	1	1	1	1	1
F3	0	1	1	1	1	1	1	1	1	0	1
F4	1	1	0	1	0	0	0	1	1	0	0
F5	1	1	1	1	1	1	1	1	1	1	1
F6	1	0	1	1	0	1	1	1	1	0	0
F7	0	0	0	1	0	1	1	1	1	0	0
F8	1	1	1	1	1	1	1	1	1	0	0
F9	0	1	1	1	0	1	1	1	1	0	1
F10	0	1	1	1	1	1	1	1	1	1	1
F11	0	1	0	1	0	1	1	1	1	1	1

After transitivity of the matrix has been check the reachability matrix is transformed. In the case of the drivers for RE business models for the DR, the matrix is only slightly affected as can be seen in Table 4-6. Reachability matrix with transitivity checked.

Table 4-6. Reachability matrix with transitivity checked

i/j	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**
F1	1	1	1	1	0	1	1	1	1	1*	1*
F2	1	1	1	1	0	1	1	1	1	1	1
F3	0	1	1	1	1	1	1	1	1	0	1
F4	1	1	0	1	0	0	0	1	1	0	0
F5	1	1	1	1	1	1	1	1	1	1	1
F6	1	0	1	1	0	1	1	1	1	0	0
F7	0	0	0	1	0	1	1	1	1	0	0
F8	1	1	1	1	1	1	1	1	1	0	0
F9	0	1	1	1	0	1	1	1	1	0	1
F10	0	1	1	1	1	1	1	1	1	1	1
F11	0	1	0	1	0	1	1	1	1	1	1

Note: 1* entries are included to incorporate transitivity

Table 4-7 shows reachability set, antecedent set, intersection set and level, created from the reachability matrix, this provides the order in how the parameters depend on each other to be implemented or enacted. The levels of partitions are read from the highest level down. Meaning that the higher level is the most import one.

Table 4-7. Level partitions for business models

i/j	Reachability set	Antecedent sets	Intersection set	Level
F1	1,2,3,4,6,7,8,9,10,11	1,2,4,5,6,8	1,2,4,6,8	6
F2	1,2,3,4,6,7,8,9,10,11	1,2,3,4,5,8,9,10,11	1,2,3,4,8,9,10,11	3
F3	2,3,4,5,6,7,8,9,11	1,2,3,5,6,8,9,10	2,3,5,6,8,9	4
F4	1,2,4,8,9	1,2,3,4,5,6,7,8,9,10,11	1,2,4,8,9	1
F5	1,2,3,4,5,6,7,8,9,10,11	3,5,8,10	3,5,8,10	7
F6	1,3,4,6,7,8,9	1,2,3,5,6,7,8,9,10,11	1,3,6,7,8,9	2
F7	4,6,7,8,9	1,2,3,5,6,7,8,9,10,11	6,7,8,9	2
F8	1,2,3,4,5,6,7,8,9	1,2,3,4,5,6,7,8,9,10,11	1,2,3,4,5,6,7,8,9	1
F9	2,3,4,6,7,8,9,11	1,2,3,4,5,6,7,8,9,10,11	2,3,4,6,7,8,9,11	1
F10	2,3,4,5,6,7,8,9,10,11	2,5,10,11	2,5,10,11	5
F11	2,4,6,7,8,9,10,11	2,3,5,9,10,11	2,9,10,11	3

Figure 4-2. ISM based Model for business models. Shows the model created based on the drivers highlighted in this study. The model is read from the bottom up. The model shows how the most important driver is climate change target; as this driver will create the environment for the other drivers to either be created or be implemented in the Dominican Republic.

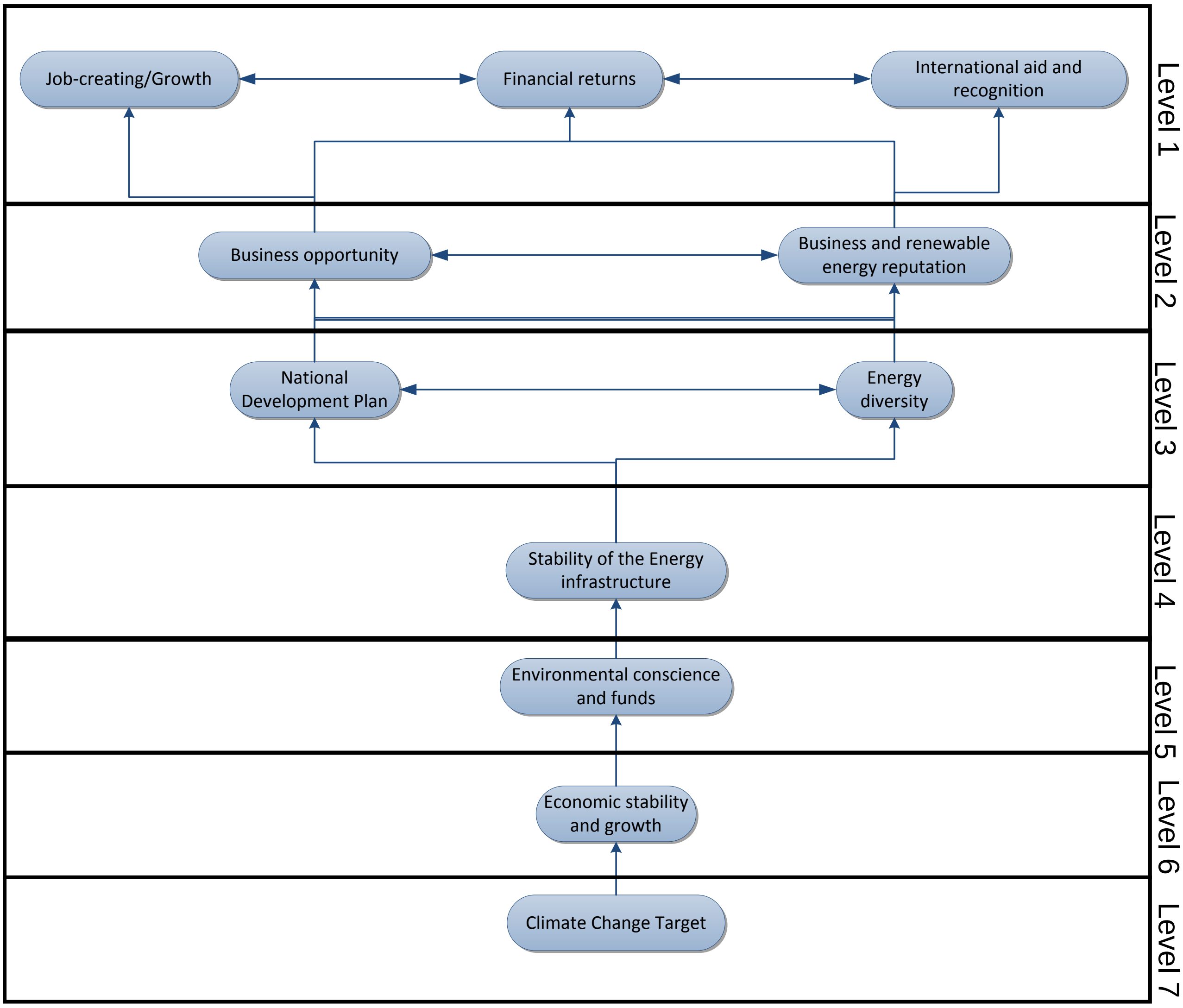


Figure 4-2. ISM based Model for business models

4.3 Findings

As (Beltramello *et al.*, 2013) explain:

"The global energy supply is facing an array of severe challenges regarding long-term sustainability, fossil fuel reserve exhaustion, global warming and other energy-related environmental concerns, geopolitical and military conflicts surrounding oil-rich countries, secure supply of energy and fuel price increase."

Renewable energy resources can support the present, and future energy demands with ease, regardless of the growth of the population. Furthermore, without perpetrating any significant damage to the global environment. Also, it aids in diminishing climate change symptoms that are affecting the present and future world.

Renewable-based activities around the world are being undertaken on a national and international relevant level platform. The mentioned case studies in chapter 2 point to a fundamental role of market demand in stimulating sustainable business models based on efficiency optimisation by information and communication technology (ICT), new financial schemes, alternative energy sources, functional sales and management services models.

New renewable business models are directly involved in the transition to renewable energy infrastructure. Developing new business models can, therefore, assist decreasing environmental pollution, improve the usage of natural resources, enhance the production and energy efficiency, while at the same time, offer a new source of economic development. Even though the market for renewable products and services is increasing, the development of new renewable business models is hindered by a series of barriers, many of which can be addressed by well-designed policies. Also, the lack of research and practical case studies, except for Costa Rica, further obstructs the creation, development and implementation of new renewable business models.

Creating, developing strengthening and maintaining the market demand for renewable energy products and services is one of the key features in a successful renewable business model. This success can be achieved by offering constant long-term incentives to help the actors (Companies, enterprises, and more) increase the renewable energy business model adoption. However, the government should create a well-designed regulatory framework and supportive demand-side policies that should enhance access to financial aid, including but not limited to. supporting renewable market development for investment risk and the development of innovative business skills. Nevertheless, the government should also review the current policies and subsidies to remove any weak or diminishing subsidy support, improve governance and to ensure that national and regional policies for renewable energy are consistent and linked together to develop a successful outcome.

Also, this will reduce the barriers to creating, develop and the growth of new and existing actors and sustainable business models. while at the same time improving the regulatory environment for new renewable business models. that would support the research and development of innovation.

Governments can aid by creating the framework conditions that will promote actors (companies) into operating by a renewable business model through which the business objectives, generation of profits and environmental sustainability can be achieved.

Financial, environmental and reputational benefits are a critical element of any business model, especially for renewable business models, and as such have been thoroughly researching in many case studies to determine the influences of business models in the developing environment.

The difference in the conception, approach, design and implementation of each of the case study previously studied is directly linked to the country, the economic situation, the government disposition and the consumer or population knowledge of the renewable energies and technologies.

The key drivers, barriers and recurred obstacles as mention in Table 4-3. Coding for ISM drivers for business models, Table 4-7. CSF of renewable energy business strategies and solutions indicates future projects in the Dominican Republic need first to invest in international projects with the endorsement and support of international political entities to help with the external barriers in the Dominican Republic (especially the lack of transperance of the government and the lack of funds and financial guarantee).

Table 4-8. CSF of renewable energy business strategies and solutions based on research.

CSF	Government	Industry	Organization
Mission and Vision	Quality of life Happiness index	Communication Gain-cost proportion	Implement strategies to achieve a better quality of life or to maintain it
Leadership	Knowledge Ability to inspire Trust Communication	Management Strategies Empower Respect Communication	Qualified personal Leading by example Communication
Infrastructure	Renewable Energy Market (Creation, fomentation and maintenance) Regulation policies and promotion Knowledge Management	Agreements for the generation and distributions Feasibility Knowledge management	Grid status Energy generation and distribution model Knowledge management
Social Acceptance and Perception	Public popularity Trust Public support	Customer Satisfaction Reputation	Public Participation Trust Respect
Public and internal Knowledge	Decrees for renewable Energy Learning Information Policies	Internal audits and training on Renewable Energy Client engagement	Implement courses on Renewable Energy and energy efficiency Public participation and action
Policies (Creation, Dissemination and Implementation	Evaluation of the supply and demand (S/D) Creation of policies based on S/D	Correct implementation of policies Up-holding of policies.	Government support Regulations for the dissemination of the policies
Renewable Energy Market	Energy Management Renewable Energy Technologies Knowledge of Renewable Energy	Available technologies and incentives	Implementation of Energy Management
Economy (Financing and status of the economy)	Risk evaluation International Financing Local financing Creation of Local incentives	Risk evaluation Affordability International investment or partnership Ownership Sound financial investments	Risk evaluation Power Purchase Agreements Implementation of Local incentives
Business Environment	Reach the international sustainable renewable goals agreements SDGS (Sustainable Development goals) 7	Sustainable measures SDGS (Sustainable Development goals) 7	Sustainable practices SDGS (Sustainable Development goals) 7

In developing countries, the energy market is based on the laws and regulations imposed by the government, fossil fuel-based electricity and the loans and aid from international entities (World Bank, OEA and more) for alternative energy projects. However, as can be seen in Chile, China, India and many other countries, this does not always imply that the renewable energy project will be successful. In developing countries, the sole responsibility for change is in the hands of the government as the absence of knowledge, deficiency of own qualifying personnel, lack of technology and funds to evolve or create the renewable energy market is dire.

The renewable market is the first step to the renewable energy economy. However, the tool to be able to develop the market is a well thought and strategies renewable business model. To undertake a renewable business model, first identify the drivers for the model and as the drivers emerge so do the barriers that will need to be addressed in the business model to be successful. Also, just as every country is unique and presents different and similar traits so does the business model as it is tailor to each country's situation and needs. The most important aspect of any Business model is flexibility. This flexibility will allow the business model to adapt to the situation and any unexpected barrier or obstacle that may develop in the implementation of this.

In one of the case studies examined (Canada, The Erie Shores Wind Farm) the renewable business models contributed to a quicker introduction of renewable technologies (ICT), processes and products, such as the use of ICT for monitoring the wind farms.

As discussed in the previous section customer demand is an essential driver of renewable business models. As highlighted by (Beltramello *et al.*, 2013 and Sahoo, 2016), the size of an actual or potential market is directly proportionated to the demand of the new renewable products and services that will stimulate innovation. This stimulation will be relative because the lucrativeness of an invention increases with the size of the market (other things being equal) and partially for the directed productivity to meeting demand in the market. This market growth will result in an invention matching a need. As (Gross, 2015) explains innovation depends on the relative profitability, which, consequently depends on demand.

Three actors (end users/consumers, businesses, and the public sector, as can be seen in Table 4-1. REBM for DR) mainly shaped the market conditions by their roles and behaviours. Consequently, businesses are dual actors as they can be innovators and users of renewable energy services and products, by their interactions with other companies in the supply chain. The private sector is vital as customers for renewable services and products (goods and technologies). Also, depending on the scale of the industry, the demands for renewable goods and services may create a significant driver (Table 4-8. Benefits of implementing renewable business models) and market demand that would motivate other actors to transform into the renewable energy business model. Azzimonti (2018), indicates the potential to regain initial renewable investments and create a profit will only increase with the growth of the renewable market size. Therefore, successful innovations have higher success rates in fast-growing economies (developed countries), predominantly in renewable markets where the demand is forceful and vibrant.

Table 4-9. Benefits of implementing renewable business models in the DR based on research

Benefits of Implementing Renewable Energy Business Models	Government	Industry	Organization
Rural Development	✓		
Low emission	✓		
Diminishing pollution	✓		
Local and global environmental goal achievement	✓		✓
Research and development of Renewable Energy technologies, strategies and business	✓	✓	✓
Upgrades to the grid and installation	✓	✓	✓
Job creation	✓	✓	✓
Energy reliability	✓	✓	✓
Lower feed and subsidies	✓	✓	✓
Improved public health	✓	✓	✓
Improved environmental quality	✓		✓
Replenishable energy source	✓		✓
Resilient energy system	✓		✓

It is therefore concluded that transforming into a renewable business model and consequently to a renewable economy for developing countries is achievable, even with the barriers presented in this research.

4.4 Summary

This chapter has addressed the research objective and question two

“To investigate the key renewable energy related business models’ initiatives that have been or planned to be implemented in the Dominican Republic.”

“What business strategies are been used in the Dominican Republic for the implementation of renewable energy projects?”

This has been done by analysing the literature and the 25 interviews performed to key stakeholders in renewable energy in the Dominican Republic. This analysis provided the main drivers, challenges and success factors for the implementation of renewable energy business models, the data from the literature and the interview had some mismatch, so an ISM analysis was performed to bring together the findings, see Figure 4-3. Renewable energy business model implementation in the Dominican Republic

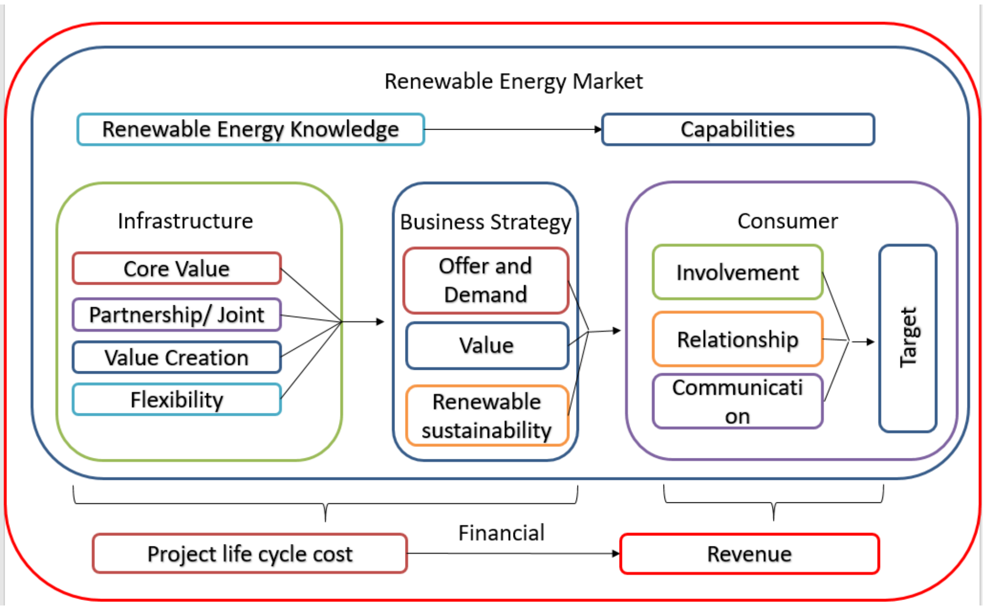


Figure 4-3. Renewable energy business model implementation in the Dominican Republic based on research

The literature highlights that the renewable business models available worldwide are as diverse as renewable energy is in existence. For the Dominican Republic, the business model implemented for renewable energy is the business as usual, no new models have been implemented even for renewable energy projects. Furthermore, the interviews show that 40% did not have any idea of the different renewable energy business models available and 56% simply remarket on what renewable energy the business was a focus on and only 4% of the interviewed understood and answered correctly on what business models has been implemented in the institution.

However, this process is incomplete without knowing what drives the sector to change to a renewable energy strategy, for that reason the chapter 5 will explore the drivers for the implementation of renewable energy projects, specifically in the Dominican Republic.

Chapter 5 . Drivers for implementation of RE in the DR

5.1 Introduction

This chapter presents the answers to the third research objective and question:

"To analyse and document the drivers for the implementation of renewable energy projects in the Dominican Republic."

"What are the key motivations for investing or implementing renewable energy projects in the Dominican Republic?"

In this chapter the content, theme and ISM analysis is described and discus to provide an understanding into what motives organizations in the Dominican Republic to invest into the renewable energy sector so that renewable projects can flourish in the country. The chapter is divided into two phases: (1) the theme and content analysis perform in Nvivo software to identify each objective and (2) the ISM analysis.

A brief definition of each driver identified is provided along with the quantification found in the interviews. The second phase is performed through a series of matrices, explain in Chapter 3 Section 3.5 of the methodology on how an ISM analysis is performed. Finally, the chapter shows the conclusions that were interpreted from the results.

5.2 Drivers

Based on the literature review several themes were identified as essential to the implementation of renewable energy (See Table 5-1. Drivers of implementing renewable energy projects). Based on the themes, the questionnaire was created for the interviews and using the same themes from the literature the theme, and content analysis was performed (Chapter 3). The results of the theme and content analysis can be seen in Table 5-1. Drivers of implementing renewable energy projects.

Table 5-1. Drivers of implementing renewable energy projects

No.	**Drivers from literature**	**Percentage**	**No.**	**Drivers from interviews**	**No. 25**	**Percentage**
1	**Returns or revenue**	63.63%	1	Business opportunity	14	56.0%
2	**Energy security**	45.45%	2	Business and RE reputation	10	40.0%
3	**Electricity sector status**	36.36%	3	Financial Returns	9	36.0%
4	**International agreement and aid**	18.18%	4	International aid and recognition	6	24.0%
5	**Health and wellbeing**	18.18%	5	Environmental conscience and funds	3	12.0%
6	**Environmental concerns**	9.0%	6	Energy diversity	2	8.0%

5.2.1 Business Opportunities:

Zalewska-kurek (2014) and Shrestha (2015) both highlight that organizations to remain relevant in their field must periodically evaluate business opportunities in their markets or new markets. This is an ability that is based on opportunity recognition analysis plan. In this study, a 100% of the interviewees agreed that business opportunities are a driving force for the implementation of renewable energy projects. However, only 56% of the stakeholders (see Table 5-1. Drivers of implementing renewable energy projects) highlighted that it was the most important force behind the implementation of renewable energy projects.

For example, EI19:

"it was a good business decision to invest in RE for lowering cost in the future."

EI15 express:

"Renewable energy projects are a business opportunity; DR is a stepping stone for other countries."

Other interviewees have been taking advantage of this business opportunity for several years, as EI1 explain*:*

"In 1991 it was a customer that ask us to install the whole system that he brought, and after that, we saw a business opportunity, and we took it."

Since this is relatively a new market in the DR, many of the areas that cover the implementation are monopolises by experience people, As EI19 explains,

"It is a business opportunity as this is the only law firm able to do the RE management for investors in the country."

And as EI2 perfectly express the attractiveness of renewable energy projects

"what I'm trying to say is that it was good business to invest in the technology that's going to be the first dispatch as you will be the first paid and the rest we can limit because we know the market we have the funds, and we have the experience."

However, this contradicts the literature review, as 64% of the reports show that revenue is the most important characteristic. Due to this contradiction, the ISM matrix was performed and can be seen in section 3 of this chapter. The ISM matrix was performed to bring the literature review and the interviews together under one model.

5.2.2 Financial Returns

Financial returns or revenue is the core objective of a business as it allows for a grow in wealth and use that wealth for the economic needs of the company. (O'Connor, Lewis and Dalton, 2013) a more detail description available in chapter 6.

5.2.3 Environmental conscience and funds:

As explained in Chapter 4, this aspect of environmental consciousness went from being a marginal though of business, something that was a marketing campaign to a core and critical aspect of any entity, especially the environmental conscience aided by the national and international funds available for renewable investment. As *EI5 highlighted:*

"Pollution the CO2, we are trying to lower pollution and to have energy less polluting, we are trying to make RE cheaper and competitive to fossil fuel."

And *EI12* agreed by saying*: "All the institutions that I worked for have the conjugation of environmental conscience and a sustainable business plan, plus the existence of a support regulation which is the 57-07 law. You have the law for support, environmental conscience and business focus for RE, and for sustainable conscience."*

And *EI8 “the law 57-07 and the government created the national commission of energy to be the promoters of the RE in the country and to aid in lowering the emissions for the country.”*

All three stakeholders agreed in the environmental consciousness as a core driver for the implementation of renewable energy projects. In regards, to environmental consciousness and funds, the literature makes a brief reference of 9%. In regards, to the funds the Dominican Republic was supposed to have for renewable or alternative energy:

- Law 112-00 Hydrocarbon law: outlines the creation of a special fund from the tax differential of the fossil fuels to finance projects of alternative, renewable or clean energy and energy efficiency. The funds are supposed to be managed by the ministry of energy and mines. However, the status of the fund is still unclear.
- The PETROCARIBE agreement between the Dominican Republic and Venezuela saw the creation of a 5% fund of the savings that the country would get by buying the fossil fuel from Venezuela. Like the previous fund, the status of this fund is still unclear.

5.2.4 International aid and recognition:

The international awareness regarding climate change, sustainability and renewable energy, has created a driving force on a global level as the responsibility to ensure a future fall on all. Due to this many nations and institutions have created initiatives and loans, to aid the nations that are not financially stable to complete the sustainable and renewable change by themselves. In the Dominican Republic the international aid and recognition is a driving force, 24% of the stakeholders a strong perspective regarding this subject as EI7 explains:

“we have all the international loans., we belong to an international project called tap-c from the European Union, which is a group form to help the countries from CARICOM and CARIFORUM and we just got a loan for 9.2 million euros, we have another ECUA Energia y mina de las Americas that is from the ONU. The point is that the country is getting all the help it can.”

And EI6: “For the organization, it creates a reputation in the region and worldwide.”

However, regarding international aid, the stakeholders identified this equally as a challenge (see Chapter 6 and 7) and a driver at 24%. The literature, on the contrary, identified in 18.18% the international aid as a driving force and does not place it as a challenge for the implementation. According to Ochs (2011) and Konold (2015) due to the Dominican Republic status as a developing country, now called medium to high economic nation, is eligible for international climate finance for renewable energy and energy efficiency by the UNFCCC’c clean development mechanism or CDM, plus the SIDS DOCK (Explain in chapter 2 sub-section 2.8), and funding from the World Bank, specifically from the International Bank Reconstruction and Development and the International Finance Cooperation initiatives.

Along with loans, from the International Development Bank (IDB). The international aid in the Dominican Republic has and will continue to be a critical financial factor for the development and implementation of renewable energy in the country. However, this does add to the high national debt and can possibly create in the future if left unchecked a financial crisis for the country.

One resource that has been unused is the Clean Development Mechanism as the Latin American and Caribbean region account only 14% of CDM global projects (Konold, 2015). This could be a potential financial tool for the Dominican Republic if properly implemented. Another possible solution for financing with international aid would be the Global Environment Facility (GEF) small grants programme. However, this programme would be for small communities, and it would aid in decentralizing the energy grid in the Dominican Republic. Table 5-2 shows all the possible international financial aid institutions and initiatives that the country has access too.

Table 5-2. International financing institutions and initiatives for the Dominican Republic

(Source Ochs, 2011; Konold, 2015; International Renewable Energy Agency, 2016)

International Financial aid institutions	**International Initiatives**
World Bank, the International Monetary fund (IFM), the International Development Bank (IDB), the European Investment Bank (EIB), the Japan International Cooperation Agency (JICA), the German Development Agency (GIZ), United Nations Development Plan (UNDP), the U.S. Export-Import Bank, the U.S. Trade and Development Agency (USTDA), the OPEC Fund for International Development (OFID), and the Organization of American States (OAS)	the Caribbean Renewable Energy Development Program (CREDP), the Energy and Climate Partnership of the Americas (ECPA), the Latin American Energy Organization (OLADE), small-island developing state docking (SIDS DOCK) and Horizons 2020.

5.3 Energy Diversity:

Energy diversity as Lo (2011) highlights is a key indicator of energy independence, as by implementing a variety of balance energy sources the energy sector is not completely bound to the fluctuations of the fossil fuel availability and prices. Contradictory, in the Dominican Republic, energy diversity is not high on the list of driving forces as the interviews showed only an 8% of the participants considered this a driving force. EI21 highlighted:

"at the moment one of the goals of the country is the diversification of the energy matrix."

And EI25:

"Renewable energy aids in the independence from fossil fuel."

However, 84% of the participants valued the energy security, energy diversity and energy independence more as a benefit of implementing renewable energy than a driving force. As opposed to the literature were 45.45% of the documents mention the energy diversity as a driving goal of the Dominican Republic. Energy diversity could as Ochs (2011), Konold (2015) and International Renewable Energy Agency (2016) all agree that this would benefit the country by lowering the expenditure of the GDP on the electricity sector, stabilised not just the energy sector but the economy as well, create new jobs and promote the study of renewable as a career. See Table 5-3 for the advantages and disadvantages of energy diversity.

Table 5-3. Advantages and disadvantages of energy independency and diversity

(Source Abraham and Mills, 2013; Oakes-Ash, Vickers and Bates, 2017)

Advantages of energy independency and diversity	**Disadvantages of energy independency and diversity**
• The growth of the GDP • Job Creation • Lower emissions • Various sources of energy • Stability of the economic and energy sector	• Cost of installation of different technologies for different resources • Location of the energy sources • Cost and integration to the grid

5.4 Business and renewable energy Reputation:

Business reputation is an important part of the performance of an organization as it can influence the perception of a business. This perception can be positive or negative and have repercussion on the revenue stream of the company. There is no literature regarding this driver. However, 40% of the interviewees highlighted that the business and renewable reputation was an indispensable driving force for the implementation of renewable energy in the Dominican Republic. As EI4 said:

"A big motivation is the reputation for being the first in the renewable energy area."

However, is not just a matter of being the first. In the Dominican Republic, reputation is a parameter for acquiring a power purchase agreement or accessing local finance. As EI3 explains:

"if you do not have a reputation in the Dominican Republic private or government sector and a PPA you will not get your project off the ground."

5.5 ISM Analysis and modelling

As with the business models the drivers for implementation showed a slight discrepancy between the literature and the interviews, as a way to resolve and show the interconnectivity of the drivers an ISM analysis was performed coding the drivers as can be seen on Table 5-4. Coding for SSIM matrix for drivers of implementing renewable energy projects. Based on the context, literature and peer group the Table 5-5. SSIM matrix for drivers for implementing renewable energy projects was built and following the steps on how to create a reachability matrix from chapter 2, the Table 5-6. Reachability matrix for implementing renewable energy projects was made. Once the binary matrix is completed the levels of partition can be seen and the Table 5-7. Level partitions for the drivers to implement renewable energy projects can be made.

Table 5-4. Coding for SSIM matrix for drivers of implementing renewable energy projects

Coding	Drivers
F1	Business opportunity
F2	Business and RE reputation
F3	Financial Returns
F4	International aid and recognition
F5	Environmental conscience and funds
F6	Energy diversity
F7	Electricity sector status
F8	Health and wellbeing

Table 5-5. SSIM matrix for drivers for implementing renewable energy projects

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	-	A	X	X	A	A	A	O
F2	-	-	V	V	A	O	V	A
F3	-	-	-	X	A	X	X	O
F4	-	-	-	-	X	V	X	V
F5	-	-	-	-	-	V	V	X
F6	-	-	-	-	-	-	V	X
F7	-	-	-	-	-	-	-	O
F8	-	-	-	-	-	-	-	-

Table 5-6. Reachability matrix for implementing renewable energy projects

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	0	1	1	0	0	0	0
F2	1	1	1	1	0	0	1	0
F3	1	0	1	1	0	1	1	1
F4	1	0	1	1	1	1	1	1
F5	1	1	1	1	1	1	1	1
F6	1	1	1	0	0	1	1	1
F7	1	0	1	1	0	0	1	0
F8	0	1	0	0	1	1	0	1

After transitivity of the matrix has been check the reachability matrix is transformed. In the case of the drivers for RE the DR, the matrix is only slightly affected as can be seen in Table 5-7. Reachability Matrix with Transitivity Checked.

Table 5-7. Reachability Matrix with Transitivity Checked

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	0	1	1	0	0	0	1*
F2	1	1	1	1	0	0	1	0
F3	1	0	1	1	0	1	1	1
F4	1	0	1	1	1	1	1	1
F5	1	1	1	1	1	1	1	1
F6	1	1	1	0	0	1	1	1
F7	1	0	1	1	0	0	1	1*
F8	0	1	0	0	1	1	0	1

Note: 1 entries are included to incorporate transitivity*

Table 5-8. Level partitions for the drivers to implement renewable energy projects

i/j	Reachability set	Antecedent sets	Intersection set	Level
F1	1,3,4	1,2,3,4,5,6	1,3,4	1
F2	1,2,3,4	2,5,6	2	3
F3	1,3,4,6	1,2,3,4,5,6	1,3,4,6	1
F4	1,3,4,5,6	1,2,3,4,5	1,3,4,5	2
F5	1,2,3,4,5,6	4,5	4,5	4
F6	1,2,3,6	3,4,5,6	3,6	3
F7	1,3,4,7	2,3,4,5,6,7	3,4,7	2
F8	2,5,6,8	3,4,5,6,8	5,6,8	2

Once the matrices have been made the level of partition reveals the interconnectivity between the parameters. For the drivers the ISM analysis provided similar results to the business models by highlighting that the environmental conscience is the main driver (see Figure 5-1. ISM based model for the drivers for implementing renewable energy projects) that will create the atmosphere for the renewable energy to be though, design and implemented in the Dominican Republic. This also highlights that the education of the population in renewable energy is key to maintaining the renewable energy sector growing as their consciousness regarding environmental concerns is the motivator of the change.

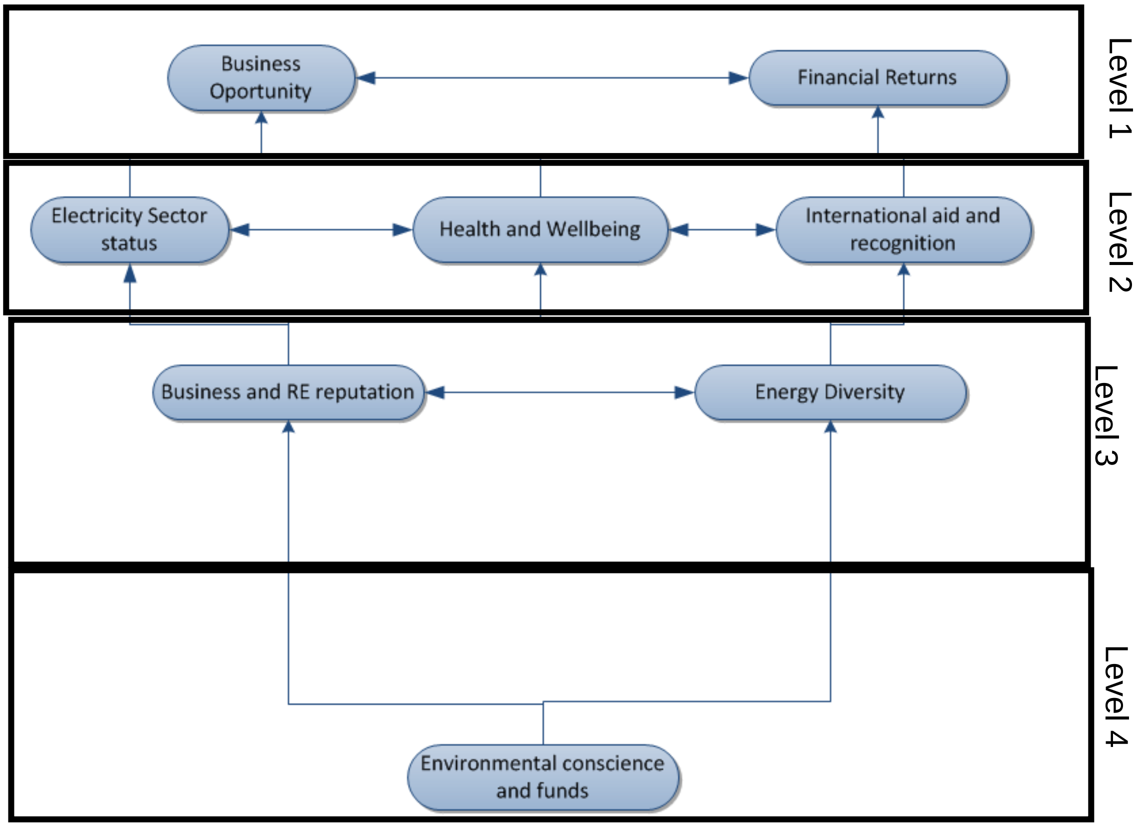


Figure 5-1. ISM based model for the drivers for implementing renewable energy projects

5.6 Summary

The drivers for implementing renewable energy projects in the Dominican Republic were discovered through content and theme analysis of the literature review and the interview of the 25 stakeholders in the energy sector of the country. This analysis was performed in the software Nvivo to make coding easier. By discussing these drivers, the third objective and research question has been answered:

"To analyse and document the drivers for the implementation of renewable energy projects in the Dominican Republic."

“What are the key motivations for investing or implementing renewable energy projects in the Dominican Republic?”

The drivers found by the literature and the ones from the interviews were in contradiction as can be seen in Table 5-8. Summary of driving forces for implementing renewable energy in the Dominican Republic, organised from most important to least. To merge and discover the importance and relationship between all the drivers an ISM analysis was performed, showing that environmental conscience and funds are the most important driver that supports and creates the other drivers.

The discrepancy between the drivers and the interviews was not significant. As some of the drivers are related to each other. For example, in the literature energy security is very important with 45.45% of the literature highlighting this as a critical driving force. However, the interviews mention more the indicator of energy security which is energy diversity and most of the participants considered this concept more of a benefit of renewable than a driver. Other drivers were more important in the literature than in the interviews. Surprisingly revenue is the third most important parameter for participants while is the first for the literature. This indicates a shift in the perception of what is traditionally a driving force, according to the interviews the business opportunity and reputation was more important. In a sense, both drivers will provide more revenue for the organization, so in the end, revenue creation is still in the core of the project motivation.

Table 5-9. Summary of driving forces for implementing renewable energy in the Dominican Republic

No.	Drivers from the literature	No.	Drivers from the interviews
1	Returns or revenue	1	Business opportunity
2	Energy security	2	Business and RE reputation
3	Electricity sector status	3	Financial Returns
4	International agreement and aid	4	International aid and recognition
5	Health and wellbeing	5	Environmental conscience and funds
6	Environmental concerns	6	Energy diversity

This chapter provides a description and paints a picture of what motivates the organizations in the Dominican Republic to invest and transform towards a renewable energy initiative. However, motivation alone will not implement a renewable energy project, and for that reason, the next chapter (6) deals with the financial aspect of the implementation of renewable energy projects.

Chapter 6 . Financing renewable energy projects in the DR

6.1 Introduction

This chapter will address the fourth research objective and question:

“To explore the essential renewable energy-related financial tools and policies initiatives that have been or planned to be implemented in the Dominican Republic.”

“What essential financial policies and tools are available for implementing renewable energy projects in the Dominican Republic.”

The focus on finance is important as the cost of a project is a key element in any project. To understand the reasons for the lack of development in the renewable energy industry the mechanism available to the investors in the Dominican Republic must be evaluated. Also, the experience and viewpoint of the key stakeholder will be analysed from the interviews conducted. This analysis will be done in three phases: (1) the evaluation of the financial tools and policies available in the country based on the literature (2) the financial tools that the interviews have knowledge and experience with and (3) an ISM analysis to bring together the findings from the first two phases.

6.2 Financial tools available for Renewable Energy in the Dominican Republic

Currently, RE financial matters in the DR are divided into two categories: (a) Financial policies to enhance RE, which are: Feed-In-Tariff (FIT), Tax incentives and RE portfolio and (b) Financial tools to implement RE projects which are: Grants, Equity, Debt, Asset-Basket security, Guarantees and Insurance, Result based financing, Carbon financing and Small-scale project financing. Countries tend to lean to a specific category and tool more than others. (See Table 6-1. Financial Tools based on interviews.) However, before decision makers can choose and implement any of these measures the risk and challenges of each must be identified. These issues and constraints are inevitably country specific.

This chapter discusses the DR financial and political tools used along with the drivers, challenges and critical success factors. The DR possess three financial policies tools with the law 57-07 (Comisión Nacional de Energía, 2012) containing financial incentives in its core, along with FIT agreements and RE portfolio being part of the mission and vision of the country's national development strategy. However, the same does not apply to the financial tools, as interviewees tended to lean on loans more than any financial tool. Regardless, the critical challenge in the DR is that no financial tool has been fully implemented only partial implementation has been achieved and in some cases minimal to zero practical implementation.

In addition to interviewees minimal knowledge of financial policies. On the other hand, when it came to financial tools, the interviewees had some knowledge. However, it was in specific areas of two particular tools like debt and grants that most interviewees had any knowledge (Table 6-1. Financial Tools based on interviews). Although, 100% of stakeholders highlighted that the only way to get a capital grant or loan from a financial institution in the DR is to be in possession of a PPA and to have a proven RE reputation or business reputation.

As Interviewee 12 (EI2) expressed:

"*Capital access is restricted by the banks you need to have a reputation for being able to get the loans, financial help and attracts investors.*"

Table 6-1. Financial Tools based on interviews

Financial tools available for the Renewable Energy projects in the Dominican Republic	**Total number of interviewees cited (N=25)**
Loans	60%
Power Purchase Agreements (PPA)	44%
International aid and loans	24%
Incentives and cost of RE	20%
Mutual Funds	12%
Asset-Backed Securities	8%
Capital grants	4%
Private investment	4%

6.2.1.1 *Loans*

Loans represent a unique aspect of the financial sector of the DR, as they are both a financial tool and a challenge for the countries development of RE projects. In this study, 60% of the interviewees cited that loans are the most common financial tool available for implementing RE projects in the DR. As interviewee 22 (EI22) highlighted:

"*The supports are essentially long-term loans.*"

As Liu and Zeng (2014) and Bloche-Daub *et al.*, (2017) explains that loans are commonly written agreements of a temporary transfer of a goods or product (money usually) between two parties at least, with specific conditions in accordance to set terms (interest rates, return time, collateral, and more). In the case of the DR, the financial institutions classify loans into consumer or personal, commercial and industrial loans. However, regardless of the end consumer, all loans in DR regarding RE are based on an instalment loan, as equal monthly payments need to be made. IE22 describes:

"*That I know there is no special loan for RE, the loans given are normal either commercial or personal loans that are handled normally depending on the reputation and guarantees that the company has and the relationship that the company has with the bank*."

As the interviewee highlighted the loans are mostly based on reputation. The need to have an established reputation is an unspoken need that the financial institutions in the DR consider.

Of this 60 % of interviewees, 78% agreed that the financial institutions are ill-prepared to fund RE projects, as EI18 said:

"This will depend on the size of the project, small projects usually for personal use, the banks now have tools for this, but big projects the banks have no tools or money to handle these projects."

Also, 22% of the interviewees pointed out that currently, the banks are expanding to include green energy loans into their portfolio. EI16 explain that:

"Lately the local bank is getting more involved in investing in the energy sector".

However, 89% agreed that the loans in existence even the green loans are based on a normal, either personal or commercial loan and therefore have the same return time and policies as a normal loan and therefore the green part is only a marketing strategy and not a real green loan. As one of the interviewee EI7 explains:

“In the county, this area is very limited as the banks lend money as it is any other loan, short time for returns, high guarantee, they do not take into account the financial actives.”

The DR Government and financial entities recently approved the use of RE technology, specifically solar panels, as asset-backed security or collateral for the loan. However, this clause is one for auto-production and not for grand scale projects. This reflects the lack of RE market in the DR, lack of leadership and lack of law coherence, as financial tools are an instrument utilised by banks to have a share in the market.

The lack of availability of loans is the key challenge that the interviewees highlighted. this may be because financial tools and options are not transparent and very little knowledge of them is available to the population. For instance, as EI14 explain:

“In this area, I do not have much knowledge. I do know that some RE projects are done with a pool of banks like Popular and Banreservas, that banks have a fund or loan for this. I am not clear as it is not public.”

The above statement highlights the lack of preparedness and leadership that the country faces regarding the change and implementation of RE. In the RE loan, only the Popular bank in the DR offer this service, however, the loan offer is usually for solar panels for personal use, and the loan terms are the same of a personal loan. As EI20 explain:

"the best thing that can be done is to enhance the local banks to invest into these projects, doing some or implementing some banking mechanism that would allow the local banks to finance with the guarantee of the government. However, the government is completely against this, something like sovereign bonds or guarantee, because this would reflect in the internal debt of the government if the government were to do this."

A support mechanism needs to be designed, implemented and maintained in the DR to successfully diversify the energy matrix in the country. Most of the stakeholders are aware of this need for financial support as EI23 highlighted*:*

"more financial support is needed from banks and financial institutions, given that few developers are able to finance all the investment with their own funds."

This is a paradox for the DR as for the implementation of a new financial mechanism especially for RE investments by the stakeholder. Specifically, the government, need to possess a high level of understanding in some key subjects, such as:

- The viability of the RE project or investment.
- The life cycle and practical implementation of any Tax incentives.
- Fundamental financial analysis (Donastorg, Renukappa and Suresh, 2017).
- However, as EI20 explains, the government is reluctant to assume more than the bare minimum of responsibility for the sector outside of fossil fuel. However, EI14, EI21and EI24 highlight another loan or sub-loan type the bank pool loan:

"*Pool of banks have been known to support RE projects."*

As Gintschel and Hacketha (2004) explains bank pool loan (BPL) is a new form of a loan that allows companies to usually borrow up to $10 million from the USA, however, this will depend on the solvency of the company and banks, the type of project and return time. This loan is done by a group of banks that join for the sole purpose of this loan to minimise the risk that one bank would incur on and the loan is usually secured with a stock of the company or project. Currently, only one RE project in DR has been awarded and has successfully executed the loan and completed the RE project, the Bio-energy plant in San Pedro a province in the DR as EI21 explains:

"*However, San Pedro Bio-energy was done with a pool of local banks, and in the end, the interest rates were set in dollars, and it works pretty well as the project was completed and it is working.*"

As no local financial entity wishes to invest alone in RE in the DR as the risks that the country represent are too high for one entity to support. This last case is fascinating as it was done by an established Dominican corporation, that not only has an outstanding reputation in the country, but that has the solvency to cover the loan and hire the needed foreigner experts in RE for the project.

This places all other projects in an uncomfortable situation, as the precedent is that loans will only go to establish, local and financially solvent companies. Restricting international investment and new investors in the area. The bank pool along with green loans seem like a possible solution to the financial difficulties that local investor face. However, many changes to the financial legislation and implementation in the DR need to be done, before these tools can be widely implemented and available for all.

6.2.1.2 *Power Purchase Agreements (PPA)*

A power purchase agreement (PPA), or electric power agreement, is a contract between two parties, one which generates electricity (the seller) and one which is looking to purchase electricity (the buyer). The PPA defines all the commercial agreements between two parties, usually the government and a private contractor or business for the fulfilment of the energy demand and sale of electricity.

This agreement covers from the beginning of the commercial operation, the schedule, penalty and payments of the delivery of electricity between the parties. However, the principal function of the PPA is to define the credit and revenue qualities that the project will generate (Comisión Nacional de Energía, 2012; and Jenkins; Guevara, 2014 and Azzimonti, 2018). However, in the DR this financial policy is used more as a financial tool that a financial agreement. As shown in this study, 44% of the interviewees noted that PPA is an essential financial tool for implementing RE projects in the DR for instance, one of the interviewees (EI8) stated that:

"what happens is that in normative there are contradictions. The normative forces you to have a PPA, and you do not always have a PPA. Financial institutions force you to have a PPA even to consider financing (Example of how by the time it comes to finance the project the PPA has to expire due to the long process to secure documentation and finance). You can always go to the spot market to sell, however with the oil prices going down the marginal price that can sell the energy at is very low. You need a PPA, and usually, this is awarded for five years, yet the financing is for 6-7 years, with this discrepancy between the two most banks refuses to finance the RE projects."

As the interviewee explains without a PPA all financial resources through the local or national bank are limited and in most of the cases will have the financial aid refused. As EI14 said:

"The PPA is a necessity because it is your way to get a guarantee for finance."

Moreover, EI2 explains further:

"T*he first RE project was done without a PPA, but in this country, if you want to have finance from a bank the first thing that they ask for is a PPA and how long and how much is your PPA for, if you do not have a PPA you will not get finance from any financial institution in the country."*

As EI2 highlighted the first RE project in the country was done without a PPA. This indicates that PPA is essential for local financial aid, it is not essential for the success of the RE project, as 93% of the 44% interviews that had knowledge regarding PPA's agreed with EI12 regarding the non-critical need of a PPA, as they highlighted that over 90% of the RE projects that have been successfully implemented in the country have been with private or international funds and later received a PPA and only 10% of the projects have been completed with the support of the local banks and a PPA before financing.

However, 7 % of the interviewees, contradict this claim as the knowledge they possess indicates that without a PPA no RE project can be done, as no local financial entity wishes to acquire the risk of financing RE projects due to the lack of support from the government and the countries financial risk category worldwide. As a consequence of this risk, the PPA which should be a financial agreement has become a requirement for the financial aid need to implement RE in the DR. However successfully, 100% of the interviewees highlighted that obtaining a PPA is a challenge in itself. As EI21 highlights:

“The biggest problem is the PPA because with the current prices in the spot market for RE is not rentable.”

The DR has no plans to change the manner in which the energy sector is managed, and in 2018 alone 10 PPA have been awarded not all for RE. However, 9% of the 44% interviewees understand that the way to move forward in the RE sector and the energy sector, in general, is to remove the PPA’s and replace them with a better system. As EI14 explains

“Seeing the experience in Latin America the PPA is not a working plan. A better way is to do auctions as you get more projects at a good price.”

Energy auctions have shown to have a better success rate and positively impact the economy while enhancing the RE market in the country's that are implemented. Energy auctions as Ming *et al.* (Lucas, Ferroukhi and Hawila, 2013) highlights are more transparent policy mechanisms of awarding power purchase agreements and allowing for the competitive nature of the business to emerge and for a better price per kilowatt to be negotiated.

6.2.1.3 *Tax Incentives and RE cost*

With current advancements in RE technologies, many countries have stabilised the investment for RE and are on par with fossil fuel. However, for developing nations this is not the reality as in many countries Renewable energy investment still demands large initial capital costs. Therefore, many governments have implemented incentives and tax exemption regulations to encourage investors and energy generators to implement RE (Ng and Tao, 2016 and Azzimonti, 2018.). In the DR, the 57-07 law regulates all the incentives, 20% of the stakeholders interviewed view the law as a financial tool and not the financial policy that it represents (Comisión Nacional de Energía, 2012). Of this 20% of stakeholders, 77.7% considered the law unstable due to the rapid reforms that the regulation has had, along with the reduction and cuts of the incentives. As EI12 highlights

"From an economic point of view, there is no stable incentive, because a government that changes a law after only four years of the creation of the law, when the life cycle of that law was of 10 years, in one month and took away."

This demonstrates the lack of faith and trust in the government's leadership and management that stakeholders have and at the same time represents a challenge to be overcome to enhance the implementation of RE in the DR. As EI7 explains:

"The main challenge is the incentive or investment."

Moreover, EI13 agrees by saying:

"The change in the incentives in 2012 that reduced the incentive and slowed down the RE."

However, 22.3% of the 20% of the interviewees do not agree that the reform and reduction of the incentives have impacted negatively the RE projects in the DR. As EI18 explains:

“However*, the initial cost for investment in RE has also been cut in half and in a way, this balance the reform out, if the initial cost of investment had remained high, then the cut of incentives would have turned the RE market back to zero. Yes, the development would have been greater if the incentive had not been cut.”*

However, the perception and reality of the impacts of the reduction and reform of the law that regulates the RE in the DR reflects an inner conflict of the management and leadership of the sector that derails possible investors, diminishes the market value and delays the RE in the country.

6.2.1.4 *International Aid or loans*

With the current climate change situation, many countries have come together to tackle the issues, while at the same time financially stable countries have been offering aid to the rest. From the Kyoto agreement to the Paris accord more than 300 billion US dollars have been set aside for international help and loans in the RE area for developing nations to aid in reaching the millennium development goal (MDGs) in renewable energy.

The EU alone has promised over 51€ million for the Caribbean and €9.3 million for DR alone (Kavanagh, 2016). However, knowledge of this aid and loans is insufficient, and the requirements are very restricting as the DR has been categorised by the UN as an upper middle-income country based on the gross national income (GNI) of 2012 (International Renewable Energy Agency, 2016).

Consequently, of this categorisation, many of the aids requested by private investors and the government have been denied and instead the country qualifies for many loans that promote a debt economy in the country. However, 24% of the stakeholders are in possession of international aids and loan information, as several interviewees explain:

EI11 *"Most international aid is from companies that want to come and implement a project here, but the funds for us to access internationally are very limited. the requirements are very high and complicated."*

EI20 "*Mostly is a pool of international banks that mostly provides financial aid for renewable projects."*

EI21 "*To the date, the majority of the projects have been done with international financing."*

EI22 *"however, the big projects that have been done in the DR have almost all been done with international bank financing".*

24% of stakeholders agree that international aid is needed. However, the interviewees had limited knowledge and information regarding the carbon credit and UN loans, which the country does qualify for along with EU loans for renewable energy development in developing nations.

6.2.1.5 *Asset-Backed Securities (ABS)*

Asset-backed security (ABS) are bonds or notes backed by financial assets. Typically, these assets consist of receivables other than mortgage loans (credit card receivables, auto loans, manufactured-housing contracts and home-equity loans).

The ABS differ from other bonds in that their solvency is derived from other sources than the ability of payment of the originator (Ng and Tao, 2016).

Financial institutions that originate loans—including banks, credit card providers, auto finance companies and consumer finance companies—turn their loans into marketable securities through a process known as securitisation (Lee and Zhong, 2015). In the DR the ABS have not been fully implemented, in 2011 the government approved and disseminated the 189-11 law for the development of the mortgage market and trust. In this new law, ABS was defined and contemplated, yet they have not been implemented in the country.

The company AES energy distributer that owns several energy projects in the DR have been partially promoting the need to include this financial tool in the local financing entities portfolio. However, research uncovers that only 8% of interviewee had any knowledge regarding ABS and 100% of this 8% confuse this term with collateral backing for loans. As EI14 highlights:

"Last year for auto- production a regulation was approved to re-classify the assets for solar panel, making 80% of the solar panel now able to be financed with lower interest and the down payment is only 20% before it was inverse." Alternatively, as *EI11 "Also in the DR, now is when we are taking solar panels as assets for loans, just recently a piece of legislation came out allowing banks to take a solar panel as an asset-backed, but it still has not been implemented. Several years ago, the issues were the price of technology. However, the prices for RE have gone down. Now the problem is the cash flow to get the technology".*

This confusion in simple financial terms demonstrates the lack of understanding of the financial tools, the need for transparency of local financial entities and a comprehensive RE education of the stakeholders, this includes more than just the awareness of RE technologies. On the other hand, the DR does possess and implement collateral banking for loans as Bloche-Daub *et al.*, (2017) explain a property or other asset that a borrower offers as a way for a lender to secure the loan. If the borrower stops making the promised loan payments, the lender can seize the collateral to recoup its losses.

Since collateral offers some security to the lender, loans that are secured by collateral typically have lower interest rates than other loans. However, for RE in the DR, the interest rates have not decreased, the loans are still considered hard regarding interest rates and returns. Also, this loan is only available for auto-production (Personal use), and only one to two banks in the DR have this credit line available. However, the interest rates range from 13.65% to 18.95% depending on the type of RE technology, initial down payment, credit history, amount of the loan and return time (which is from 5-10 years) in comparison to the RE loan in the UK, China and India that are between 3.5%-11.5% from Natural Energy Sources (NES). A possible solution for these hard loans would be the implementation of soft loans for RE. A soft loan is a loan with a below-market rate of interest (Guerrero-Liquet *et al.*, 2016). This is also known as soft financing. Sometimes soft loans provide other concessions to borrowers, such as long repayment periods or interest holidays. Soft loans are usually provided by governments for projects they think are worthwhile.

6.2.1.6 *Capital Grants*

The first financial tool that many countries use for financing RE is Capital grants, as the World Bank (The World Bank and Climate Investment Funds, 2013) explains this is a contribution usually by a government to an independent governmental body or authority to cover part of the cost of the latter's facilities (as federal grants for highways or public housing). In the DR, several funds have been created because of different Government measures. for example, with the PETROCARIBE contract with Venezuela, a RE public fund was created with 5% of the supposed savings that the agreement was created for the DR, yet it has never been implemented (Group, 2016).

Also, with the creation and implementation of the Energy law (Law 102 of the DR) another 5% where to be allocated for the fomenting of alternative energies in the country. Both funds are obscure to the population, as the research showed 0% of the interviewed participants had any knowledge of these funds, their availability or how to apply for them. This lack of transparency contradicts the national goal to reach 25% of RE by 2025 as it diminishes the investment and narrows financial options for current and future investments. At the same time, it sends a message to the financial entities of a lack of commitment and support of the RE.

The most obvious and widely publicized barrier to renewable energy is cost—specifically, capital costs, or the upfront expense of building and installing solar and wind farms. Like most renewables, solar and wind are exceedingly cheap to operate—their “fuel” is free, and maintenance is minimal—so the bulk of the expense comes from building the technology.

The average cost in 2017 to install solar systems ranged from a little over $2,000 per kilowatt (kilowatts are a measure of power capacity) for large-scale systems to almost $3,700 for residential systems. A new natural gas plant might have cost around $1,000/kW. Wind comes in around $1,200 to $1,700/kw.

Higher construction costs might make financial institutions more likely to perceive renewables as risky, lending money at higher rates and making it harder for utilities or developers to justify the investment. For natural gas and other fossil fuel power plants, the cost of fuel may be passed onto the consumer, lowering the risk associated with the initial investment (though increasing the risk of erratic electric bills).

However, if costs over the lifespan of energy projects are taken into account, wind and utility-scale solar can be the least expensive energy generating sources, according to asset management company Lazard. As of 2017, the cost (before tax credits that would further drop the costs) of wind power was $30-60 per megawatt-hour (a measure of energy), and large-scale solar cost $43-53/MWh. For comparison: energy from the most efficient type of natural gas plants cost $42-78/MWh, coal power cost at least $60/MWh.

Even more encouragingly, renewable energy capital costs have fallen dramatically since the early 2000s and will likely continue to do so. For example: between 2006 and 2016, the average value of photovoltaic modules themselves plummeted from $3.50/watt to $0.72/watt—an 80% decrease in only 10 years.

6.2.1.7 *Private Investment*

Regarding venture capital, as Azzimonti (2018) demonstrates, is a financial tool that defines the capital that investors facilitate to new (startup) and small but established companies that are believed to have long-term growth potential, making then a business opportunity. Venture capital comes from wealthy investors, investment banks and any other financial institutions. However, it does not always take just a monetary form, it can be provided in the form of technical or managerial expertise. In the DR, this tool is present in all renewable projects as 90% of the projects have been financed almost in its entirety by the private sectors own capital. As 87.5% of the interviewers noted the financial process for a RE project is practically non-existent. As EI12 explains:

"In the beginning, we did not have any financial support because no market had been created, to such a degree that the first wind farm was developed with private investment completely no financing what so ever."

Although several RE loans are now in play, these loans are the same as a personal loan and are only available for auto-production (Individuals who wish to have solar panels in their house). However, this is not available for big projects. Other factors that interviewees marked were: (a) Reputation: financial institutions will not even consider your project if you do not have a business reputation in the country and for RE you need the specific area of expertise. (b) The need for a Power Purchase Agreement (PPA) from the government to guarantee the project. Contradictorily, this life cycle of the PPA is not enough to complete the phase of permits and finance, the life cycle of 5 years discourages financial institutions to invest in RE, along with the lack of a fair market and reputation of the country and precisely the lack of leadership of the government makes this a compulsory part yet one that discourages financial entities.

6.2.1.8 *Renewable Energy Portfolio*

As per Tampier and Beaulieu (2006), Dolezal *et al.* (2013) and Ng and Tao (2016) a renewable portfolio standard (RPS) or renewable energy portfolio (REP) is a regulation to aid the diversification of the energy matrix in a country and enhance the RE development by increasing the generation of energy from RE sources. This regulation creates an obligation mechanism on the electricity supply to generate a specified fraction of their energy from RE. Tampier and Beaulieu (2006) explain this regulation has worked in many countries, such as USA, UK, Belgium and many more.

This measure tends to allow more price competition between different types of renewable energy but can be limited in competition through eligibility. Those supporting the adoption of RPS mechanisms claim that market implementation will result in competition, efficiency, and innovation that will deliver renewable energy at the lowest possible cost, allowing renewable energy to compete with cheaper fossil fuel energy sources. In the DR, the RE portfolio is one of the political measures taken to aid in the implementation of alternative sources as it is mention in the national strategic plan of the country for 2030. However, of the stakeholders only 4% had any knowledge of this measure, as EI8 explains:

"The creation of a project investment portfolio, we have many investors, yet they do not have the financial means to do it. Is a financial issue; we have been working with

the superintendent de Bancos to reevaluate asset so that loans can be better financed."

Moreover, the government has created the measure but not any of the financial or political tools that this measure needs to be implemented and to promote the take-up of the RE market or projects.

6.2.1.9 *Mutual Funds*

Mutual funds as Bobinaite and Tarvydas (2014) explains is an investment programme funded by shareholders that trade in diversified holdings and is professionally managed. In this aspect, only 12% of the interviewees had any knowledge, as this is a new trend in the DR and one that as EI2 explains:

"one of the new financial trends in the Dominican Republic is mutual funds but it is something that is just starting is very new what's right now in the Dominican Republic is fix Rent fix income bonds commercial paper all other financial trends are difficult to implement in the Dominican Republic due to the economic limitations that the population has and the access and offers that the banks have for such endeavours"

Moreover, EI24 said:

"*Co-financing is available."*

Furthermore, EI20 further highlighted: "*Some local banks provide financing to projects that are not too big. Meaning small projects below ten megawatts, projects above that I would say that a mutual fund or pool of banks can do it but at high rates and the company needs to give not only collateral but enough guarantee, not just the concession they have to give the project as collateral."*

The comments and percentage of the interviewees that had any knowledge regarding mutual funds show that the population has not been informed and as the stakeholder highlighted are difficult to implement due to the economic limitations and lack of marketing options from the banks to the public.

6.3 Financial barriers, drivers and critical success factors

After understanding the financial policies and tools that exist in the DR, the next critical step is to identify, categorise and analyse the financial challenges or barriers, along with the financial drivers and critical success factors of RE projects in the DR. As can be seen in Figure 6-1. Financial challenges in the DR based on interviews, was done with stakeholder in the energy sector of the DR. With this foundation six challenges were highlighted: (1) Lack of RE loans is the main challenge with 50% of the interviewees highlight this a the key issue of the lack of development in the RE sector in the country, (2) Lack of knowledge is the second critical barrier, 33.33% of the interviewees had minimum to no knowledge regarding the financial policies or tools for RE projects, demonstrating the lack of information and resources that have been assigned by the government for the promotion and development of the RE market. As one of the interviewees explained:

"I do not have much knowledge in this regard, while we were constructing our first project there was much competition yet this was the only project to be realised while all the others are stuck for what reasons I can only speculate, maybe lack of support or finance."

(3) The third key challenge is the lack of financial guarantee, as 33.3% of the interviewees explain that a PPA is essential in the RE project. Even though the PPA

is an agreement in the DR is uses as a financial tool as without it the chances of having a successful project are minimal. (4) The fourth challenge in the DR is the reduction of the tax incentives, with the reform of the 57-07 law in 2012 where the incentives were cut from 75% to 40%, this government decision impacted the RE investment and projects that had been submitted and approved as of the 800mw of RE that have been approved only 25% of them have been implemented. As the interviewees pointed out:

"The change in the incentives in 2012 that reduced the incentive and slowed down the RE investment also the lack of knowledge in RE and the lack of education in this type of energy."

this opinion is shared by 22.2% of the stakeholders as the research shows. While the fifth challenge is lack of RE technology assets recognition. This was only considered by 11.1% of the interviewees, and the sixth challenge is the interest rates and returns time. This was only highlighted by 5% of the stakeholders, demonstrating the lack of knowledge in the area along with the lack of development that this area has in the DR.

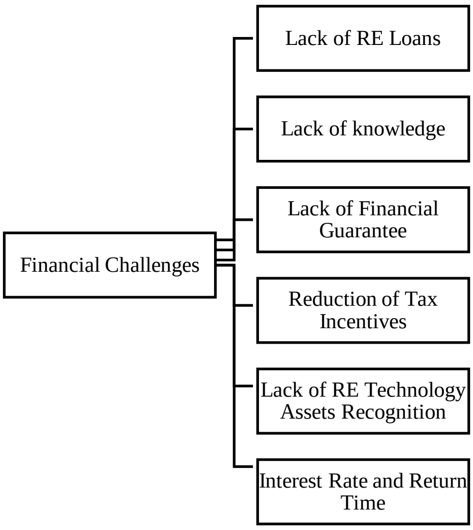


Figure 6-1. Financial challenges in the DR based on interviews

Even with the challenges presented in Figure 6-1. Financial challenges in the DR based on interviews) the DR has a growing investment into RE, around 900 MW of RE projects have been approved along with several expansions of the projects already in services (Group, 2015). In accordance with the interviews, the key drivers can be seen in Figure 6-2.Financial drivers for the DR based on the interviews) in order of importance. These drivers are the key to promoting and developing a RE market in the DR. As these drivers represent the attractive features of the RE projects that must be increased and maintained. Interviewee EI23:

"*And for the banks to lend the money, the projects have to have a more or less assured financial return so that the project can repay the loans."*

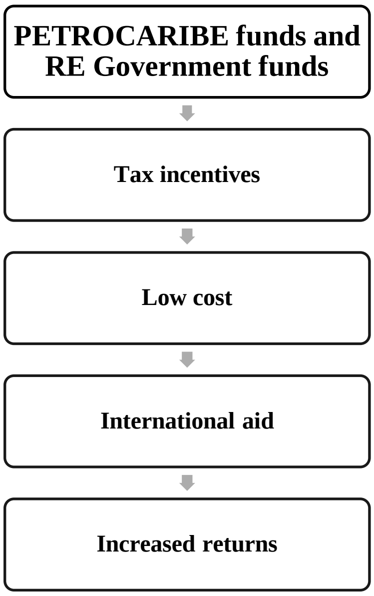


Figure 6-2.Financial drivers for the DR based on the interviews

In this area of drivers, the interviewees were more knowledgeable as 72% agreed

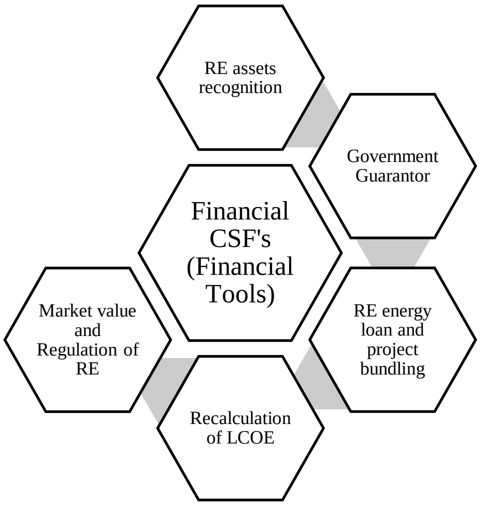


Figure 6-3. Financial CSFs for the DR based on the interviews

that the most important driver is the financial gain from this business opportunity. These financial drivers are based on the financial tools, agreements and policies available in the country, regardless of the knowledge of the population. For these drivers to work, several critical success factors must be monitored, and key performance indicators must be created to assure the correct and successful implementation of the financial aspects of a RE project, as can be seen in Figure 6-3. Financial CSFs for the DR based on the interviews) the CSF's were built based on the interview's knowledge and the available financial stability and information of the DR, considering the successful and unsuccessful projects implemented in the country regarding renewable energy in the last ten years.

6.4 ISM analysis and modelling

In this case, the financial tools from the literature and the ones from the interviews where aligned. However, the ISM was performed to confirm the importance and relationship of the different financial tools as the findings from the only provided one tool (loans) and the interviews provided eight financial tools. For that purpose, Table 6-2. Coding for SSIM Matrix for financing the implementation of renewable energy projects was made in order to create Table 6-3. SSIM Matrix for financing the implementation of renewable energy projects.

Table 6-2. Coding for SSIM Matrix for financing the implementation of renewable energy projects

Coding	Financial tools available for the Renewable Energy projects in the Dominican Republic
F1	Loans
F2	Power Purchase Agreements (PPA)
F3	International aid and loans
F4	Incentives and cost of RE
F5	Mutual Funds
F6	Asset-Backed Securities
F7	Capital grants
F8	Private investment

Table 6-3. SSIM Matrix for financing the implementation of renewable energy projects

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	-	X	X	A	O	X	V	V
F2	-	-	X	V	V	V	V	V
F3	-	-	-	X	O	O	O	O
F4	-	-	-	-	V	V	V	V
F5	-	-	-	-	-	O	O	V
F6	-	-	-	-	-	-	O	V
F7	-	-	-	-	-	-	-	V
F8	-	-	-	-	-	-	-	-

Once the linkage or lack of has been identified in the SSIM matrix then the Table 6-4. Reachability matrix for financial tools in the Dominican Republic was made by replacing the letters by their counter binary equivalent. This matrix will allow us to understand the level of relationship between the tools.

Table 6-4. Reachability matrix for financial tools in the Dominican Republic

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	1	1	0	0	1	1	1
F2	1	1	1	1	1	1	1	1
F3	1	1	1	1	0	0	0	0
F4	1	0	1	1	1	1	1	1
F5	0	0	0	0	1	0	0	1
F6	1	0	0	0	0	1	0	1
F7	0	0	0	0	0	0	1	1
F8	0	0	0	0	0	0	0	1

Table 6-5. Reachability Matrix with Transitivity checked

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	1	1	0	0	1	1	1
F2	1	1	1	1	1	1	1	1
F3	1	1	1	1	0	1*	0	1*
F4	1	0	1	1	1	1	1	1
F5	0	0	1*	1*	1	1*	0	1
F6	1	0	0	0	0	1	0	1
F7	0	0	0	0	0	0	1	1
F8	0	0	0	0	0	0	0	1

Note: 1* entries are included to incorporate transitivity

After transitivity of the matrix has been check the reachability matrix is transformed. In the case of the financial tools for RE in the DR, the matrix is only slightly affected as can be seen in Table 6-5. Reachability Matrix with Transitivity checked.

The binary matrix allows for the importance of the different tools to be determined as *Table 6-5. Level of partition Matrix for financing the implementation of renewable* *energy projects* was created and allows for a graphical representation to be built *Figure 6-4. ISM based model for financing the implementation of renewable energy projects*.

Table 6-6. Level of partition Matrix for financing the implementation of renewable energy projects

i/j	Reachability set	Antecedent sets	Intersection set	Level
F1	1,2,3,6,7,8	1,2,3,4,6	1,2,3,6	3
F2	1,2,3,4,5,6,7,8	1,2,3	1,2,3	5
F3	1,2,3,4	1,2,3,4	1,2,3,4	3
F4	1,3,4,5,6,7,8	2,3,4	3,4	4
F5	5,8	2,4,5	5	4
F6	1,6,8	1,2,4,6	1,6	2
F7	7,8	1,2,4,7	7	2
F8	8	1,2,4,5,6,7,8	8	1

These models reveal that PPA's are the most important tool based on the analysis and contradicting the literature and 60% of the interviewees. Also, this tool opens the path for the rest of the tools to be considered and implemented in the DR.

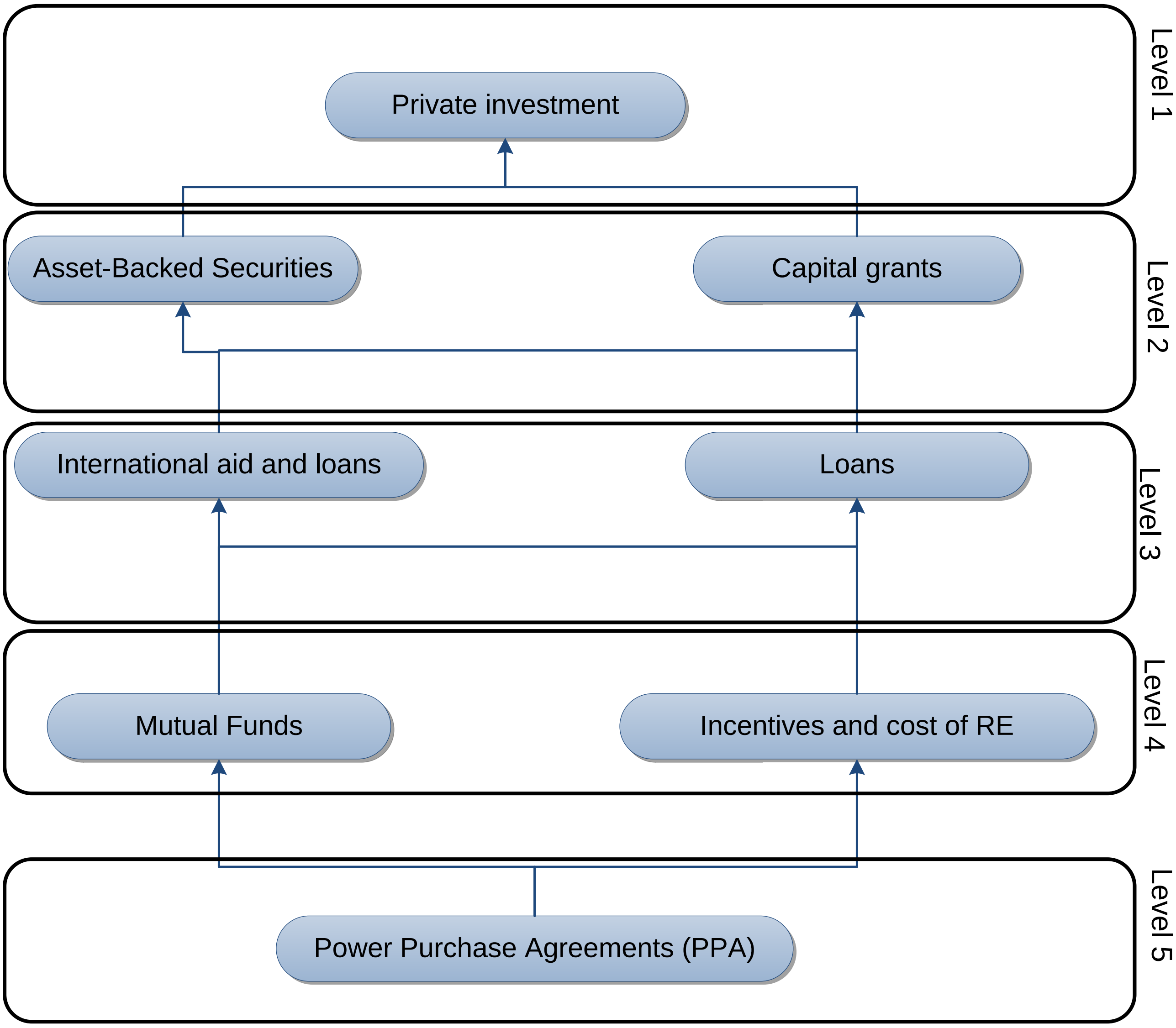


Figure 6-4. ISM based model for financing the implementation of renewable energy projects

6.5 Summary

This chapter has addressed the fourth research objective and question:

"To explore the essential renewable energy-related financial tools and policies initiatives that have been or planned to be implemented in the Dominican Republic."

"What essential financial policies and tools are available for implementing renewable energy projects in the Dominican Republic."

This chapter discusses the financial tools and policies in the Dominican Republic available for the development of renewable energy projects. However, these tools and policies have not been fully implemented, and some of these tools have not been implemented at all in the renewable energy sector. The main policy in effects is the incentives, and the main tool in effect is the hard loan. This chapter presents the need for diversification in the creation and implementation of financial tools for the development of renewable energy projects. By analysis the theory and the interviews with key stakeholders, it can be inferred that the lack of support from the government in the renewable energy sector has provoked that the financial institutions in the Dominican Republic remain on the sidelines of this sector (Table 6-6. Summary of the financial status in the DR regarding RE based on the interviews). To better understand their behaviour and the reason why so many of the project failed the challenges that the developers face must be analysed, and therefore the next chapter will discuss the challenges.

Table 6-7. Summary of the financial status in the DR regarding RE based on the interviews

Financial tools in the DR for RE	**Financial barriers in the DR for RE**	**Financial Drivers in the DR for RE**	**CSFs in the financial sector of DR for RE**
Loans	Lack of RE loans	PETROCARIBE funds and RE government funds	RE energy loan and project bundling
PPA	Lack of financial guarantee	Low cost	Government Guarantor
Incentives and cost of RE	Reduction of Tax incentives	Tax incentives	Market value and Regulation of RE
International aid and loans	Lack of knowledge	International aid	
Asset-backed security	Lack of technology asset-bracket	Increase returns	RE asset recognition
Capital Grants	Interest Rates and return times		Recalculation of LCOE
Private investment			
RE portfolio			
Mutual funds			

Chapter 7 . Challenges of implementing RE projects in the DR

7.1 Introduction

This chapter discusses the findings regarding the challenges that were identified by the research. The main challenges that renewable energy faces are discussed in Sub-section 2.12 of Chapter 2 the literature review. This chapter deals with challenges that the Dominican Republic faces based on the 25 interviews conducted to the stakeholders. This chapter tries to answer the fifth research question:

"What challenges does the implementation of renewable energy projects faces in the Dominican Republic?"

Linked to the fifth research objective:

"To study and record the challenges of implementing renewable energy projects in the Dominican Republic."

The challenges are presented in 2 phases: a general phase dealing with a generalize definition and presentation of the challenges and then the second phase of each challenge break down and different components.

7.2 Challenges

To quote Newton:

“For every action, there is an equal and opposite reaction.”

In implementing renewable energy in the Dominican Republic, the projects will face opposing forces from different areas created by the status of the electricity sector in the Country. Because of these opposing forces, the literature was analyses along with the interviews and themes of challenges because apparent and was quantified with content analysis, as can be seen in Table 7-1. Challenges to implementing renewable energy projects.) the challenges from the researcher sources prove to be mismatched while the literature provided with three generalized categories: (1) Regulatory Framework Challenges, (2) Institutional and Economic Challenges and (3) Technical and Non-technical losses.

The interviews were more detailed providing eight critical challenges that were faced and will continue to face when implementing renewable energy in the Dominican Republic: (1) Renewable energy law implementation (2) renewable energy micro and macro market (3) financing (4) Technical and technological challenges (5) leadership for renewable energy (6) permit solicitation-acquisition-process (7) renewable energy knowledge availability and (8) land acquisition. It can be argued that the challenges from the literature encompass the ones from the interviews and to see the interrelationship between them an ISM analysis was done (see Section 7.11).

Table 7-1. Challenges to implementing renewable energy projects

No.	Challenges from Literature	Percentages	No.	Challenges from interviews	No.25	Percentage
1	**Regulatory Framework**	54.54%	1	RE law implementation	23	92.00%
			2	RE micro-macro Market	23	92.00%
			3	Financing	21	84.00%
2	**Institutional and economic**	54.54%	4	Technical and technological	17	68.00%
			5	Leadership for RE	17	68.00%
			6	Permit solicitation-acquisition-process	15	60.00%
3	**Technical and non-technical losses**	54.54%	7	RE knowledge	12	48.00%
			8	Land Acquisition	7	28.00%

7.3 Renewable energy law implementation

Renewable energy law is a political framework created by the government to rule over the development, commercialization and implementation of all types of renewable sources (solar, wind, geothermal, tidal, biomass and more). However, the renewable energy law for the Dominican Republic 57-07 mostly address the incentives for solar and wind, as the name of the law implies: *Law 57-07 about the incentives for the development of renewable energy and its speciality regiments.* This law was drafted based on the renewable laws in Europe, specifically the Spanish, German and French laws. It was placed in effect in 2007 and then reformed in 2012. (See Table 7-2. Law 57-07 of alternative energy sources in the Dominican Republic for a summary of the Law.)

Table 7-2. Law 57-07 of alternative energy sources in the Dominican Republic

Law	Main objectives	Scope for renewable	Incentives	Reform
Law 57-07	(a) to increase the diversity of energy sources. (b) reduce dependence on imported fossil fuels. (c) stimulate private investment in renewable energy. (d) ensure that private investments comply with rules and regulations. (e) mitigate the negative environmental impacts of fossil fuel generation. (f) promote social community investment in renewable energy projects. (g) contribute to decentralization of power and bio-fuel production to increase the market competition and (h) contribute to the achievement of goals of the National Energetic Plan, especially those related to renewable energy.	a) Wind less than 50 MW. b) Small and micro-hydro are less than 5 MW. c) Solar installations (photovoltaic) of any size. d) Electric plants using, bio-mass as the main fuel source, at power capacity less than 80 MW. f) Biofuel plants (distilleries or bio-refineries) of any production volume. g) Energy farms, plantations or agroindustry infrastructures of any kind destined for the production of biomass for energy generation. h) Installations for the exploitation of ocean energy. i) Solar thermal for water heating or space cooling.	1. Exemption from import duties on necessary renewable energy equipment. 2. Exemption from value-added tax for certain equipment expressly listed in the law. 3. Exemption from income tax for up to ten years until the year 2020. If the income comes from selling or installing renewable energy systems, parts, and equipment specified under the law, 35% of local content is necessary. 4. A 5% tax reduction on interest on foreign financing of RE projects. 5. A single tax credit of up to 75% (depending upon the energy technology) on the cost of capital equipment used in renewable energy projects. 6. Small-scale renewable energy projects destined for community use, up to 500 kW, can apply for financing at lowest market rates, for 75% of the total cost.	In 2012 with the Law 253-12 on Strengthening the Government's Collecting Capacity for Fiscal Sustainability and Sustainable Development some incentives were reduced such as the Tax Credit from 75% to 40% of the investment cost for self-producers. Also, the articles 10 and 23 related to the incentives of the income tax for the power generators were eliminated. In 2015 the Article 5 of the Law was modified: the size of biomass and urban solid waste (USW) projects benefited from the incentives was increased up to 150 MW allowing the collusion with other sources if the biomass and the USW mean at least the 50% of the primary energy. And geothermal projects were

				included.

Both the literature (54.54%) and the interviews (92%) signalled the law as a challenge for different reasons. But how could it be that a law that was created to implement the renewables by a challenge? The problem is not the law itself, but rather how it was worded and what was left out of the law, as EI11Explain:

"The law 57-07 is an excellent law for the region. However, we need to keep legislating, and we need to support better the law is still very abstract. some points depend on how you interpret them, they are not very clear, and we need more government support. The law 57-07 is an excellent law but has many gaps even though it has gone through a lot of modifications."

And EI15 agrees:

"Lack of transparency, as a sector it is very ambiguous the infrastructure is not clear. However, this can only be done if the country's government is not ambiguous in its dealing regarding renewable energy."

As the interviews highlighted the 57-07 law has ambiguity in its ruling, that create a lack of trust from the investors in the implementation of renewable energy. Also, the literature and the interviews both stress the conflict of the different laws of the legal framework of the Dominican Republic.

As Konold (2015) the country is in a constant state of reform, as with every four years a new president and party take the position of governing the country, and this brings forward a new group of goals and plans for the country. This change in government can mean the termination of a project at any stage and the reform of any plan or law. This also means the implementation of new laws without reviewing any conflict with other laws. As EI15 said.

"*Conflict in the implementation of the legal framework, the ambiguity when it comes to design, and actual execution of the project are the biggest challenges regarding the legal framework in the Dominican Republic."*

This is a challenge that the government of the Dominican Republic will need to address. Some recommendations are provided in Chapter 11. A more in-depth look at the laws in the Dominican Republic, see Chapter 2.

7.4 Renewable energy micro and macro market

Table 7-3. Challenges in the renewable energy macro and micro market

Challenges-RE micro-macro Market from interviews	**No. 23, (92%)**	**Percentage**
Development	13	56.52%
Status or stage	10	43.48%
Micro	4	17.39%
PPA	4	17.39%
Macro	3	13.04%
Competitiveness	3	13.04%
Spot market	2	8.70%

The renewable energy market, according to (Ochs, 2011) is an economic system in which the decisions regarding investment, production and distribution are guided by the price signals created by the supply and demand needs of a nation, region or area. In the case of the Dominican Republic, the government tried to include the renewable energies in the existing energy market with the creation of the law 57-07 and defining in the law the prices in a Feed-in Tariff rate (see Table 7-4. Renewable energy prices under Feed-in tariff rates of the 57-07 law)

Table 7-4. Renewable energy prices under Feed-in tariff rates of the 57-07 law

Energy source		**Feed-in Tariff (U.S cents per kWh**	**Spot Market (U.S cents per KWh)**
Wind	Connected to the grid	12.5	18
	self-generation for sale to the grid	4.9	
Solar	self-generation greater than 25 kW for sale to the grid	10	
	greater than 25kW connected to the Grid	53.5	17.5
	Less than or equal to 25 kW connected to the grid	60	
Small Hydro	Connected to the grid	10	
	self-generation for sale to the grid	4.8	
Biomass	Connected to the grid	11.6	
	self-generation for sale to the grid	4.8	
Municipal Solid Waste	For sale to the grid	8.5	

However, this did not have the reaction the government wanted, nationally or internationally. In the local environment, the distribution company owned by the government considered the rates too high to be able to be implemented. In the international environment these rates, especially for solar were considered unreal and inapplicable, as for example, Germany pays U.S 0.40 cents for ground mount solar energy and 0.49 for a roof-top generation, and United Kingdom pays U.S 0.50 cents for standalone between 10-50 kilowatts. Because of the unrealistic FIT prices to date, no renewable energy project has been implemented relying on these FIT policy prices and this policy is considered non-operational in practice.

In the spot market, the Dominican Republic is also paying more for renewables as the wind gets a price of U.S 0.18 cents per kWh and the international average is U.S 0.14 cents per kWh.

Although the literature does not treat the market as a challenge to be overcome the interviewers revealed another story. As 92 % of the participants, highlighted that not just the status of the market was a challenge but the fact that the market is barely created, as EI15 said:

"The market is initiating, the market has just taken the first steps and this is due to local interest (example of how the energy is blocked by companies that are based with fossil fuel and have government interest) (example of how the latest projects to be approved by government have all been based on fossil fuel and how international investment had been blocked by geopolitical purposes)"

Or as EI4 highlighted:

"Is there a phase before the initial phase, because it hasn't even started in the Dominican Republic. For a market to exist the country needs to recheck the law, renewable energy should be first when it comes to generation and continue with the incentives for people that wish to developed renewable energy projects."

However, this challenge is not just about the status of the market, based on the information and analysis of the interviews the challenge was further divided into: (1) development (2) Status or stage (3) Micro (4) PPA (5) Macro (6) Competitiveness and (7) Spot market (see Table 7-3. Challenges in the renewable energy macro and micro market). This categorization of the areas that compose an economic market, made for an easier understanding of the Dominican market.

- Development: As explaining the renewable energy market has not been properly developed in the Dominican Republic, the 57-07 law needs to be reform again as in 2017 its natural life cycle ran out and it was given an extension until 2020 to be renewed. However, this law needs more than just to be renewed; the market for renewable needs to have the levelized cost of electricity calculated so that proper rates can be allocated in the market for renewables. Allocations, for the entrée into the market of the local financial entities as currently, they have remained in the side-lines of renewable energy, mostly due to the lack of proper market development by the government. As EI19 explain:

"The energy market is in diapers, I worked in the first renewable energy project, and that was 5 years ago, and the market is still underdeveloped, it is still very new."

- Status or stage: as can be inferred from previous examples of the views of the participants the status of the market is new or beginning yet this is not the opinion of all the participants. The perception of the market changes depending on the sector the participant is from. The participants from the private sector considered the market to be in an initial stage while the participants from the public sector considered the market to be thriving. As EI7 said:

"I believe that we are in plain boom and development of renewable. (Example of renewable plants that started that year, biomass and solar and second phases for both) this indicates an increase of an 8% in renewable energy in DR."

This mismatch is an example of the dichotomy of perspectives that a simple market can have. However, it does not change the fact that out of 200 renewable energy projects approved in the Dominican Republic in the last 10 years, only 4 have been successfully implemented. As EI14 expressed:

"I do feel that even though we have approved many projects they do not get done, we need to check this. Because what we approve and what has been done does not correspond"

- Micro and Macro: the same mismatch can be said about the micro or auto production market and the macro or national generation projects. In this case, the dichotomy was not between the participants, but the discrepancy is between the growth of both areas of the market. As explained in Chapter 2 the Dominican Republic electricity sector has been for decades in a crisis state. As a result, the purchase of household auto-generation (Invertor with a pack of four to six battery pack and a group of solar panels) has become normalised.

  Due to the grey-outs, the population to mitigate the lack of energy has invested in Small fossil fuel plants. However, due to the noise, smell, maintenance and prices of the fuel, the majority has changed to inverters with 4-6 batteries and solar panels as a mitigation technique for the lack of energy. This has created a boom in the micro-renewable market. This growth has attracted the interest of the financial entities that now provide loans and assets backed loan based on solar panels (see Chapter 6 for a more in-depth financial review). As EI8 expressed:

  "In the macro market level of a 10% that we should have we are at 3%

in the individual market is excellent more than 30,000 users of renewables."

The macro environment has not done so well, with the local financial entities still in the sidelines and the cause of the failure of so many projects a mystery for the government.

- PPA: Power purchase agreement is a contract between the energy generators and the energy distributor or purchaser. In the Dominican Republic, this agreement is managed by the CDEEE as the institution responsible for energy distribution. However, very few companies have a PPA as the contract is usually made behind closed doors and the details of the energy agreement are not known to the public. However, this is contradicting as 17.39% the participants expressed that without a PPA the project could not move forward. As EI8 expressed:

"*what happens is that in normative there are contradictions. The normative forces you to have a PPA, and you do not always have a PPA. Financial institutions force you to have a PPA to even consider financing (Example of how by the time it comes to finance the project the PPA has to expire due to the long process to secure documentation and finance). You can always go to the spot market to sell, however with the oil prices going down the marginal price that can sell the energy at is very low. You need a PPA, and usually, this is awarded for 5 years, yet the financing is for 6-7 years, with this discrepancy between the 2 most banks refuses to finance the RE projects."*

So, the PPA even though is an agreement, functions more like an all-purpose tool in the Dominican Republic.

- Competitiveness: As International Renewable Energy Agency, (2018) competitiveness is the ability of business of delivering service or goods for their value to consumers or customer better than the competition. In the Dominican Republic's macro market, the fossil fuel industry is already established with more infrastructure, expertise, reputation and support from the financial industry and the government. This establishes a presence in the market makes for a formidable obstacle for renewables to enter into the market to compete. Also, the fact that the electricity is not broken down for the consumers by energy source, it is broken down by different energy prices, as can be seen in Figure 7-1. Fragment of a Dominican energy bill.

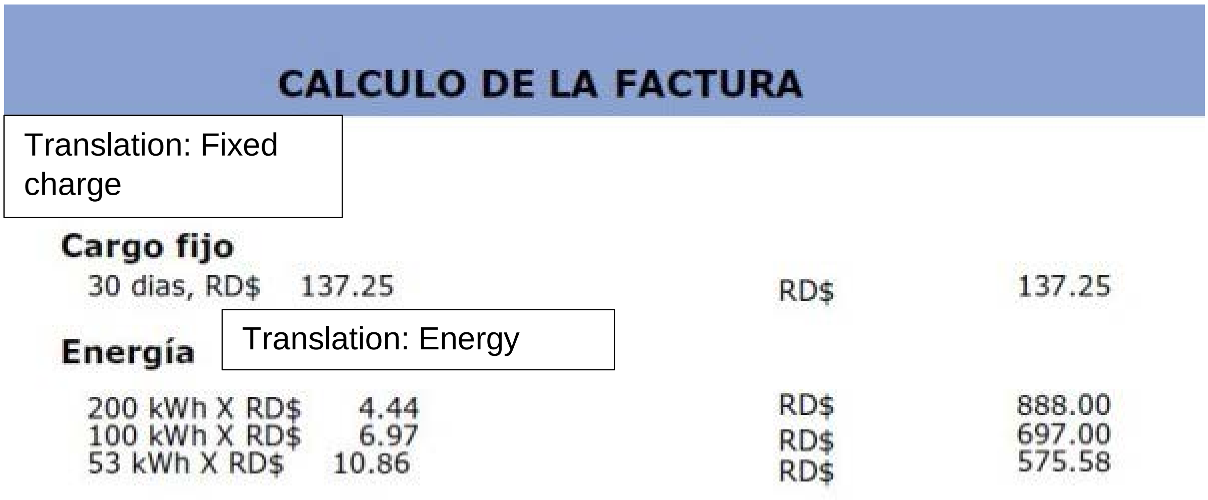


Figure 7-1. Fragment of a Dominican energy bill

(Source CDEEE, 2019)

Regarding the micro market is a different story. As the small sellers of auto-production have more on an even playing field. As EI1 explain:

"*A lot of competition… a lot of capital… they bring the solar panels from somewhere... and they give credit to customers that I can't do… Let's say that a company offers a whole system installation and everything without an initial cost, and I can't compete with that… and I don't know how they handle their capital… if they have low interests… here we have a lot of Spanish companies installing solar systems… These companies land big projects since they come with experience with a established brand.*

- Spot Market: The spot market according to Maekawa *et al.* (2018) is a public financial trading market in which commodities are exchanged for immediate delivery, and it settles in 2-3 days. In the Dominican Republic at least 20% of the energy is traded through the spot market according to regulations from law 125-01 (electricity law). This is done to settle the differences between the contracted, produced (according to merit order) and consumed electricity. The wind farm Los Cocos was built without a PPA so must sell the energy it produces in the spot market. As EI8 said:

"You can always go to the spot market to sell, however with the oil prices going down the marginal price that can sell the energy at is very low."

7.5 Financing

The financing challenges were rank by both the literature and the interviews in the middle, with 54.54% from literature and 84% of the interviews highlighting the different financial challenges. This is another example of how the literature generalised the information regarding renewables.

By simple comparison of the challenges identified by both, it can infer that the literature group together in three categories what the interviews detailed in eleven categories (see Table 7-5. Challenges in financing renewable energy projects). For this research, the challenges have been divided into four categories:

- Financial tools: Loans, Incentives and cost, International aid, Mutual Funds, renewable assets recognition, capital access and private investment
- Financial Policies: Portfolio
- Agreement: PPA
- Risk: Financial risk perception and reality and lack of knowledge

Table 7-5. Challenges in financing renewable energy projects

No.	Financing challenges	Percentage	No.	Challenge Financing from interviews	No. 21	Percentage
1	**Loans**	90.90%	1	Loans	16	76.19%
			2	PPA	11	52.38%
			3	Incentives and cost	8	38.10%
			4	International Aid	7	33.33%
2	**lack of capital**	81.81%	5	Lack of knowledge	6	28.57%
			6	Mutual funds	3	14.29%
			7	RE assets recognition	2	9.52%
			8	Financial Risk	2	9.52%
3	**Lack of guarantee**	81.81%	9	Capital access	1	4.76%
			10	Portfolio	1	4.76%
			11	Private investment	1	4.76%

7.5.1 Financial policies

According to Itskhoki and Moll (2019) financial policies refer to the regulations, supervision and oversight of the financial and payments systems, including the markets and institutions, with the purpose of promoting financial, stability, market efficiency and client-asset and consumer protection. In the Dominican Republic regarding renewable energy three policies exist, which are: Feed-In-Tariff (FIT), Tax incentives and RE portfolio.

The DR possess three financial policies tools with the law 57-07 (Comisión Nacional de Energía, 2012) containing financial incentives in its core, along with FIT agreements and RE portfolio being part of the mission and vision of the country's national development strategy. As discussed the FIT in tariff although an active policy is not implemented. The tax incentives are administered by a group of entities. The 57-07 law created the National Commission of Energy, and this entity was supposed to administer and advise in regards to everything related to renewable energy.

However, this is simpler said than done, in the process of implementation several Dominican entities are involved, from the superintendency of electricity to the newly created ministry of mines and energies to the Dominican Distributor and the Dominican Transmission of electricity enterprise (ETED). With so many institutions involved the flow of the implementation should be faster and easier, instead the accumulation of entities makes the interpretation and implementation of the law muddle and complicated. In regards, to the interviews, only 4% identified the renewable energy portfolio as a challenge, and only 38.10% identified the incentives as a challenge.

Feed in Tariff: Feed-in tariff (FIT) is a financial policy or legislation that provided financial incentives to renewable energy projects developers by setting a fixed price for the sale of the energy generated from the renewable source. Some of the advantages are: Financial certainty, more cost-effective, less bureaucratic, generates more competitiveness, more jobs and is fast to implement (Abolhosseini and Heshmati, 2014). However, as discussed, the DR did not set a realistic price range for the FIT and it's yet to be implemented.

Renewable energy portfolio standards: As per (Patterson, 2013) renewable energy portfolio standards (RPS) is a policy that requires electric generators to supply to the distributor and consumers a specific amount of energy load from renewable energy. In the DR the law 57-07 mentions the RPS yet does not define the minimum amount. It can be inferred that like FIT the policy is in the legislative framework yet cannot be implemented until defined by the government of the Dominican Republic.

Incentives and cost: This policy is defined and in effect in the Dominican Republic in the form of the law 57-07. (see Table 7-2. Law 57-07 of alternative energy sources in the Dominican Republic).

However, due to the reformed of 2012 of this law, the interviewees highlighted that this derailed investors as the incentives were cut from 75% to 40% and diminished the trust in the government's leadership, as EI12 explain:

"From an economic point of view, there is no stable incentive, because a government that changes a law after only 4 years of the creation of the law, when the life cycle of that law was of 10 years, in one move takes away the incentives without any technical, regulation analysis to back up the change, obviously that adds a big risk to the economic aspects because you do not make an investment in RE just for 4 years, the RE projects are 20 or more year investment… "

7.5.2 Financial tools

Regarding financial tools, the Dominican Republic possess a diverse financial system and tools. However, the implementation of these financial diversity has not reached the renewable energy sector. Interviewees and the literature tended to focus on loans more than any financial tool. For a more in-depth discussion regarding the financial tools of the Dominican Republic see Table 7-6. Summary of financial tool implementation in the DR and Chapter 6 for a more in-depth review.

Table 7-6. Summary of financial tool implementation in the DR

Financial tool	Implemented in the renewable energy sector
Loans	☑ however, only hard loans are available for auto-production not for macro-scale projects. Recently a pool of banks has financed the San Pedro Bioenergy to distribute the possible risk involved.
International Aid	☑ The DR is part of many international initiatives and has received aid from many international institutions, for a more in-depth discussion, please see chapter 5 section 2.4
Private investment	☑ In the DR, this tool is present in all renewable projects as 90% of the projects have been financed almost in its entirety by the private sectors own capital. As 87.5% of the interviewers noted the financial process for a RE project is practically non-existent. (See chapter 6)
Mutual funds	☐ has been contemplated by financial institutions has not yet been implemented
RE assets recognition	☑ and ☐ In the DR the assets backed security (ABS) have not been fully

	implemented, in 2011 the government approved and disseminated the 189-11 law for the development of the mortgage market and trust. In this new law, ABS was defined and contemplated, yet they have not been implemented in the country for the macro scale projects. However, in the auto-production, many banks are accepting solar panels as security for investment. (see chapter 6)
Capital access	☐ In the DR, several funds have been created because of different Government measures, yet the funds have never been implemented

7.5.3 Agreement Power purchase agreement (PPA):

As discussed this is an agreement to secure the purchase of energy generation for distribution. However, in the Dominican Republic, this is an all-purpose tool, from a financial guarantee to a need document for document procurement. The PPA has become a compulsory part of a renewable energy project. (See chapter 6 for a more in-depth discussion of PPA).

7.5.4 Financial risk:

The financial risk of the country is medium to high according to the best's country risk report (2018) by the A.M. Best Company, inc and (2019) Organization for Economic Co-operation and Development (OECD). The risk that a country possesses is calculated by evaluating the economic, political and financial system risk. Based on the evaluation a grade is given to the country. The Dominican Republic has an overall grade of CRT-4 or tier 4 meaning a high level of country risk, see Figure 7-2. Risk tier grading. In the individual categories, the country scored a moderate in the economic risk but high in the political and financial system risk.

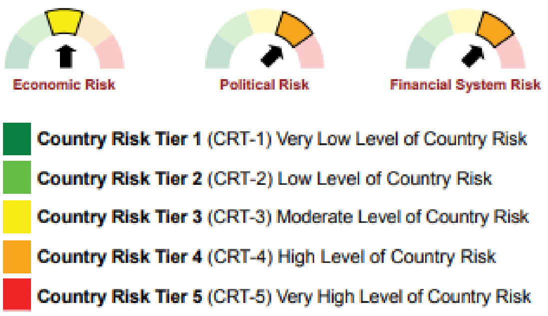


Figure 7-2. Risk tier grading

Source: The Best's Country Risk assessment (2018)

as EI20 explains:

"the other problem is the risk of the country; generally the investors and international investors see the country as a risk, and it true if you look up the credit score of the country in the different entities is very low, we are below what would be a rational risk of investment, and finally when a person gets all the permits the financing has been used up or has evaporated due to the time it takes to get the permits, financing is very complicated, very few have the muscle to finance this type of projects."

The political and financial situation of the Dominican Republic impacts the possibility of investment in the country.

4.1.1. Lack of financial knowledge

This challenge was defined by the observation of the lack of knowledge and understanding of the financial tools of the interviewees. 28.57% had no idea what financial tools were available for renewable energy projects. As EI16 express:

"I do not know clearly any instrument or tool to support the renewables."

It can be inferred that the lack of knowledge in the financial area can impair the deployment of renewable energy projects, due to lack of information and options of investment and finance.

7.6 Technical and Technological Challenge

Table 7-7. Technical and technological challenges

Challenge from literature	Percentage	Challenge from interviews	Percentage
Technical and non-technical losses	54.54%	Challenge- Technical and technological	68.00%

The technical and technological challenge is a common theme among the literature and the interviews in relatively the same degree (Table 7-7. Technical and technological challenges). The electricity infrastructure in the Dominican Republic was installed in the 1930s by the then dictator and president of the country Leonidas Trujillo. Since then the grid has suffered from unintentional islanding, voltage fluctuations, losses in transmission and more. The technical losses in the electricity infrastructure are usually due to distribution losses due to the ageing grid, illegal connections to the grid, capped prices for electricity which leads to inadequate investment in upgrades for the system, as well as the grey-outs.

The literature highlights that of the 32% of distribution losses around 12% is from the inefficient interconnection lines from the generators to the substations to the consumers, and the ageing transmission lines and 20% is from non-payment of the consumers. This 32% deficit according to Konold's (2015) estimation cost the country around USD 100 million yearly in deficits. In 2014 alone, the non-technical losses of the non-payment and electricity theft cost 1.7% of the national GDP or USD 1 billion.

However, new literature from the yearly performance report of the CDEEE (2017) collected during the interviews, shows that the non-payment of the consumers is 2.99% of the total energy billed vs the energy that was collected as can be seen in Figure 7-3. Energy billed vs energy collected, and it has been that way for 2016-2017.

Corporación Dominicana de Empresas Eléctricas Estatales (CDEEE)

Dirección Gestión de Energía - Gerencia Control de Gestión

Indicadores de Desempeño

	Acumulado Año	
	2016	**2017**
energy billed (GWh)	**9,278.5**	**9,644.2**
Edenorte	2,900.7	3,036.2
Edesur	3,550.5	3,678.7
Edeeste	2,827.3	2,929.4
Energy bill collected (GWh)	**9,000.3**	**9,355.3**
Edenorte	2,886.5	2,984.4
Edesur	3,386.4	3,544.1
Edeeste	2,727.4	2,826.8

Figure 7-3. Energy billed vs energy collected

Source: CDEEE internal documents, 2018

It can be inferred then that the non-technical losses have been reduced from 20% to 2.33% in the span of three years. Indicating that the approach of the distributor of assigning the electricity based on the level of payment is working. However, the technical losses still exist and must be address.

- Technology: Regarding the technology, for renewable, the prices for solar and wind have dropped, due to the increase in installations worldwide and the advancement in research and development of these technologies. However, the cost of implementing tidal and the wave is still extremely high. (See chapter 2 for a more in-depth discussion)

7.7 Leadership for renewable energy

Per Golusin *et al.* (2013) explains that leadership sets the direction of something new, by building a vision and communicating the vision and passion behind it. In the renewable energy sector, the leadership must come not just from CEO's and directors but from all levels of government. In the Dominican Republic, 68% of the participants felt that the leadership is lacking due to: (1) the lack of planning (2) the conflict of interest (3) government instability (4) lack of support (5) Lack of trust and (6) the subsidies. (see Table 7-8. Leadership challenges for implementing renewable energy projects).

Table 7-8. Leadership challenges for implementing renewable energy projects

Challenges-Leadership for RE	**N=17 interviewees**	**Percentage**
Lack of planning	8	47.06%
Conflict of interest	5	29.41%
Government instability	4	23.53%
Lack of support	4	23.53%
Lack of trust	3	17.65%
Subsidies	1	5.88%

- Lack of Planning: The Climate Group (2018) highlights that one of the key characteristics of leadership is the ability to plan, whether for the future or for today. In the Dominican Republic 47.06% of the participants highlighted the lack of planning from the government, as EI5 said:

“Lack of planning of the infrastructure is the problem.”

The government does not have a clear path to achieve the goals that it has set. A strategic plan of implementation must be set in place for the successful transition to renewables.

- Conflict of interest: As Konol (2015) defines conflict of interest is the situation where an individual or organization is involved in multiple areas and focusing on one interest could work against another. In the Dominican Republic, this seems to be a theme as several of the generators are government and privately own. Also, 29.41% of the participants highlight the challenge that this represents in the country. EI5 expressed:

“The problem is that a lot of people have a private interest that goes against renewable energy. The Government agreements and interest with fossil fuel plants.”

- 23.53% of the participants express the challenge of government instability, due to the lack of continuity of the projects and plans, that one president and the party does, the next makes it their mission either to stop or to replace. The Dominican Republic needs a continues plan regardless of who occupies the seat of power in the country.
- Lack of Support, again 23.53% of the stakeholder expressed a lack of support from the public sector for renewables. As EI23 highlights:

“the lack of support from the Dominican state in providing guarantee through PPA’s and thus facilitating financing would allow many of the projects that have been stuck for a long time to go forward.”.

- Lack of trust: Due to many of the challenges already presented, as the instability, lack of support and conflict of interest, has created in the investing community a lack of trust in the government regarding renewable energy. As EI19 explains:

“*When the government were not on your side, you could not get a PPA, and without a PPA no financial institution would give you funds so you would have to get the funds yourself.”*

This lack of proper leadership creates a negative investment atmosphere for renewables that caps the investment interest and support.

7.8 Permit solicitation, acquisition and process

The process for acquiring the permits necessary for a renewable energy project in the Dominican Republic is convoluted as it is spread across a multitude of government agencies with some overlaps and contradicting mandates, and a how-to guide does not exist in the country. In this research, a possible implementation follows through guide has been created, as 60% of the participants express that this was one of the critical challenges. As EI14 explains:

“The bureaucracy is a challenge, the time of the permits, because of the impacts of the renewable energy it takes time. Permits are not hard but take time. The provisional concession that permits you to make the studies based on this you will get the permits from environment ministry and so on.”

And as EI20:

“when a person gets all the permits the financing has been used up or has evaporated due to the time it takes to get the permits; financing is very complicated, very few have the muscle to finance this type of projects.

And EI21:

"The first major problem that we faced was the permits since I worked in the first wind farm, and there was no background for the government no one knew what documents or where to get them, as the project evolved so did the permits and the process for them.

Since the previous challenges must be address by the government or financial entities the research can only provide recommendations (see Chapter 11 section 11.5). However, for the challenge of permit solicitation this research has created a guide for the obtention of the necessary paperwork for all the permits needed to develop a renewable energy project in the DR. The guide contains a step by steps of what entities need to be visited and in what order, the cost of the documents, the duration to obtain the document and additional requirements for obtention (See Annex C for the complete guide for a summarised and graphical guide see Figure 7-4. Guide of Permit Solicitation for a RE project in DR.

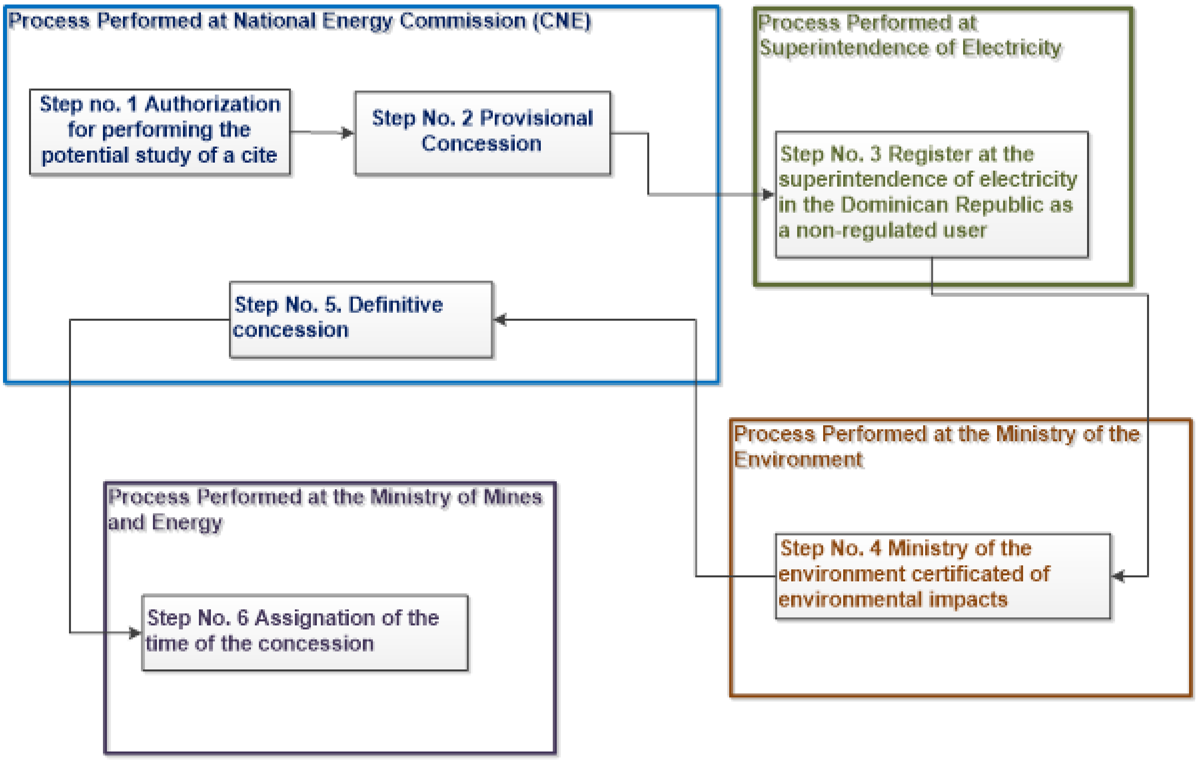


Figure 7-4. Guide of Permit Solicitation for a RE project in DR

This guide is a summary of the process to acquire the necessary documentation to begin construction of the renewable energy project in the Dominican Republic.

7.9 Lack of Renewable knowledge

The lack of renewable energy education in the Dominican Republic is a key challenge. As EI8 explains:

"Also the lack of knowledge in general and to specific areas that can be used for RE creates resistance to believe that RE can work"

The lack of awareness regarding the potential of the country in renewable energy makes the population vulnerable to supporting bad decisions. As EI11 explains:

“Knowledge is the main barrier, Dominicans need to see to believe, (explaining how people he talks to daily still disbelieve in RE). education basically, also the failed projects of other companies have a bad impact on RE.”

Also, EI5:

“we need to educate or orient the population of the benefit of RE, taking into account that we cannot build RE project without measure or consideration.”

Also, the few projects that do get implemented need to bring in exported workers as the local workforce is unprepared. However, this is changing as already two universities have implemented master in renewable energy implementation and efficiency. As EI21 highlights:

“We are preparing personal. So, we have graduates from masters in RE that we could not guarantee that they will get a job in RE.”

Also, the local government is educating the population on energy-saving techniques such as low voltage light bulbs. However, more needs to be done.

7.10 Land acquisition

Land acquisition in the Dominican Republic is the purchase of land with a specific purpose by the private or public sector. In contrast to other countries, this is not the appropriation of land by the government. However, the legal process of obtaining the land in the Dominican Republic is a complicated and inter-ministry process, as many steps need to be taken: (1) The land needs to be check to see if it is privately or publicly own (2) See if a land title has been issued, if not the title has to be issued before a purchase can be made (3) see if the land has no illegal settlers that will need to be relocated (4) Check that the proposed land is not an environmental protected area or water production area or an agriculture area. Once all of these have been checked then the land can be purchased.

This leads to side cost that increases the proposed cost of the project. The stakeholders interviewed for the study highlighted this issue. However, only 28% of the participants indicated that this was an issue.

7.11 ISM

The challenges of implementing renewable energy in the DR, has the particularity that the ones identified in the literature were in generalised manner while the interviewees provided challenges in a smaller scale. It can be inferred that the challenges from the literature encompass the ones from the interviews.

Due to this inclusion and because the focus of the study is the implementation of renewable energy projects, the micro scale of challenges provided by the interviews was used to analyse in ISM and provide a linkage between them along with a graphical understanding of the importance of the different challenges. To that end *Table 7-9. Coding for SSIM matrix for the challenges of implementing renewable energy projects* was created to code the information and be able to create *Table 7-10. SSIM matrix for the challenges of implementing renewable energy projects*.

Table 7-9. Coding for SSIM matrix for the challenges of implementing renewable energy projects

Coding	Challenges
F1	RE law implementation
F2	RE micro-macro Market
F3	Financing
F4	Technical and technological
F5	Leadership for RE
F6	Permit solicitation-acquisition-process
F7	RE knowledge
F8	Land Acquisition

Table 7-10. SSIM matrix for the challenges of implementing renewable energy projects

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	-	X	V	V	A	X	A	V
F2	-	-	X	X	A	A	A	V
F3	-	-	-	X	A	X	X	X
F4	-	-	-	-	X	O	A	O
F5	-	-	-	-	-	V	X	V
F6	-	-	-	-	-	-	A	V
F7	-	-	-	-	-	-	-	V
F8	-	-	-	-	-	-	-	-

Once the matrix with the relationship of the different parameters had been created Table 7-11. Reachability matrix for the challenges of implementing renewable energy projects was made by replacing the letters with the binary equivalent until Table 7-11. Reachability matrix for the challenges of implementing renewable energy projects was completed.

Table 7-11. Reachability matrix for the challenges of implementing renewable energy projects

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	1	1	1	0	1	0	1
F2	1	1	1	1	0	0	0	1
F3	0	1	1	1	0	1	1	1
F4	0	1	1	1	1	0	0	0
F5	1	1	1	1	1	1	1	1
F6	1	1	1	0	0	1	0	1
F7	1	1	1	1	1	1	1	1
F8	0	0	1	0	0	0	0	1

Table 7-12. Reachability matrix with transitivity checked

i/j	F1	F2	F3	F4	F5	F6	F7	F8
F1	1	1	1	1	0	1	0	1
F2	1	1	1	1	0	0	0	1
F3	0	1	1	1	0	1	1	1
F4	0	1	1	1	1	1*	0	1*
F5	1	1	1	1	1	1	1	1
F6	1	1	1	0	0	1	0	1
F7	1	1	1	1	1	1	1	1
F8	0	0	1	0	0	0	0	1

Note: 1* entries are included to incorporate transitivity

After transitivity of the matrix has been check the reachability matrix is transformed. In the case of the challenges for RE in the DR, the matrix is only slightly affected as can be seen in Table 7-12. Reachability matrix with transitivity checked.

The interpretation of the binary matrix is *Table 7-13. Level of partitions matrix for the challenges of implementing renewable energy projects*, that provides the different levels of importance of the challenges based on their relationship to each other.

Table 7-13. Level of partitions matrix for the challenges of implementing renewable energy projects

i/j	Reachability set	Antecedent sets	Intersection set	Level
F1	1,2,3,4,6,8	1,2,5,6,7	1,2,6	5
F2	1,2,3,4,8	1,2,3,4,5,6,7	1,2,3,4	2
F3	2,3,4,6,7,8	1,2,3,4,5,6,7,8	2,3,4,6,7,8	1
F4	2,3,4,5	1,2,3,4,5,7	2,3,4,5	4
F5	1,2,3,4,5,6,7,8	4,5,7	4,5,7	6
F6	1,2,3,6,8	1,3,5,6,7	1,3,6,	3
F7	1,2,3,4,5,6,7,8	3,5,7	3,5,7	6
F8	3,8	1,2,3,5,6,7,8	3,8	1

Once the relationship and importance (levels) is known then a graphical model was created Figure 7-5. ISM based model for the challenges of implementing renewable energy projects. Demonstrating that leadership and knowledge of RE is the core challenge and it can be inferred than once overcome the other challenges will follow.

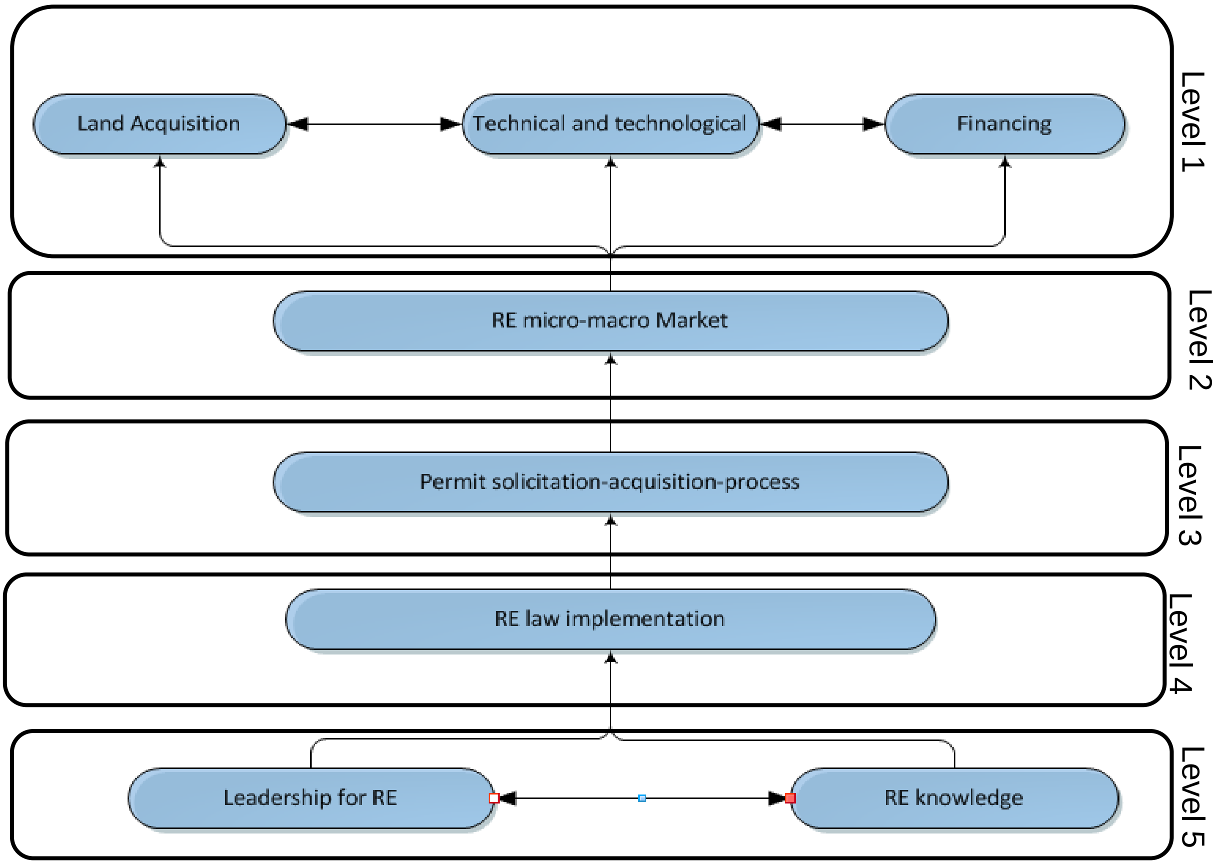


Figure 7-5. ISM based model for the challenges of implementing renewable energy projects

7.12 Summary

The dichotomy between the challenges identified by the literature and the interviews (see Table 7-13. Summary of the challenges of implementation of RE projects in the DR.) provided an insight into different scales of the challenges. The literature provides a macro view of the challenges in a generalised manner. While the interviews provided a micro scale or individual challenge.

Due to the focus of the research being on project implementation and the fact that the challenges from the literature encompass the ones from the interview, the content analysis was performed on the micro scale of challenges. The content analysis provided with a categorization from most important to least of the challenges based on the statically context in the interviews (see Table 7-13. Summary of the challenges of implementation of RE projects in the DR.). However, to confirm these findings and to provide a different perspective an ISM analysis was also performed and provided a new outlook of the challenges. This outlook identified the core challenges as: (1) Lack of leadership and (2) Lack of RE knowledge.

From Figure 7-5. ISM based model for the challenges of implementing renewable energy projects, it can be inferred that the core challenges create the environment for the rest of the challenges to developed. Therefore, once the main obstacles have been addressed in this case by the government/organization leadership and the educational programs in all levels then the other challenges will be address in a more comprehensive and rapid manner.

One challenge out of eight was address and a possible solution was presented in this chapter, the permit solicitation and acquisition process. As the other challenges are related to the government involvement, the research with the information gathered in the data collection created a guide for the permit solicitation with the necessary entities, duration, cost and requirements need for the acquisition of permits for the development of renewable energy projects.

Table 7-14. Summary of the challenges of implementation of RE projects in the DR.

Summary of the chapter	
Challenges from Literature	1. Regulatory Framework 2. Institutional and economic

	3. Technical and non-technical losses
Challenges from interviews	1. RE law implementation 2. RE micro-macro Market 3. Financing 4. Technical and technological 5. Leadership for RE 6. Permit solicitation-acquisition-process 7. RE knowledge 8. Land Acquisition

This chapter has addressed the fifth research question

"What challenges does the implementation of renewable energy projects faces in the Dominican Republic?"

Linked to the fifth research objective:

"To study and record the challenges of implementing renewable energy projects in the Dominican Republic."

And in doing so has open the path to understanding the critical success factors that will be discussed in the next chapter.

Chapter 8 . Critical Success Factors for implementing RE projects in the DR

8.1 Introduction

This chapter discussed the sixth research objective and question:

“To examine and detail the critical success factors of implementing renewable energy project in the Dominican Republic “

and

“What are the factors that could guarantee the successful implementation of renewable energy projects in the Dominican Republic.”

This chapter discusses the critical success factors that might aid in the implementation of renewable energy projects as successful development has been 4/200. The critical success factors were identified and analysed from the interviews, as the literature in the subject is very generic to the country and not specific to the projects themselves. The interviews highlight several areas, and themes were created for the content analysis and ISM analysis. In this case, the ISM analysis was performed to see the interconnection between all the critical success factors.

8.2 Critical Success Factors in the Dominican Republic

Behavioural changes, as well as an increase in renewable energy knowledge and investment, are the key to enhancing the adoption of more sustainable practices worldwide. However, this increase is detained by unsustainable practices, especially in the energy area. As many developing countries (Low-middle economy countries) are still locked in outdated and environmentally unfriendly energy method of fossil fuel for power generation.

Case in point of the Dominican Republic (DR), a country with high sustainable goals yet it has locked its energy sector on fossil fuel. Despite the fact, that the fossil fuel energy generates several critical issues to the nation: Fossil fuel imports are susceptible to unstable oil prices, and with around 85% of the energy in the country coming from Fossil fuel, this results in a high cost to the country of ±8% of the GDP, making the countries trade market unbalanced and contributing to the pollution and global climate change, which of the region the DR is the greatest CO_2 polluter.

In addition, the energy sector in the DR suffers from blackouts due to the inadequacy of fossil fuel power generating plants and the high cost of the tariff along with technical and non-technical issues that have plagued the country for years. The paradoxical matter is that the DR has a renewable energy potential to not only supply its energy demand but to aid in supplying energy to neighbouring countries.

The DR faces challenges related to three specific areas: Government, Private sector and the end user. Better coordination between the involved actors would result in a successful implementation of renewable energy strategies. For this coordination and implementation, is where Critical Success Factors (CSFs) should be used.

CSFs are an x-number of the main areas where an organisation, institution, department, project and so on, must achieve an efficient performance to realise its mission, vision and goals. CSFs can be derived from literature and organisational document review. However, Gandhi *et al*., (2015) defines CSFs as an information analysis to a project's (Organization, Institution and more) ability to exploit its strengths and weaknesses, therefore implying an interlinking of the CSFs and the current strengths and the current barriers of the project. Also, CSFs provide a vital instrument for measuring the performance goals of a project.

Also, CSFs can be obtained from the analysis of interviews with the principal management personnel about their specific position (business or project related) and the barriers encountered in reaching the goals and objectives of the specific project, department or organisation that the interviewers belong. It is a combination of these two methods that this research is based on.

CSFs indirectly affect the renewable energy strategies, as their effect is on the asserted goals of the project and as a way to enable the success of the project mission. CSFs will also aid in increasing the efficiency of the generation, transmission, and distribution of renewable energy (RE) in the power sector of the DR. This transformation to RE must be an essential priority in the country.

In this evolving environment characterised by increasing electricity demand, the pipeline of new power generation projects is key for the sustainability of not just the country but of the world. The foremost objective of the research is to find and fill potential gaps in the existing research that might result in conclusions that will formulate an efficient CSFs and ultimately a Framework for the successful implementation of Renewables.

This chapter provides a landscape of main energy resources in the Dominican Republic. Section three is focussed on the methodology. While section two presents the description of the case study of the DR with its sustainable goals and renewable energy potential. Furthermore, section four focuses on CSFs in a general manner and the un-unique and unique CSFs of the DR. Finally section five contains the conclusions that have been reached after the analysis.

8.3 ISM analysis

The critical success factors are a unique addition of the interviews. This is the result of the lack of documented studies in the Dominican Republic. Since no project information, other than the basic, is available the critical success factors had to be identified from the participants. However, the ISM was conducted to confirm the importance and the relationship between the results. To that end Table 8-1. Coding for SSIM matrix for critical success factors of implementing renewable energy projects was made to code the information and be able to build Table 8-2. SSIM matrix for critical success factors of implementing renewable energy projects based on the relationship or lack of there between the factors.

Table 8-1. Coding for SSIM matrix for critical success factors of implementing renewable energy projects

Coding	Critical Success Factors
F1	Access to the Grid
F2	Implementation of the legal framework for RE
F3	Coordination and communication
F4	Financial tools for RE projects
F5	Knowledge Creation and Exploitation
F6	Transparency

Table 8-2. SSIM matrix for critical success factors of implementing renewable energy projects

i/j	F1	F2	F3	F4	F5	F6
F1	-	A	A	X	V	A
F2	-	-	X	X	X	X
F3	-	-	-	V	X	V
F4	-	-	-	-	X	A
F5	-	-	-	-	-	A
F6	-	-	-	-	-	-

Table 8-2. SSIM matrix for critical success factors of implementing renewable energy projects allolws for the binary relationship to be built in Table 8-3. Reachability matrix for critical success factors of implementing renewable energy projects and interpret in Table 8-4. Level of partitions matrix for critical success factors of implementing renewable energy projects.

Table 8-3. Reachability matrix for critical success factors of implementing renewable energy projects

i/j	F1	F2	F3	F4	F5	F6
F1	1	0	0	1	1	0
F2	1	1	1	1	1	1
F3	1	1	1	1	1	1
F4	1	1	0	1	1	0
F5	0	1	1	1	1	0
F6	1	1	0	1	1	1

The final reachability matrix (see Table 8-3. Reachability matrix for critical success factors of implementing renewable energy projects) was computed by incorporating the transitivity. Transitivity means the contextual relation in which if variable A is related to B and B is related to C, then A will be necessarily related to C. The transitivity measurement was computed by conducting a power iteration analysis.

Since there was no transitivity effect in the context of this research, transitivity entry does not exist in matrix.

This interpretation of the binary matrix allows the creation of the graphical model in Figure 8-1. ISM based model for critical success factors of implementing renewable energy projects. From the model and interpretation it can be surmise that transperancy in the process of implementation is the key critical success factor.

Table 8-4. Level of partitions matrix for critical success factors of implementing renewable energy projects

Coding	Reachability set	Antecedent sets	Intersection set	Level
F1	1,4,5	1,2,3,4,6	1,4	2
F2	1,2,3,4,5,6	2,3,4,5,6	2,3,4,5,6	3
F3	1,2,3,4,5,6	2,3,5	2,3,5	4
F4	1,2,4,5	1,2,3,4,5,6	1,2,4,5	1
F5	2,3,4,5	1,2,3,4,5,6	2,3,4,5	1
F6	1,2,4,5,6	2,3,6	2,6	3

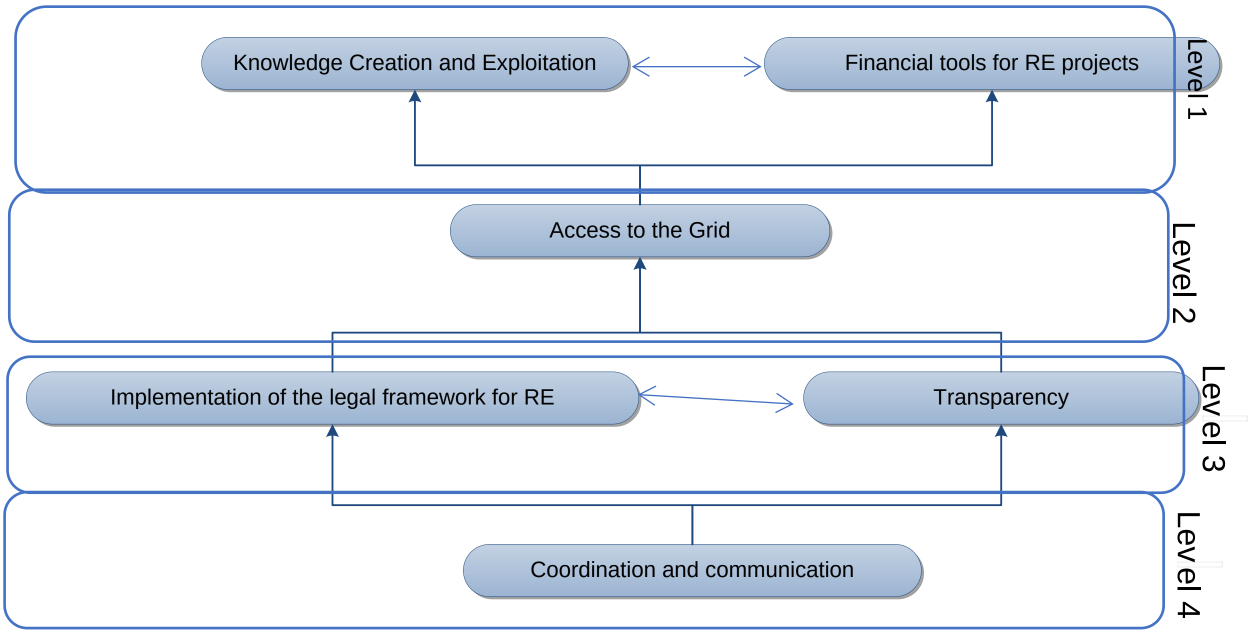


Figure 8-1. ISM based model for critical success factors of implementing renewable energy projects

8.4 Discussion of critical success factors for the implementation of renewable energy projects in the DR.

As stated CSFs are a limited and defined a number of fields that, if implemented correctly, will ensure successful completion of the goals and mission of the organisation or project (Gandhi*, et al.*, 2015). Many researchers (Luthra, Garg and Haleem, 2015; Scoones, Leach and Newell, 2015 and Luthra, Garg and Haleem, 2016) defined these factors as key subjects where measures and tasks must be correctly implemented to ensure favourable results, this area is essential if the goals of the project are to be achieved. These particular areas must receive continuous and meticulous attention.

Luthra, Garga and Haleem (2016) focused the research at the renewable industry level and proposed that CSFs be common across the organisations within the energy sector. This CSFs are non-unique at an industry-level, this means that these particular factors are relevant for any company in the renewable energy project. However, Gandhi et al., (2015) explains that CSFs might differ from project to project depending on the hierarchy of the CSFs. This would re-established concepts from 1979 of CSFs and would reintroduce the notions of managerial-level CSFs and organizationally unique CSFs.

A thorough discussion of several researchers (Gandhi, *et al.*, 2015 and Luthra, Garg and Haleem, 2016)the tiered nature of CSFs, can be divided into four specific levels: industry, organisational, department, and individual. Now, this classification is based on the industry or environment analysed. Ahlborg and Hammar (2014) restore five different levels of CSFs based on the different departments or roles in a project and how each contributes to achieving the mission of the project: (a)the structure of the specific project (industry/project CSFs) (b) competitive approach, project importance, and physical location (strategy/approach CSFs) (c) the current social-political-economical-technological-climate change environment (environmental CSFs) (d) challenges/barriers to implementing the project (temporal CSFs) leadership and knowledge management (management CSFs).

A renewable project CSFs may contain any or all of these types. Analysing and understanding the different types of CSF helps the projects professional recognise whether the CSFs are common or unique and how they may continue or evolve. no organisation can manage to create and implement a strategy that does not provide acceptable care to the primary factors which are the cause of success in the project.

As Ahlborg and Hammar (2014) described the CSFs for implementing renewable technologies, however, the focus of the research, in this case, was on simply implementing the technology and did not take into account the challenges and drivers needed for the whole project. In this chapter, the focus has been on the entire project and its key actors in the DR specifically, as this country is usually used as a testing ground for companies, since it is one of the largest and fastest growing economies, investors and organizations will usually set the base of operations in the country or do a trial and error of the projects in country. The thought behind this is that if it works in the DR, it will work for the rest of the region. In this way, the DR becomes a mirror of the area.

In the case of the DR, after conducting the interview's and analysing the data, the key CSFs were determined as can be seen in Table 8-5. Critical success factors for implementing renewable energy projects.

Table 8-5. Critical success factors for implementing renewable energy projects

CSFs	Percentage of interviewees Cited (N=25)	Possible Measures
Creation of financial tools for renewable energy projects	84%	Reports on: RE loans, Incentives, Cooperatives, Interest rates
Coordination between the different stakeholders	80%	Knowledge management reports and logs
Knowledge creation and exploitation related to RE business	75%	RE education and training, RE higher education curriculum
Implementation of the Legal Framework	72%	The implementation committee, Surveys, incentives tracker, the disclosure of incentives reports
Update and provide access to the grid	64%	Reports on the rate of change of energy line connections and private connection forms
Transparency in the legal and financial tools available	60%	Reports and logs of open source publications of documentation, public auctions of agreements

8.5 Summary

This chapter addresses the research objective and question:

"To examine and detail the critical success factors of implementing renewable energy project in the Dominican Republic "

and

"What are the factors that could guarantee the successful implementation of renewable energy projects in the Dominican Republic."

The chapter provided an in-depth view of the key factors for success for renewable energy projects in the Dominican Republic. Due the lack of documentation regarding the few projects that have been implemented in the Dominican Republic, the CSF were identified from the interviews of the key stakeholders. These CSF's identified through content analysis of the interviews and provided from most important to least important the following items: (1) Creation of financial tools for renewable energy projects, (2) Coordination between the different stakeholders, (3) Knowledge creation and exploitation related to RE business, (4) Implementation of the legal Framework, (5) Update and provide access to the grid and (6) Transparency in the legal and financial tools available. To validate the results from the content analysis an ISM analysis was performed with illuminating results.

The ISM provided an interconnectivity of the CSF's based on the transparency of the process of implementation. Establishing that the most important CSF's is the transparency in which the implementation of the project is performed. This provides an understanding into the next logical step which is to view the benefits that the successful implementation can provide for the organization and country, and this will be the focus of the next chapter.

Chapter 9 . Benefits for implementing RE projects in the DR

9.1 Introduction

This chapter highlights the benefits of implementing renewable energy projects in the Dominican Republic. By doing so, the seventh research objective is to address:

"To investigate and document the benefits of implementing renewable energy projects in the Dominican Republic."

Along with the seventh research question:

"What are the possible benefits that the Dominican Republic could achieve by implementing renewable energy projects?"

This chapter is divided into two parts: (1) the generalised benefits from both the literature and the interviews (see Table 9-1. Benefits of implementing renewable energy projects) and (2) the individual break-down of each benefit. This categorization aids in the understanding of each benefit and how it affects the participants, organizations and the Dominican Republic in general.

9.2 Benefits

The Cambridge dictionary (2018) defines benefits as:

"a helpful or good effect, or something intended to help."

and that is what a benefit is, a product or services that have a good effect either on an individual a group or entity. In this research, the benefits were first identified in the literature review. However, the themes identified were too generalised and ambiguous (see Table 9-1. Benefits of implementing renewable energy projects). The problem with ambiguity is that it does not provide a tangible benefit for the people to understand; it becomes an abstract concept that is understandably good but unquantifiable.

For example, socio-economic benefits, understandably the literature is describing the financial advancement that the country can achieve through renewable energy, and the literature is quick to speak in volumes of the financial gain. However, the term socio-economic means more than just financial revenue, yet in the literature, it is used as a synonym of financial returns, and the social aspect of the benefit is all but forgotten.

Table 9-1. Benefits of implementing renewable energy projects shows the comparison of the benefits found in literature and the ones that the interviews uncovered. It is obvious that the benefits are in different scale: (1) the benefits from the literature are more in a macro scale while the (2) benefits from the interviews are more in a micro scale.

Table 9-1. Benefits of implementing renewable energy projects

No.	**Benefits from literature**	**%**	**No.**	**Benefits from the interviews**	**No.25**	**%**
1	**Socio-economic**	100%	1	Energy independency	22	88.0%
2	**Renewable goal achievement**	90.9%	2	Environmental and Public health	21	84.0%
3	**Environmental**	72.72%	3	Economic Returns	10	40.0%
4	**Energy security**	45.45%	4	Job Creation	8	32.0%
			5	Social and tourist	6	24.0%

9.2.1 Energy independence VS Energy Security

This is a controversial benefit, since the literature calls it energy security, and places it as the last benefit with a 45.45% mention, while the interviews refer to this benefit as energy independence, making it the most important benefit by 88% of participants. These terms are not interchangeable. Energy security is defined by the International Energy Agency (2016) as an energy source that is continuously available at an affordable price. This definition does not specify if fossil fuel or renewable, if it is constant and at a good price the nation will have energy security.

This will impact the economy and social sector in an assumed good way. However, for the Dominican Republic and the energy crisis that the nation faces, this security cannot come from fossil fuel. The country does not possess fossil fuel reserves or coal, however, as Chapter 2 explains, 85% of the energy is based on non-renewable fuel and in the last 10 years, has led to an increase of the national external debt.

The country has implemented plans for a continuous energy stream, by activating a plan called “24 hours of light program” in many sectors, this is based on the level of payment done by the sector. The levels have been divided into four categories based on the cost recovery index (CRI):

- **Category A with a CRI ≥90%:** This category is applied to communities that are connected to the same circuit and that at least 90% of the residents of the area pay their electricity bill. These areas which have a category A are introduced into the 24/7 electricity program. This program in theory is to provide continues energy to the sector, however, this is not always the case, and even these sectors suffer from grey-outs or blackouts due to the ageing and uncapable grid.

- Category B 65-90% CRI: This category is applied to communities with 65-90% of the resident of the area or circuit pay their bill. Since the range is high, in theory the grey-outs programmed for this sector are short and should not last more than 2-4 hours. However, many sectors report more than 4 hours of grey-outs.
- Category C 52-65 CRI: This category is applied to communities that are connected to the same circuit and that 52-65% of the residents pay their bill. As a result of the medium range of payments the CDEEE programs longer periods of grey-outs or longer grey-outs. These areas can have 6-8 hours of grey-outs of 3-4 periods of 2 hours of grey-outs during the day and night.
- Category D≤ 52% of CRI: the last category is for circuits with a low paying range, bellow 52%. This circuits receive electricity in short ranges of 2-3 hours per day and 2-4 hours per night. Making this a target population for the non-payment and a group that the corporation and government should focus on to change or to improve.

However, this program also selects the sector that will suffer the greatest grey-outs, as the page for CDEEE, the national distribution agency shows the name of the sector and the hours of light and by consequence the hours that the community will be without electricity. In addition, as explained in chapter 2 the distribution losses of the Dominican Republic are mostly blamed on the level of payment of the different sectors, but as Figure 9-1 Energy charged, and energy paid by consumers in 2016-2017 in The DR. show that in 2016 and 2017 the difference 278.2GWH and 288.9GWh 2.99% of the total energy that was charged to consumers was not paid.

This does not correspond to the 32% distribution losses that the literature claims the country has in great part by the non-payment of consumers. And does not justify the grey-outs or blackouts the country faces.

Corporación Dominicana de Empresas Eléctricas Estatales (CDEEE)

Dirección Gestión de Energía - Gerencia Control de Gestión

Indicadores de Desempeño

	Cumulative year	
	2016	2017
energy billed (GWh)	**9,278.5**	**9,644.2**
Edenorte	2,900.7	3,036.2
Edesur	3,550.5	3,678.7
Edeeste	2,827.3	2,929.4
energy paid by consumers (GWh)	**9,000.3**	**9,355.3**
Edenorte	2,886.5	2,984.4
Edesur	3,386.4	3,544.1
Edeeste	2,727.4	2,826.8

Figure 9-1 Energy charged, and energy paid by consumers in 2016-2017 in The DR.

Source: CDEEE. 2018.

This further proves that energy security cannot be reliant on fossil fuel. But can it rely on renewables, as Chapter 2 explains the Dominican Republic has abundant renewable energy sources and potential, but it lacks the trust and experience in renewables by the public sector to be considered a viable option. Even though , renewables could represent a trillion dollar return investment (Konold, 2015) for the country, aid in lowering the national debt, among other benefits that will be discussed further in this chapter.

In terms of energy independence, this is defined by Abraham and Mills, (2013) as the constant supply of secondary energy by local energy source of the region or nation. As EI8 express:

“End the dependency and the law and government created the CNE to be the promoters of the RE in the country.”

And further highlights

“the independence from the fossil fuel and we stop being affected by the international oil prices.”

Two mechanisms exists to achieve energy independence: (1) the nation will import the bare minimum of non-national energy resources either from primary or secondary sources and will generate the rest or (2) Import what’s needed from a low risk, low-cost reliable supply chain. As the mechanism shown is not the complete cut off from the international supply chain, as the interviews would like to believe, but either a reduction or a better supply chain. In the Dominican Republic, the second mechanism has been implemented with the PETROCARIBE deal, however, due to civil unrest in Venezuela the deal has been at a standstill, and the Dominican Republic has had to rely on other suppliers. As EI15 expressed:

“The most important benefit is the non-dependency of fossil fuel or other countries because of the geopolitical issues in the region.”

However, is energy independence a possibility for the Dominican Republic. The energy dependency that the country possesses is an indicator of energy vulnerability and instability in the energy sector as well as a sub-indicators of globalisation index, as the infrastructure is based on trade regulations and can be affected by the geopolitical issues. Energy independence seems like the answer to this issue.

9.2.2 Environmental and Public health

This benefit was on both the literature and the interviews. However, the importance which the literature and interviews give to this benefit is very similar. The literature 72.72% and 84% from interviews. The environmental benefits of renewable energy are well documented:

- Lowering global warming: this is due to the near-zero emissions of renewables. In the Dominican Republic, is one of the top three emitters of the Caribbean region with a 24.4 $MtCO_2e$ (USAID, 2017) CO2 emission, of which 77% are from the electricity sector alone. The implementation of renewable energy could exponentially decrease the emission from the country. (see Table 9-2. Comparison of CO2 emissions of renewable and fossil fuel)

Table 9-2. Comparison of CO2 emissions of renewable and fossil fuel

(source Bonini and Swartz, 2014; International Renewable Energy Agency, 2016)

Fossil fuel	Renewable
natural gas emits between 0.6 and 2 pounds of carbon dioxide equivalent per kilowatt-hour	Wind emits 0.02-0.04 pound of carbon dioxide equivalent per kilowatt-hour on a life cycle
coal emits between 1.4 and 3.6 pounds of carbon dioxide equivalent per kilowatt-hour	Solar 0.07-0.2 pounds of carbon dioxide equivalent per kilowatt-hour for a life cycle
	Geothermal emits 0.1-0.2 pounds of carbon dioxide equivalent per kilowatt-hour
	Hydroelectric 0.1-0.5 pounds of carbon dioxide equivalent per kilowatt-hour

The lowering of emissions aids, not just the country but the region that has been greatly affected by climate change and GHG.

The interviewees agree with EI8: *"we also are very happy to reduce the carbon footprint and educate a client into RE so that they invest and promote RE."*

- Improved public health

The International Renewable Energy Agency (2016) estimated that around $74.6 billion USD are used for the public health effects of fossil fuel, especially coal and natural gas. This is because fossil fuels, contaminate the air and water, and the damages were done to nature and the population are vast. Pollution from fossil fuel has been linked to but not limited to: (1) heart attacks, (2) breathing problems such as asthma, lung and throat cancer, neurological damages, death and many more serious problems. As EI14 explain:

"pollution of the city, as I take out technology that is polluting, I reduce respiratory issues in the population."

Renewable energy does not pose these issues as they do not produce these contaminants. Biomass could produce some water contamination due to the resource being used to cool down the biomass reactor. However, emissions are minimum compared to fossil fuel.

9.2.3 Economic Returns

Renewable energy is a trillion-dollar economic return industry worldwide. An according to the literature the most important benefit in 100% of the cases, however, the literature refers to this as a socio-economic benefit, it mentions economic returns as more of a driver in a 63.63%. Ochs (2011), Konold (2015) and the International Renewable Energy Agency (2016) all agree that the minimum returns that the Dominican Republic could see by implementing renewable energy in a 25-30% capacity in the energy matrix is annual savings of USD 1 billion in the electricity sector alone, USD 0.9-3.5 billion per year from CO2 emission reduction and population welfare.

This is a possible total of USD 2.1-5.3 billion per year for the country's economy. This could possibly stabilise the sector, and the revenue at a national level could improve the other sectors of the country. The interviews agreed in a 40%, the private sector has seen the potential and as EI11 explain:

"Financially speaking it is good business; it is very rentable." And explain further *"Financially is a good investment, the country gets taxes from my projects."*

The interviewees see the profit in micro and on a macro scale.

9.2.4 Job Creation

Job creation is a benefit identified by interviews in 32% while 18.18% of the literature places this a socio-economic benefit. Renewable energy is a more labour-intensive industry, as for example, solar panels need a workforce to be installed, and wind farms maintenance is done by technicians. The fossil fuel industry is very automated (Abolhosseini and Heshmati, 2014). Ochs (2011) and Konold (2015) both estimated that around 12,500 new jobs could be created with the implementation of renewable at 30 % in the Dominican Republic. This is not taken into consideration the ripple effect that renewable energy projects have on the local economy of the town, region and nation where they are constructed. As EI15 highlights:

“Renewable energy creates new jobs and jobs of high calibre along with the creation of technical careers.”

Or as EI14:

“RE is the future, first are the new job sources… Creates jobs for the population and diversification of the jobs maybe even personal challenges in this area of engineering.”

This job creation affects the economic sector of the nation, but it also affects the quality of life of the population by improving the job market and the happiness index of the population.

9.2.5 Social and tourist

This is a benefit that according to research may be unique to the Dominican Republic. This benefit was only found in the interviews, and only 24% of the participants mention this benefit, of social and tourism. As Bidwell (2013) in most countries the population is against the installation of renewable energy, especially wind as the impact on the natural view is affected. The opposite happens in the Dominican Republic, the population is intrigued and likes the look of renewable, especially wind, as EI2 explains:

"Even from a tourist point of view, the renewable energy parks, especially wind have because a tourist attraction so big that a viewing area had to be constructed for people to take pictures and tours schedule."

The renewable energy parks in the Dominican Republic have become such an internal tourist attraction that the ministry of tourism has included pictures of the wind farm in several of the marketing campaigns. (see Figure 9-2. Marketing campaign including wind farms and Figure 9-3. wind energy farm in the Dominican Republic)

Figure 9-2. Marketing campaign including wind farms

Figure 9-3. wind energy farm in the Dominican Republic

If implemented correctly this attractiveness of the renewable energy for tourism could represent another large income for the country's economy.

9.2.6 ISM analysis and modelling

The benefits of implementation of renewable energy projects in the DR are found in the literature in a generalised and ambiguous manner, as the few documents englobe almost all benefits in the category of socio-economic. On the contraire the interviews provide more variety regarding the benefits of implementation. For this reason, the benefits from the interviews were coded in Table 9-3. Coding of SSIM matrix for benefits of implementing renewable energy projects. This coding was used in the creation of Table 9-4. SSIM matrix for benefits of implementing renewable energy projects.

Table 9-3. Coding of SSIM matrix for benefits of implementing renewable energy projects

Coding	Benefits
F1	Energy independence
F2	Environmental and Public health
F3	Economic Returns
F4	Job Creation
F5	Social and tourist

Table 9-4. SSIM matrix for benefits of implementing renewable energy projects

i/j	F1	F2	F3	F4	F5
F1	-	O	X	V	O
F2	-	-	X	V	V
F3	-	-	-	X	X
F4	-	-	-	-	x
F5	-	-	-	-	-

This relationship matrix is the foundation of the Table 9-5. Reachability matrix for benefits of implementing renewable energy projects.

Table 9-5. Reachability matrix for benefits of implementing renewable energy projects

i/j	F1	F2	F3	F4	F5
F1	1	0	1	1	0
F2	0	1	1	1	1
F3	1	1	1	1	1
F4	0	0	1	1	1
F5	0	0	1	1	1

Table 9-6. Reachability Matrix with transitivity checked

i/j	F1	F2	F3	F4	F5
F1	1	1*	1	1	1*
F2	0	1	1	1	1
F3	1	1	1	1	1
F4	0	0	1	1	1
F5	0	0	1	1	1

Note: 1* entries are included to incorporate transitivity

After transitivity of the matrix has been check the reachability matrix is transformed. In the case of the challenges for RE in the DR, the matrix is only slightly affected as can be seen in Table 9-6. Reachability Matrix with transitivity checked

This binary matrix demonstrates the relationship in an understandable manner as to facilitate the interpretation of the data into Table 9-7. Level of partitions matrix for benefits of implementing renewable energy projects.

Table 9-7. Level of partitions matrix for benefits of implementing renewable energy projects

i/j	Reachability set	Antecedent sets	Intersection set	Level
F1	1,2,3,4,5	1,2	1,2	3
F2	2,3,4,5	1,2,3	2,3	2
F3	1,2,3,4,5	1,2,3,4,5	1,2,3,4,5	1
F4	3,4,5	1,2,3,4,5	3,4,5	1
F5	3,4,5	1,2,3,4,5	3,4,5	1

The interpretation of the relationship provided the needed levels to create Figure 9-4. ISM based model for the benefits of implementing renewable energy projects. The model demonstrated that the crucial benefits of implementation are: environmental and public health and energy independence. These two benefits provide evidence that the change towards a renewable energy sector would create further benefits that would impact the different pillars that support a nation.

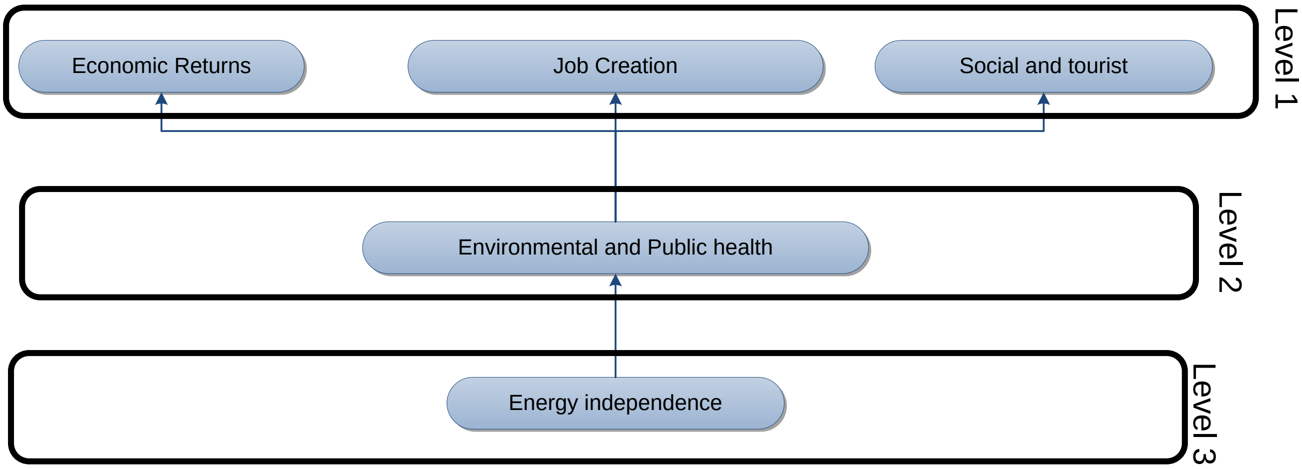


Figure 9-4. ISM based model for the benefits of implementing renewable energy projects

9.3 Summary

This chapter's aim was to answer the seventh research objective:

"To investigate and document the benefits of implementing renewable energy projects in the Dominican Republic."

Along with the seventh research question:

"What are the possible benefits that the Dominican Republic could achieve by implementing renewable energy projects?"

And it does that by discussing the benefits identified from the limited literature and the content analysis of the 25 interviews of the key stakeholders in the renewable energy sector in the Dominican Republic. The contrast between the benefits from the literature and the interviews is mismatch as the literature like with the challenges views the benefits in a global or generalize manner. While the interviewees provided a more individual understanding of the benefits.

For this research, as the focus is on project implementation and since the benefits from the literature encompass the ones from the interviews, the smaller scale was chosen for the ISM analysis. The ISM was performed to validate the results from the content analysis. The analysis grouped the benefits in two levels and energy independence and environmental and public health resulted in the most important benefits. These results, match with the content analysis and it can be concluded that the rest of the benefits are a result of the impact of the core benefits identified by the ISM analysis (Table 9-7. Summary of challenges for implementing renewable energy projects in the DR).

Table 9-8. Summary of challenges for implementing renewable energy projects in the DR

No.	**Benefits from literature**	**No.**	**Benefits from the interviews**	**No.**	**Benefits from ISM**
1	Socio-economic	1	Energy independency	1	• Energy Independence • and environmental and public health
2	Renewable goal achievement	2	Environmental and Public health	2	• Economic returns, • Job creations • and social and tourist
3	Environmental	3	Economic Returns		
4	Energy security	4	Job Creation		
		5	Social and tourist		

The chapter highlights the possible benefits that the Dominican Republic can achieve by the implementation of renewable energy. The benefits quite outweigh the challenges and would aid the country in its development and population happiness.

The next chapter will explain how the research proposes the projects be implemented in the Dominican Republic for a successful initiative.

Chapter 10 . Framework for the implementation of RE in the DR

10.1 Introduction

In this research to achieve the proposed aim and objectives, explain in chapter 1, a qualitative approach was implemented, and a wide range of data sources was analysed due to the exploratory nature of the research. The research process was divided into two main stages: Literature review and stakeholders' interviews. The research and theoretical framework were established to guide and control the review of the literature and the interviews.

The Literature review was divided into 3 steps, (1) the general information regarding renewable energy in developing countries (2) the general status of the DR energy system and (3) the specific parameters and qualities of RE in DR. An analysis and summary of the information gained was carried out progressively at all stages of the research. The interviews were divided into the private or public sector. The source of the primary and secondary data is addressed in chapter 2. Along with a more detailed discussion of the research process and methodology are included in chapter 3.

The conceptual framework of the research includes the political, economic, social and technological environment of RE in the DR the different components of the framework helped to identify the propositions to be tested and guided the analysis and geared the research to answer the research questions.

10.2 Research Aim and Objectives

The aim of this research was to develop a strategic framework for renewable energy infrastructure implementation as a possible solution for the energy challenges that the Dominican Republic faces and to improve the development and quality of life of its citizens. The framework is the final product of this research as it was detailed at the beginning of the research and it was the core driver of the research as its better detailed in the methodology chapter. Each component of the research is linked to an objective, as can be seen in greater detail below in sub-headings 10.3.

10.3 Conceptual Framework

The research question is answered in the form of a conceptual framework which paths a course for the achievement of sustainable energy provision to the Dominican Republic. The important issue underpinning this conceptual framework is to stress the importance of energy efficiency and renewable energy in the plan towards the provision of improved electricity supply in the Dominican Republic.

10.3.1 Graphical Framework

Figure 10-1. Kotter's eight step process

The Proposed framework (Figure 10-2. Framework) was created based on the findings from the literature review and the analysis of the interviews conducted to critical stakeholders of the energy sector in the Dominican Republic. The framework is composed of 5 levels, that will be explained in detailed below. The foundation of the framework is systematic, based on Kotter’s 8 steps process for leading change (see Figure 10-1.), as inputs create pressure on the organization inducing a change, it is important to differentiate between change and transformation. Transformation is a comparison of the past to the present and describing the differences between the two. While change is proposing a future and adapting the present to the proposed future.

The outcomes of the implementation of the inducers of change are the creation of value whether social, economic or environmental; all levels are tied together throw a feedback loop that will maintain the framework from becoming obsolete and aid in knowledge management of the existing and future energy projects in the Dominican Republic.

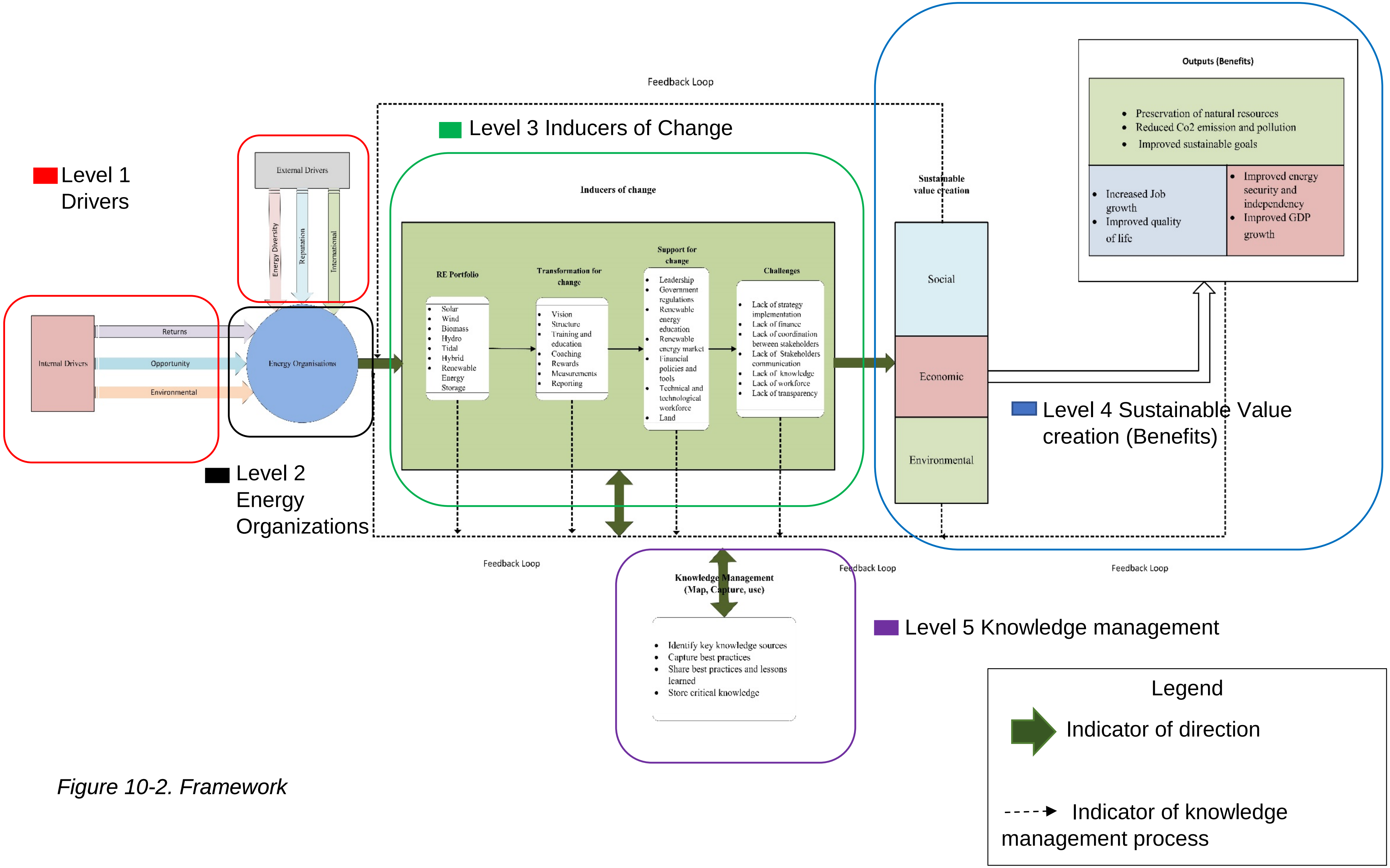


Figure 10-2. Framework

10.3.1.1 *Level 1*

Level one or the inputs of the framework (Figure 10-2. Framework) represent the drivers that provide the pressure for change to the organizations or level 2. This level is divided into internal and external drivers (Figure 10-3. Framework for implementing renewable energy projects in the Dominican Republic level 1), as the motivation for change can be created and promoted from the inside of an organization and as well as from external influences.

Both internal and external factors are driving the running business. According to Lozano (2015) the external drivers are the driving forces outside of the entities development, and the internal drivers are the permanent driving forces inside an organization or nation that guide the development and vision of the entity. In this framework the internal drivers are:

- Business Opportunities: Zalewska-kurek (2014) and Shrestha (2015) both highlight that organizations to remain relevant in their field must periodically evaluate business opportunities in their markets or new markets. This is an ability that is based on opportunity recognition analysis plan. (see Chapter 5 for a more in-depth review)
- Finance Returns: Financial returns or revenue is the core objective of a business as it allows for a grow in wealth and use that wealth for the economic needs of the company (O'Connor, Lewis and Dalton, 2013). (a more in-depth review see chapter 6)

- Environmental conscience and funds: As explained in chapter 5, this aspect went from being a marginal though of business to a core and critical aspect of any entity, especially the environmental conscience aided by the national and international funds available for renewable investment.

All three internal drivers maintain the business in a competitive and high-speed changing world. Internal driving forces, which are the things, situations or events that are occurred inside the business and these generally under control of the company.

Energy Level 1

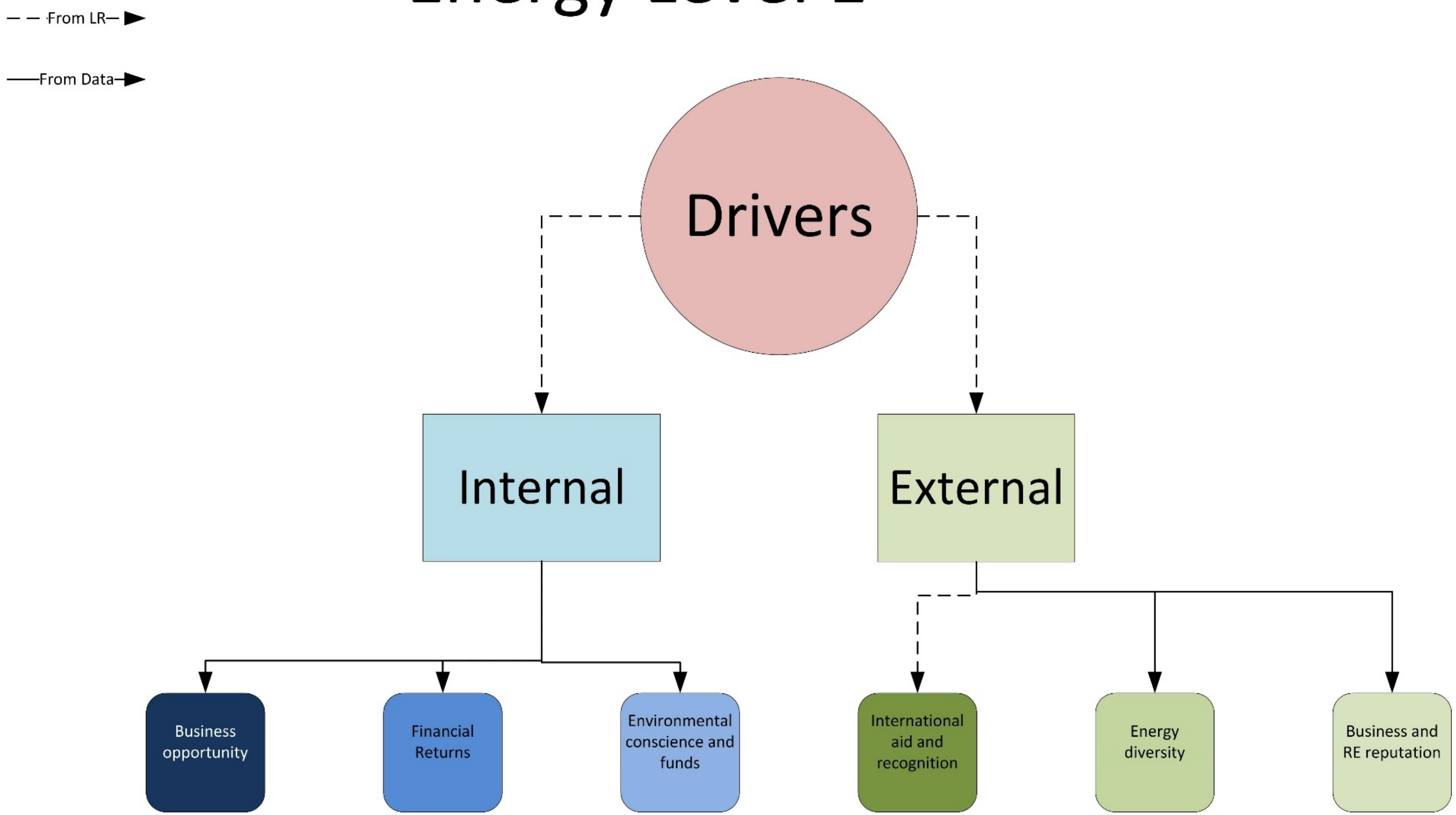


Figure 10-3. Framework for implementing renewable energy projects in the Dominican Republic level 1

The external drivers are:

- International aid and recognition: The international awareness regarding climate change, sustainability and renewable energy, has created a driving force on a global level as the responsibility to ensure a future fall on all. Due to this many nations and institutions have created initiatives and loans, to aid the nations that are not financially stable to complete the sustainable and renewable change by themselves. (See chapter 5)
- Energy Diversity: Energy diversity as Lo (2011) highlights is a key indicator of energy independence, as by implementing a variety of balance energy sources the energy sector is not completely bound to the fluctuations of the fossil fuel availability and prices. (See Chapter 5)
- Business and renewable energy Reputation: Business reputation is an important part of the performance of an organization as it can influence the perception of a business. This perception can be positive or negative and have repercussion on the revenue stream of the company. (see Chapter 5)

10.3.1.2 *Level 2*

Level 2 of the framework deals with the energy entities or organizations that the research is based on (Figure 10-2. Framework). These organizations can be from the private or public energy sector and as such covers the auto-generation (individual generation by customers) of energy and the energy provider (Figure 10-4. Framework for implementing renewable energy projects in the Dominican Republic level 2).

- Public auto-generation
    a. Individual households auto-generation: Due to the degree of grey-outs, the population has increasingly invested into in-house generation.
    b. Governmental institutions: Many government facilities are in sectors that have a so call 24/7 electric grid connection. However, many of these building also have auxiliary power allocated from different alternative sources of energy, housed in the building.
- Private auto-generation

Individual business auto-generation (individual generation by customers): Due to the cost and number of grey-outs, many businesses from manufacturing to services goods, have taken the decision of implementing auto-generation for their everyday operation. Many of the manufacturing organizations have been using biomass as it's not only a source of energy but a waste management mechanism.

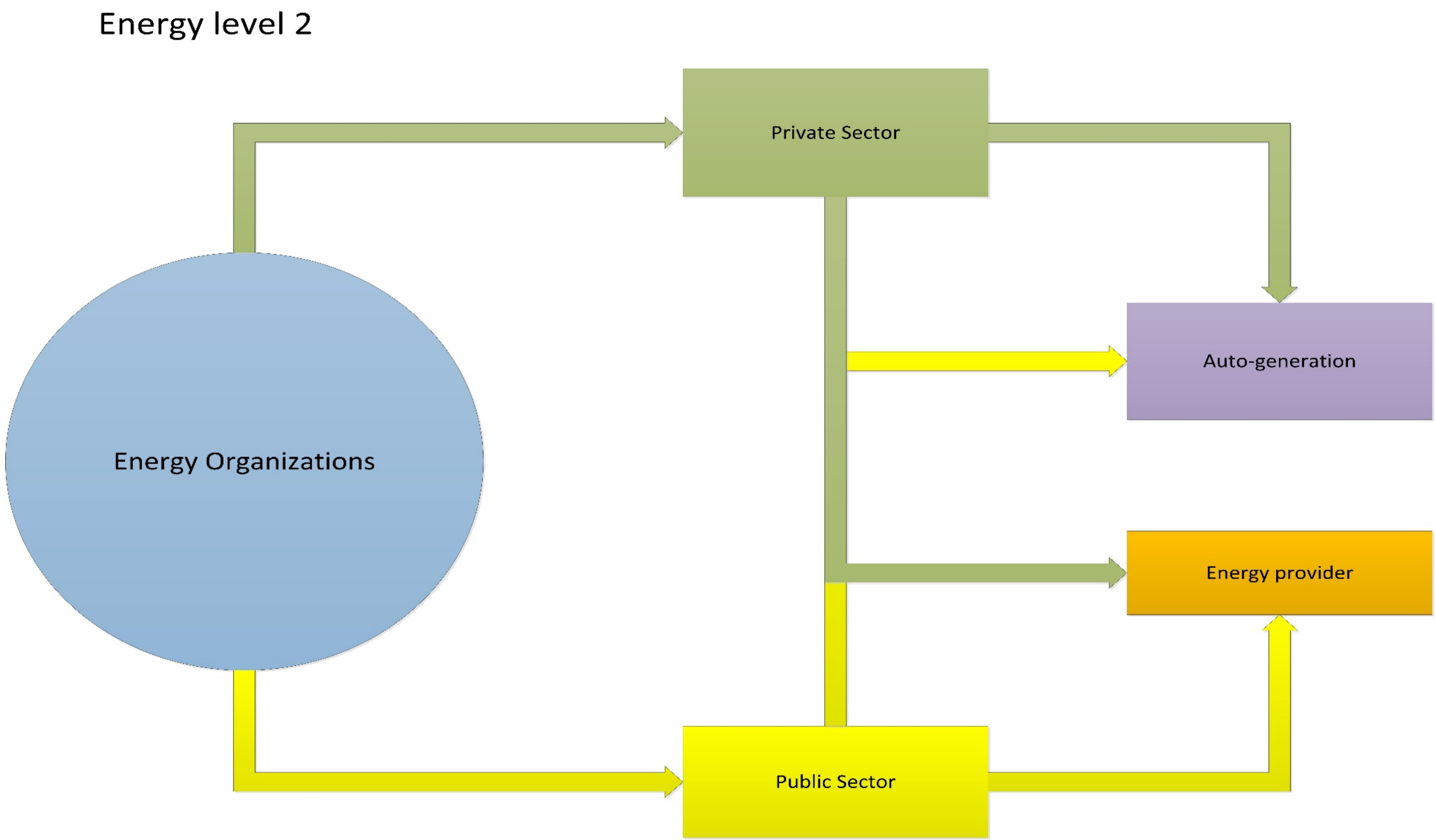


Figure 10-4. Framework for implementing renewable energy projects in the Dominican Republic level 2

- Public energy provider: The public sector does not own any generation plant in its entirety. The public sector co-owns several with the private sector.
- Public energy distributor

A lits of the public distributires of energy in the DR can be seen in Table 10-1. Public distribution company in DR, along with the owner of the dirtributer.

Table 10-1. Public distribution company in DR

Distribution	Owner
1. EdeNorte	State-Owned
2. EdeSur	State-Owned
3. EdeEste	State-Owned

- Private energy provider

Over 80% of the generation of electricity in the DR is privately own as can be seen in Table 10-2. Private generators in DR, this table also shows the name of the company that owns the generators along with the type of generation, fuel that it uses and the capacity of the plants. The most popular fuel is the oil no. 6. This fuel oil is a heavy commercial fuel obtained from crude oil, heavier than gasoline and naphtha, used for the generation of power.

Fuel oil No. 6 has a high viscosity requiring preheating to 104-127□ and is a residual material meaning that it is material that has remain after the more valuable parts of crude oil have been used. This means that this fuel has some impurities. On the other hand, fuel no.2 is a distillate home heating oil. Also, known as bunker A. (Vermeire, M., 2012)

- o Private energy generator

Table 10-2. Private generators in DR

Generation Plant Name	Owner	Type	Fuel	Capacity MW
Barahona Carbón	Haina	Steam	Coal	53.6
Sultana del Este	Haina	Diesel	Fuel oil No.6	153
Manzanillo III	Haina	Diesel	Fuel oil No.6	1.4
Haina IV	Haina	Diesel	Fuel oil No.6	60
Pto Plata II	Haina	Steam	Fuel oil No.6	39
Pto Plata I	Haina	Steam	Fuel oil No.6	27.6
Haina I	Haina	Steam	Fuel oil No.6	54
Haina II	Haina	Steam	Fuel oil No.6	38
Haina (TG)	Haina	Gas t.	Fuel oil No.2	100
Manzanillo II	Haina	Diesel	Fuel oil No.2	0.8
San Pedro (TG)	Haina	Gas t.	Fuel oil No.2	32.1
Barahona (TG)	Haina	Gas t.	Fuel oil No.2	32.1
Quisqueya 2	Haina	Natural Gas, HFO, Fuel Oil No. 6	Fuel oil No.6	215
Pedernales	Haina	Diesel	Fuel oil No.6	5.1
CEPP-II	CEPP	Diesel	Fuel oil No.6	39.2
CEPP-I	CEPP	Diesel	Fuel oil No.6	11.2
Monte Rio	Monte rio	Diesel	Fuel oil No.6	100.1
Seaboard EDM	Seaboard	Diesel	Fuel oil No.6	73.5
Palamara	Union Fenosa	Diesel	Fuel oil No.6	95.1
La vega	Union Fenosa	Diesel	Fuel oil No.6	73.6
CEPP-II	CEPP	Diesel	Fuel oil No.6	39.2
CEPP-I	CEPP	Diesel	Fuel oil No.6	11.2
Seaboard EDN	Seaboard	Diesel	Fuel oil No.6	37.8
Manzanillo III	Haina	Diesel	Fuel oil No.6	1.4
Metaldom*	Metaldom	Metal creators and have excess energy that they inject into the grid	Fuel oil No.6	42
Haina IV	Haina	Diesel	Fuel oil No.6	60
Smith**	Smith Enron	Steam	Fuel oil No.6	66
Pto Plata II	Haina	Steam	Fuel oil No.6	39
Pto Plata I	Haina	Steam	Fuel oil No.6	27.6
Haina I	Haina	Steam	Fuel oil No.6	54

Haina II	Haina	Steam	Fuel oil No.6	38
Monte Plata Solar	Electronic J.R.C., S.R.L.	Solar	Sun	30
Los Cocos	Egehaina	Wind	Wind	134.5

- Private Energy distributer

The private distribution of electricity in the DR is minor compared to the areas that CDEEE handles. However, Table 10-3. Private energy Distributer shows the few and isolated private distributers. These distributers only handle a city or small town.

Table 10-3. Private energy Distributer

Distributer	**Owner**
Costasur	Private
Bayahibe	Private
Cap Cana	Private
CSTPC	Private
CEPM	Private
Luz y Fuerza	Private
Progreso del Limon	Private
Las Galeras	Private
Pedernales	Private

- Private technology for generation provider

The market to sell technology for auto-production is a grown market in the DR. Due to the grey-outs discussed in chapter 2, the population and banks are getting involved in the auto-production or auto-generation of energy. This infers that the market to sell this technology has quite the boom in the DR.

- Public-Private Energy Provider.

The government by itself does not own a generator. However, it has made agrememts with several companies to co-own fossil fuel generator plants. (see Table 10-4. Public-Private generators in DR)

- Public-Private energy generator

Table 10-4. Public-Private generators in DR

Generation Plant Name	Owner	Type	Fuel	Capacity MW
1. Itabo II	Itabo	Steam	Coal	115
2. Itabo I	Itabo	Steam	Coal	128
7. Palamara	Union Fenosa	Diesel	Fuel oil No.6	95.1
8. La vega	Union Fenosa	Diesel	Fuel oil No.6	73.6
14. AES Andres	AES	NGCC	Natural Gas	285
21. Los Mina VI	AES	Gas T.	Natural Gas	103
22. Los Mina V	AES	Gas t.	Natural Gas	103
42. Higuamo II	Itabo	Gas t.	Fuel oil No.2	34.5
43. Higuamo I	Itabo	Gas t.	Fuel oil No.6	34.5
44. Itabo I TG	Itabo	Gas t.	Fuel oil No.2	34.5
45. Itabo II TG	Itabo	Gas t.	Fuel oil No.2	34.5
46. Itabo III TG	Itabo	Gas t.	Fuel oil No.2	34.5

10.3.1.3 *Level 3.0*

This level is the most complex as it contains the inducers of change. The level is composed of 4 sublevels as to better understand the process of change (Figure 10-5. Framework for implementing renewable energy projects in the Dominican Republic level 0.3). Sublevel 3.1 the renewable energy portfolio, 3.2 transformation for change, 3.3 support for change and 3.4 the challenges.

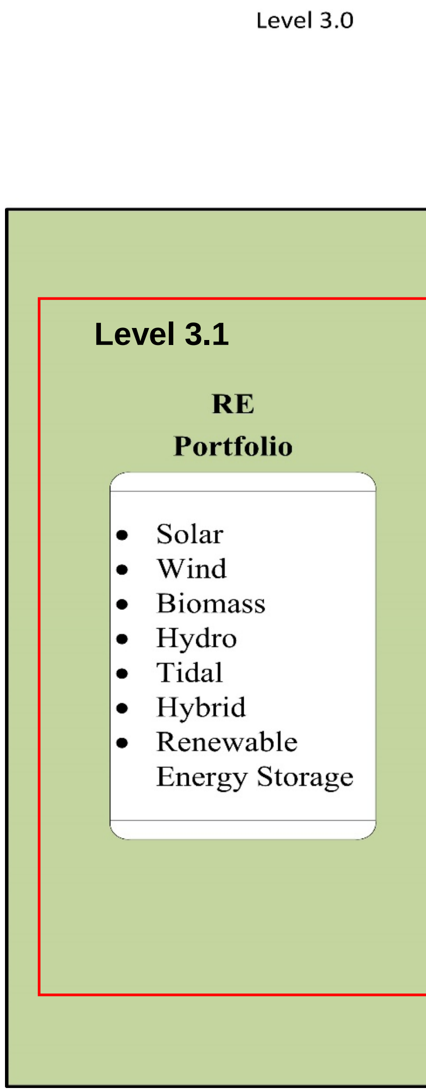


Figure 10-5. Framework for implementing renewable energy projects in the Dominican Republic level 0.3

- **Level 3.1 Renewable energy portfolio**

Level 3.0 of the renewable energy resources is a technical level (Figure 10-5. Framework for implementing renewable energy projects in the Dominican Republic level 0.3). This level represents the renewable energy or energies selected for implementation in the case of the Dominican Republic the options are: Wind, solar, hydro, biomass, tidal, hybrid and energy storage. However, the selection of the portfolio is much more than the energy type.

This level has several steps that must be completed: (1) the forecast of the renewable energy for the nation, region and area must first be known, (2) from this forecast a location must be selected and (3) new measurements of the location taken to confirm the forecast, however, the new measurements must be more detail to the potential energy by day and hour and not by year as the forecast tends to be. Once the new measurements are known, (4) the management of such resources must be done, (5) selection of the technology and the (6) workforce, whether any existing technology and workforce are available or if the need for importation exists (Figure 10-6. Framework for implementing renewable energy projects in the Dominican Republic level 3.1).

The Dominican Republic is well endowed with a variety of renewable energy resources which include hydro-electricity, biomass, solar and wind. For in-depth, please see Chapter 2.

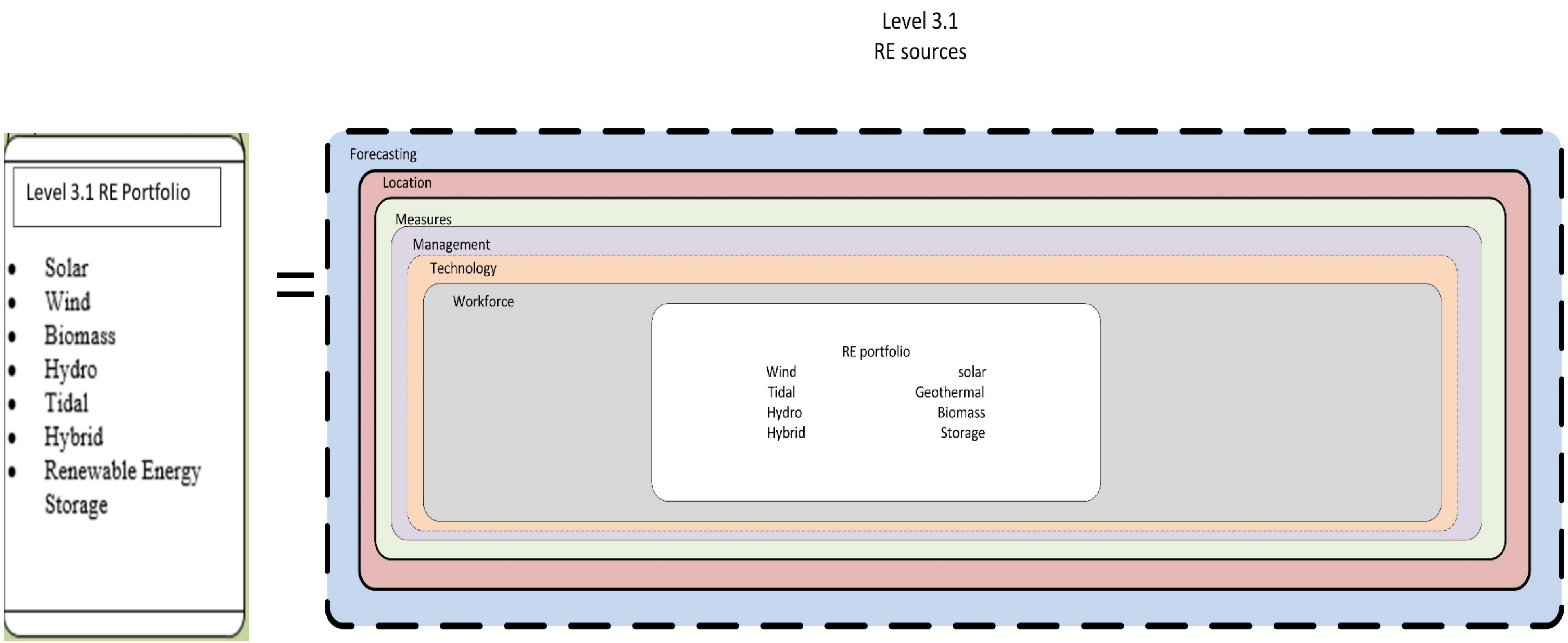


Figure 10-6. Framework for implementing renewable energy projects in the Dominican Republic level 3.1

- **Level 3.2. Transformation for Change**

Transformation for change address the need to restructure an organization around the five core areas (consumers, employees, supply chain, owners, and regulators). This restructuring is central in addressing the changes to the purpose, culture, processes, performance and human resources of the organization around its new direction (Uhl and Gollenia, 2016).

This level deals with the transformation for change: (1) Vision, (2) Structure, (3) Training and education, (4) Coaching, (5) Rewards, (6) Measurements and (7) reporting (Figure 10-5. Framework for implementing renewable energy projects in the Dominican Republic level 0.3 and Figure 10-7. Framework for implementing renewable energy projects in the Dominican Republic level 3.2.) This transformation for change is due because the renewable energy implementation will cause a ripple effect in the energy environment becoming a driving force for changes in the organizations.

a) Vision: The vision of any organization or individual is a guide to what it wants to become or transform and how to do it.
b) Structure: After a vision is described, the organization must establish the functions that must be performed to implement the vision. These functions must be organized, categories, determine and coordinated, that is the function of the structure (Winnubst, 2017).
c) Training and education: The changes to the energy sector that renewables bring will cause external changes in the sectors environment. Changes that will cause the need for the organizational workforce to be re-educated in the new methods,

this will create flexibility, efficiency and adaptability in the sector and on the workforce

d) Measurements: To ensure that the change in the organization and in the environment is taking place it needs to be measured. The measurements also aid in knowing the efficiency and effectiveness of different methods implemented by the different organizations and helps with lessons learned for future changes or transformations.

e) Reports: The measurements provide the unit of analysis for the effectiveness, efficiency and more of the different renewable energy projects implementations, then reports are the interpretations of the measurements.

f) Rewards: As reports provide an interpretation of the measurements, the rewards function is to improve the performance inside the organization. Externally the rewards are the benefits created by the implementation of renewable energy. However, internally in the organization there needs to be a corresponding reward for the transformation and change to this new implementation that would lead to a better quality of life.

g) Coaching: The measurements provide the unit of analysis the reports the interpretation and the rewards provide the needed incentives to maintain the transformation in the organization. However, not everything always goes as plan and for that coaching is implemented. Coaching is a deliberate support mechanism to achieve and clarify the direction, goals, and measurements that the organization is trying to achieve, through interpersonal interaction.

Level 3.2

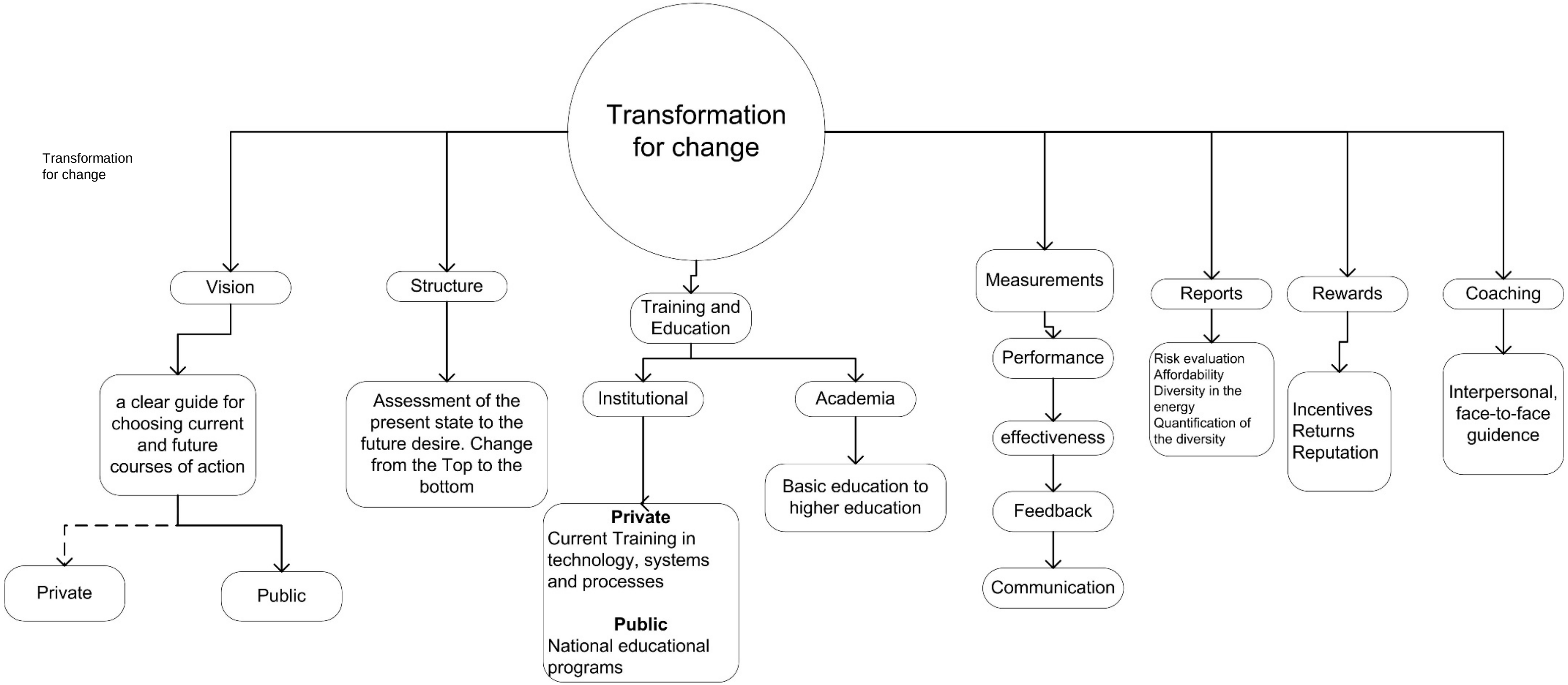


Figure 10-7. Framework for implementing renewable energy projects in the Dominican Republic level 3.2

- **Level 3.3. Support for Change**

This level deals with the needed support mechanism for change: (1) Leadership, (2) government regulations, (3) renewable energy education, (4) renewable energy market, (5) financial policies and tools, (6) Technical and technological workforce and (7) Land acquisition (Figure 10-5. Framework for implementing renewable energy projects in the Dominican Republic level 0.3).

a) Leadership: Leadership is a critical factor in a transformation for change. As the change is usually implemented in a pyramid effect, from top to bottom. Without leadership, the effects of the environmental change impact the organization and may diminish the revenue if a proper opportunity plan is not recognised and place in effect.
b) Government regulation: These regulations vary from country to country. However, the foundation of them is the same. Regulation is a process of making and implementing rules and norms to govern the behaviour and interaction of humans. In the Dominican Republic for renewable energy, only the 57-07 law exist along with the 202-08 decree that regulates the Law 57-07. The 57-07 law was created based on several European renewable laws, including the Spanish, German and French renewable law. However, this law does not cover everything as it does not create a market or standards for renewable energy. (See Chapter 2 and chapter 7 for a more in-depth analysis)
c) Renewable energy education: As explained in Chapter 9, the implementation of renewables will increase the job market, to fulfil this increment education at all levels, from primary to higher education, will need to adapt and include a more renewable energy inclusive curriculum.

Currently, two universities in the country are imparting a masters in renewable energies the Pontifica Universidad Catolica Madre y Maestra (PUCMM) and Instituto Tecnologico de Santo Domingo (INTEC). Both masters are great and focus on different energy aspects of renewables: (1) the one in PUCMM is more focus on the implementation of renewables while the one from INTEC is more focus on energy efficiency. However, renewable energy education is not just about traditional education in a classroom, and it is also about research and development. The technology for renewables already exists but improvement not just of the technology but of the systems, sector infrastructure needs. For example, this research.

d) Renewable energy market: A define market serves to identify not just the competition but the new opportunities and gaps in the sector. Market creation is a development strategy to provide access to existing or new services and products. However, these new services and products cannot be introduced into an existing market without several studies and adaptations done to the market. In the Dominican Republic, this was not considered, and renewable energy was bundled together with traditional sources of energy. (For more in-depth see chapter 7)

e) Financial policies and tools: The Dominican Republic possess several policies and financial tools available yet not to reach for renewable energy. (See chapter 7 and Chapter 2)

f) Technical and technological workforce: This is part of renewable energy education and job creation. To successfully implement and maintain a greater renewable energy sector new generation of scientists, engineers, and technicians need to be formed. The preparation of the future workforce is no small task. The wind energy industry employs more people than coal mining (De Place, 2009), and the solar industry employs more than oil and gas combined (Solar Foundation, 2016). As of 2016, the renewable energy industry employs over 8 million people worldwide, and these numbers are certain to continue to grow in the future (IRENA, 2016).

g) Land acquisition: The process for purchasing or acquiring land in the Dominican Republic is a long, complicated one, please see Chapter 7

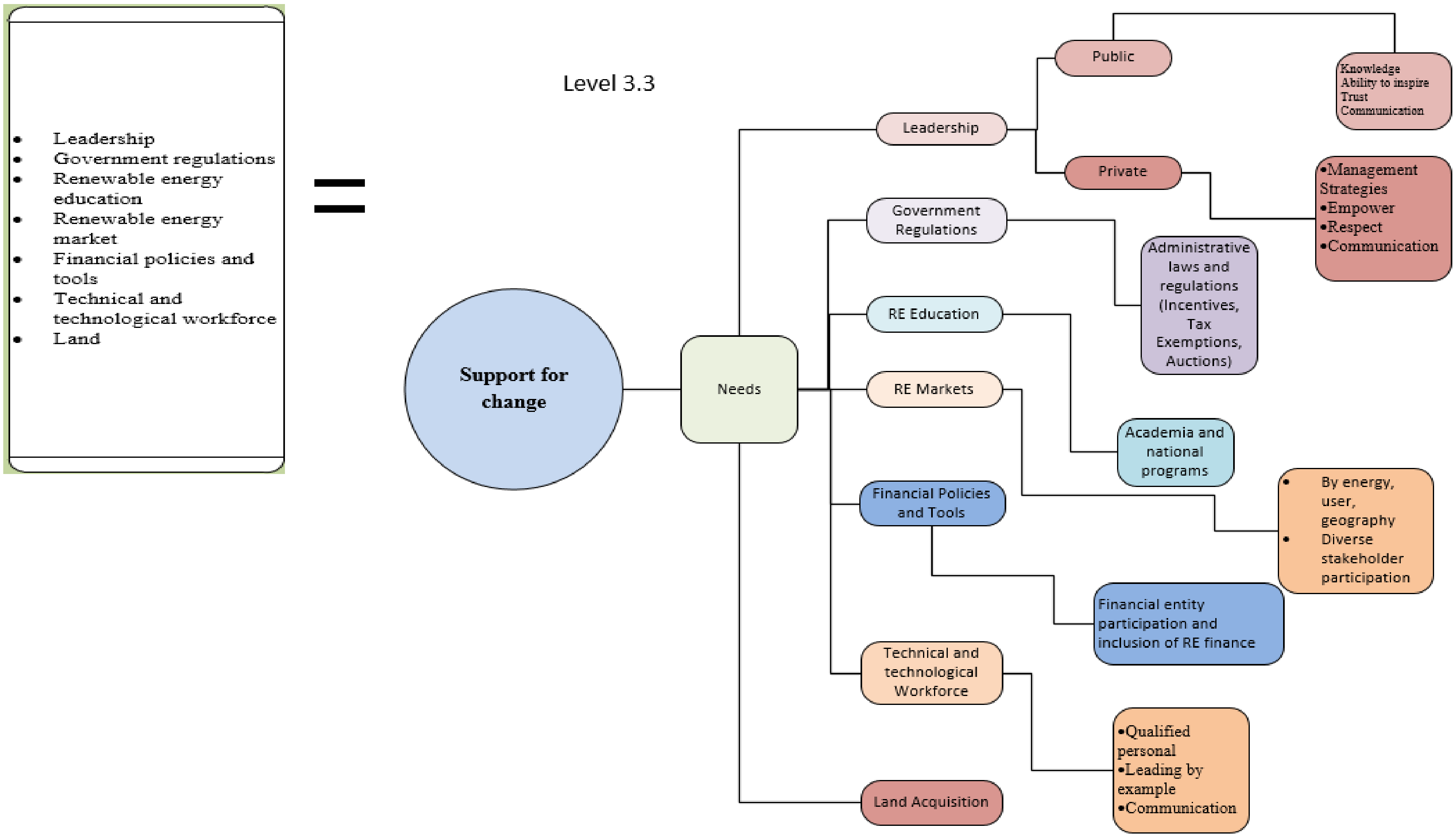


Figure 10-8. Framework for implementing renewable energy projects in the Dominican Republic level 3.3

Level 3.3
Support for
change

Figure 10-8. shows the in-depth details of level 3.3 with the different functions and areas affected by the needs to support for change.

- **Level 3.4**

This level represents the challenges that were identified during the interviews of the stakeholders (Figure 10-5. Framework for implementing renewable energy projects in the Dominican Republic level 0.3). These are (1) Lack of strategy, (2) Lack of finance, (3) Lack of coordination between the stakeholders, (4) Lack of stakeholder's communication, (5) Lack of knowledge, (6) Lack of workforce and (7) Lack of transparency. A more detailed definition and information on chapter 7 and Figure 10-9. Framework for implementing renewable energy projects in the Dominican Republic level 3.4.

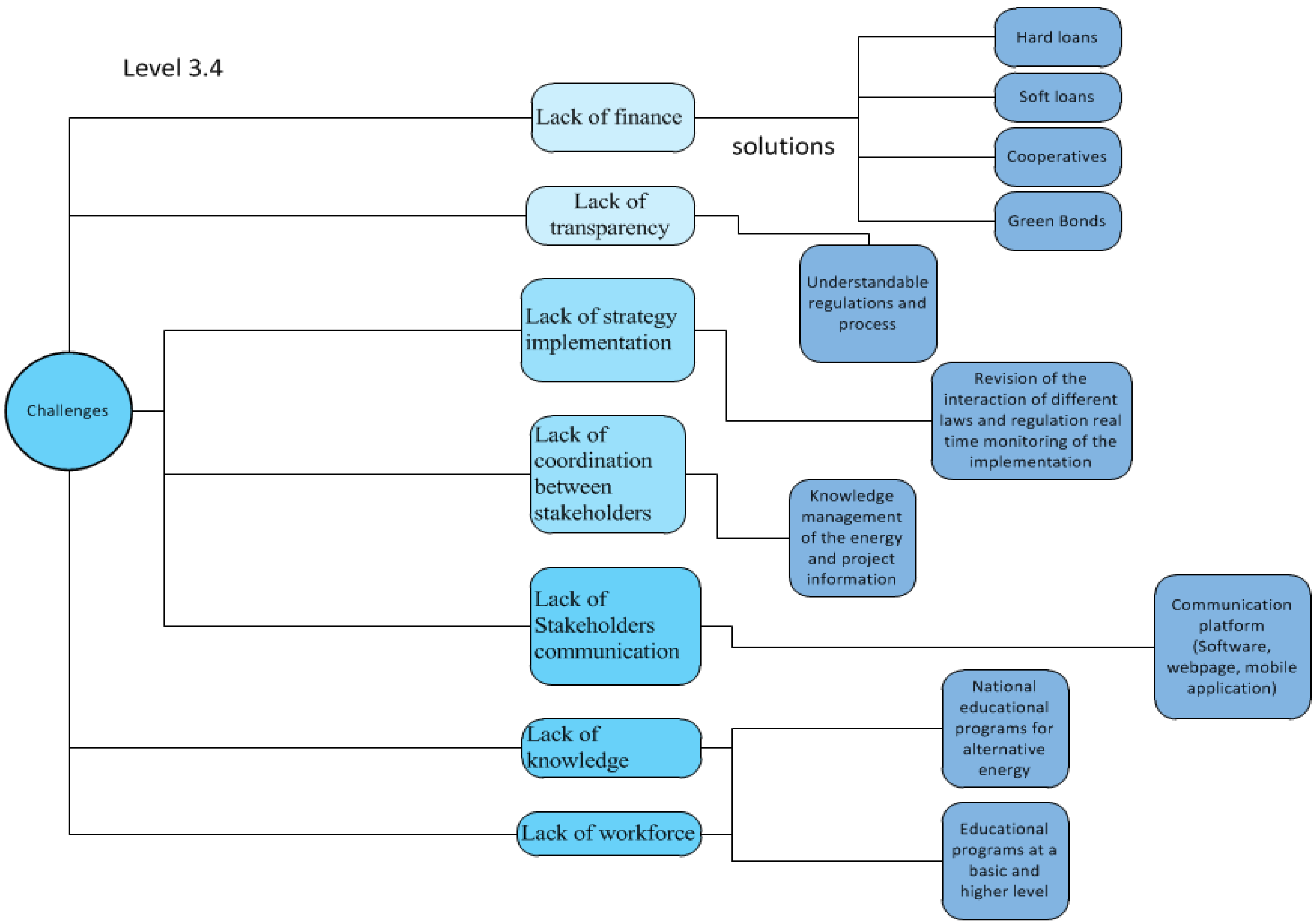


Figure 10-9. Framework for implementing renewable energy projects in the Dominican Republic level 3.4

10.3.2 Level 4.0

This level visualized the benefits or outputs that can be achieved with the framework for implementing renewable energy projects. These benefits have been grouped in (1) social, (2) economic and (3) environmental (Figure 10-2. Framework). The interviews highlighted the specific benefits of each category. (see Chapter 9)

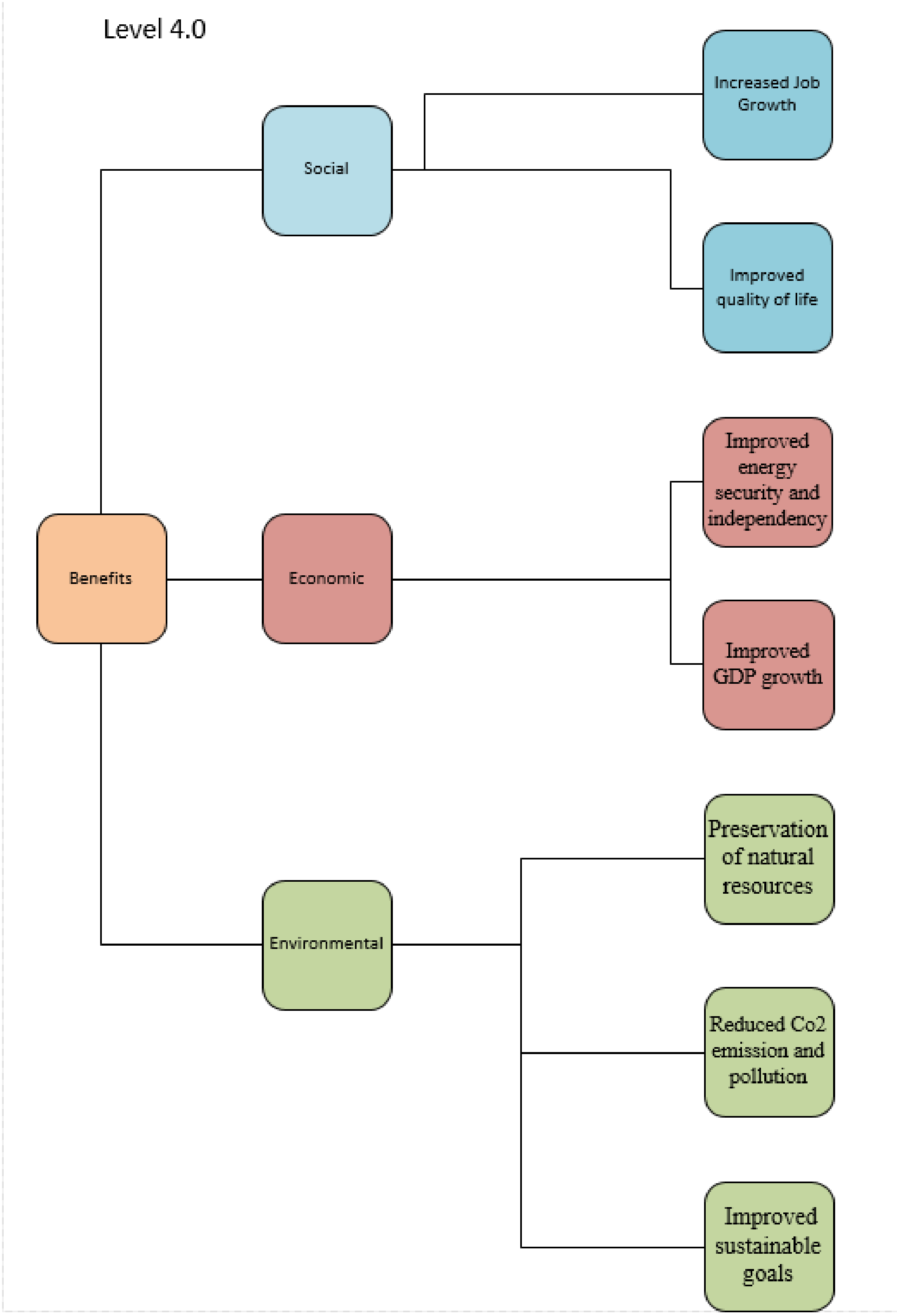


Figure 10-10. Framework for implementing renewable energy projects in the Dominican Republic level 4

Level 4.1 Social

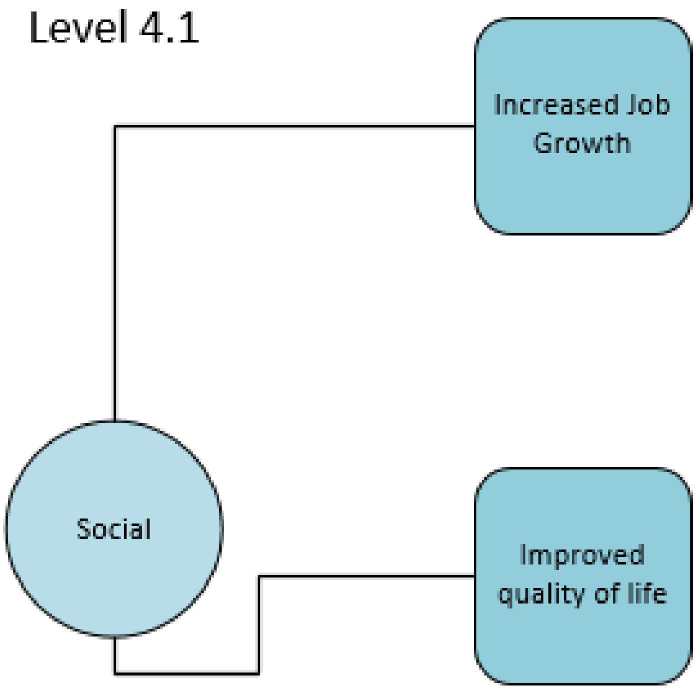


Figure 10-11. Framework for implementing renewable energy projects in the Dominican Republic level 4.1

- **Level 4.2 Economic**

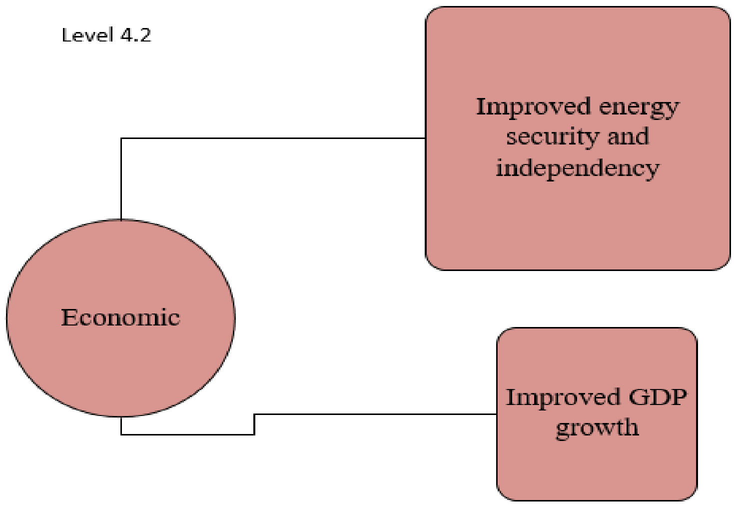


Figure 10-12. Framework for implementing renewable energy projects in the Dominican Republic level 4.2

- **Level 4.3 Environmental**

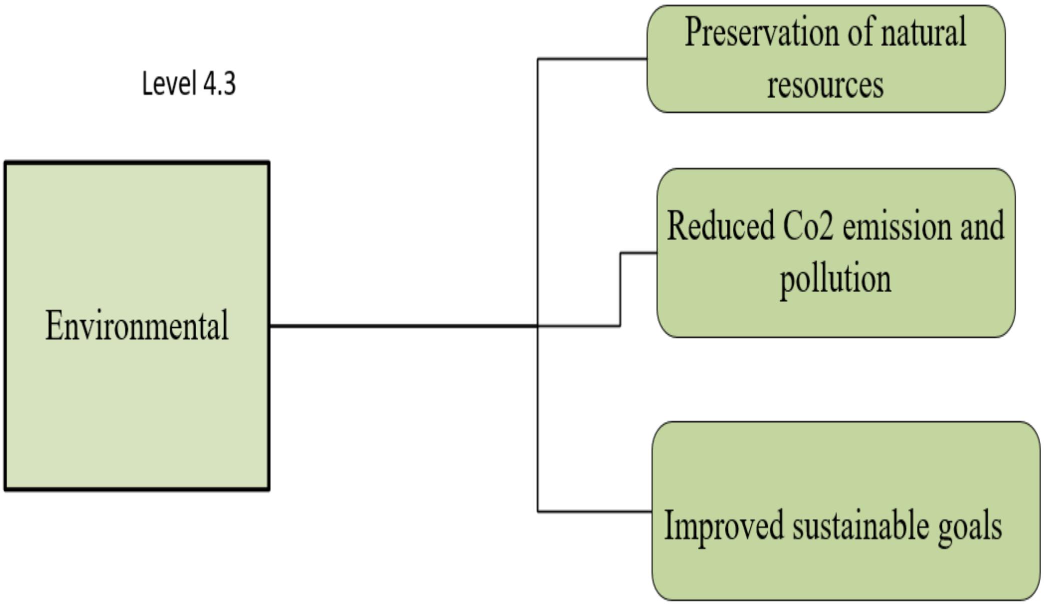


Figure 10-13. Framework for implementing renewable energy projects in the Dominican Republic level 4.3

10.3.3 Level 5

This level is a feedback loop to aid in the knowledge management and to, over time, modify the framework by mapping, capturing and using the critical knowledge, practices and lessons learned from past, present and future projects implemented in the Dominican Republic (Figure 10-2. Framework and Figure 10-14. Framework for implementing renewable energy projects in the Dominican Republic level 5).

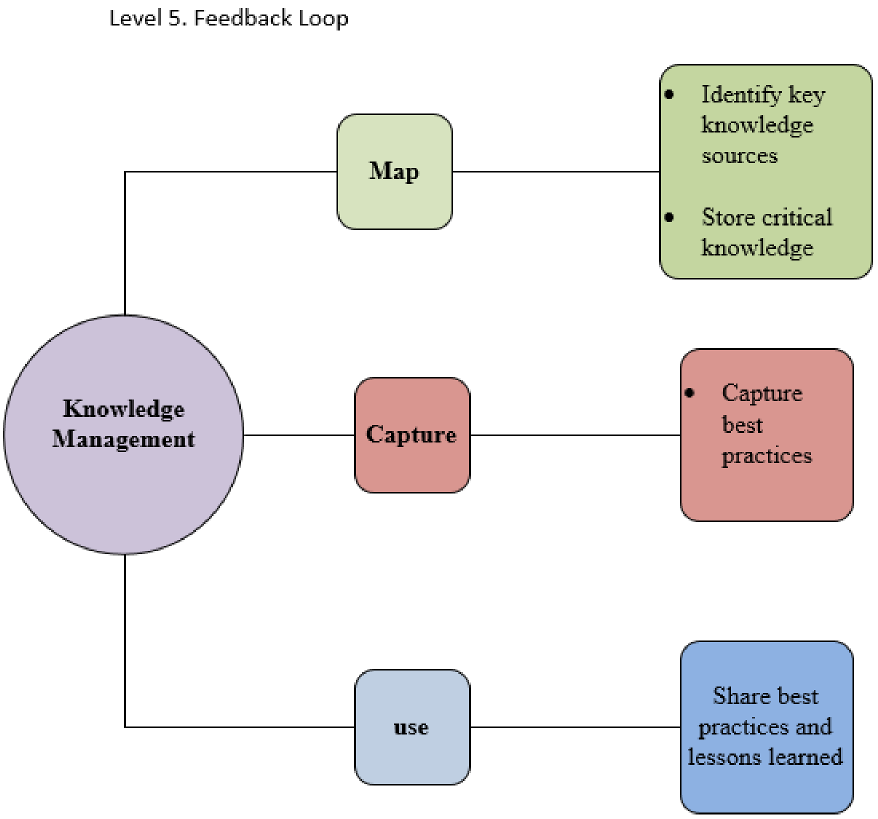


Figure 10-14. Framework for implementing renewable energy projects in the Dominican Republic level 5

a) Map

Knowledge management maps is a technique that aids in providing an interpretive description of a situation from different points of view. This technique consists of the selection of relevant details of the situation to paint the issues or problem in a summarise manner (Hansen and Kautz, 2010). This is critical for the Dominican Republic as the intercommunication between departments, ministries and projects are a mismatch. This would aid by providing the information in one source for the access of all the stakeholders.

b) Capture

Once the information from the different projects has been mapped, it must be stored for future use. The knowledge storage can be done in physical memory systems and informally retained as values, rules and beliefs that are associated with culture and organizational structure (Denner and Blackman, 2013).

c) Use

According to Denner and Blackman (2013) knowledge management use is the ability of individuals, organizations, entities and more to find, access, and use information and knowledge stored memory systems, whether informal or formal or internal of the organization or external. Knowledge must be used to developed new knowledge.

10.4 Validation

10.4.1 Introduction

Process Validation is defined as the collection and evaluation of data which establishes scientific evidence that research can deliver a new contribution to knowledge. As Weis and Willems (2017) highlight in qualitative research, the key criterion is not the quantity, but the quality of the samples that define the range needed for the evaluation of the relevance of the research, a more detailed investigation into validation can be found on the methodology chapter of this research.

The validation of the developed framework was done based on content validity. In general, content validity involves evaluation of any new relevant discovery by creating a survey/questionnaire instrument to ensure that the developed item, in this case, the framework, includes all the items that are essential and eliminates undesirable items to a construct domain (Grant and Osanloo, 2014 and Pendse and Inman, 2017). The content validity for this research was also based on Creswell eight validation strategies, specifically the peer review and the member checking.

10.4.2 Validation Protocol and coding

A questionnaire was performed in a focus group environment to validate the developed framework. This questionnaire would allow experts in the field to comment on the proposed framework. For that purpose, 5 questions were developed to asses that the scope, understanding, flow and issues that were meant to be addressed by the proposed framework were. Along with a question that would allow the interviewee to suggest changes to the structure of the framework. The names and background of the interviewees are confidential, and as such a code for each validation participant was created:

EVF#= energy validation focus group + # participant

An invitation to 10 of the participants or 40% was sent, the real target was 10% of the participants or more. However, 16% or 4 stakeholders participated in the focus group. For coding purposes, the participants are identified as EVF1, EVF2, EVF3, EVF4. The responses of the participants were recorded and transcript for analysis. Although only 4 stakeholders participated, the representation of the different sectors of the energy environment was achieved, as between the 4 stakeholders the public, private and academic sector was covered.

10.4.3 Responses

The four participants were asked the same questions, and the responses were tabulated in Table 10-5. Validation questions part 1 and Table 10-6. Validation questions part 2 below. All agreed on the usefulness and understanding of the framework. However, 50% of the participants found that a legend is needed to properly understand the flow of the framework.

Table 10-5. Validation questions part 1

Questions (N=4)	Good	Bad
1. What is your opinion on the level of completeness in terms of the overall contents of the proposed framework?	4	0
2. What is your opinion on the level of completeness in terms of the logic (i.e. flow/ sequence within the framework and how it mirrors what should be done) used within the proposed framework?	4	0
3. What is your opinion on the issues covered within the developed strategic framework?	4	0
4. What is your opinion on the level of understanding of the proposed framework?	4	0

The comments were reviewed, and a legend for better flow and understanding of the framework was created and incorporated into the framework.

Table 10-6. Validation questions part 2

Questions (N=4)	Yes	No
5. Do you have further comments/suggestions regarding any areas that need to be improved/included/deleted within the proposed framework?	2	2
6. Would you recommend the framework for use in the DR? For the public or private sector?	4	0

10.5 Summary

The proposed framework is the culmination of not just the evaluation of the literature but of the evaluation of case studies and interviews of critical stakeholders in the renewable energy infrastructure.

One major requirement for the provision of sustainable energy in the Dominican Republic is making good use of the abundant sources of renewable energy available in the Dominican Republic.

Chapter 11 . Conclusions and recommendations

11.1 Introduction

This chapter presents the research aim and objectives. To do so the research process is described, and the conclusions and recommendations are provided.

11.2 Research Process

Aim	This research aim is to evaluate the status of renewable energy strategies in the Dominican Republic. For developing a strategic framework for renewable energy infrastructure implementation in the Dominican Republic as a possible solution for the energy crisis that the country faces and to improve the development and quality of life of its citizens.
Research Objectives	• To review the literature related to renewable energy sources and infrastructure in general and the Dominican Republic. • To investigate the critical renewable energy related business models' initiatives that have been or planned to be implemented in the Dominican Republic • To analyse and document the drivers for the implementation of renewable energy projects in the Dominican Republic. • To explore the essential renewable energy-related financial tools and policies initiatives that have been or planned to be implemented in the Dominican Republic • To study and record the challenges of implementing renewable energy projects in the Dominican Republic • To examine and detail the critical success factors of implementing renewable energy project in the Dominican Republic • To investigate and document the benefits of implementing renewable energy projects in the Dominican Republic • To develop and validate a strategic renewable energy management framework for the benefit of Dominican Republic organisations.

Research questions	1. What is the status of renewable energy worldwide? In the Dominican Republic? 2. What business strategies have been used in the Dominican Republic for the implementation of renewable energy projects? 3. What are the key motivations for implementing renewable energy projects in the Dominican Republic? 4. What essential financial policies and tools are available for implementing renewable energy projects in the Dominican Republic 5. What challenges does the implementation of renewable energy projects face in the Dominican Republic? 6. What are the factors that could guarantee the successful implementation of renewable energy projects in the Dominican Republic? 7. What are the possible benefits that the Dominican Republic could achieve by implementing renewable energy projects? 8. What process could be followed or implemented to guarantee the successful implementation of renewable energy projects in the Dominican Republic?
Research	Qualitative research
Ideology	Pragmatism
Approach to enquiry	Qualitative
The main purpose of the investigation	Exploratory research due to the complexity of renewable energy issues and the paucity of comparable research in the area
Sample technique	Purposive snowball sample
Sample size	25
Sample diversity	Directors, CEO's Ministers
Data collection method	Semi-structure interviews
Unit of analysis	Energy Industry
Embedded unit of analysis	Individual employee
Method of analysis	Content, theme and ISM
Outcome of analysis	Framework

11.3 Key findings

Objective 1: To review the literature related to renewable energy sources and infrastructure in general and the Dominican Republic.

Research question 1: What is the status of renewable energy worldwide? In the Dominican Republic?

The current literature is vast regarding renewable energy, due to the global awareness of the positives impacts on climate change. More and more countries are implementing renewable energy. However, not all countries are successful in the implementation. Therefore, the Dominican Republic was chosen to identify why a country with such renewable potential and growing economy was failing in the implementation. The research showed a lack of exploration in the area. The existing literature for the Dominican Republic's consists of 11 reports and 1 journal paper. The lack of documentation and the difficulty of obtaining more documentation provided evidence into the need for an in-depth study into the gaps of the Dominican Republic power system, these gaps are:

- Lack of proper investigation or studies into the different aspects of the electricity sector (economic, legal, technological, educational, social, environmental)
- Lack of renewable energy potential studies, the only ones have done where the solar and wind. Biomass, offshore wind, tidal and wave all need to be performed
- The focus of the literature only into energy efficiency and projections for the future and no critical evaluation of the current conditions

These gaps leave the Dominican Republic literature and electricity infrastructure vulnerable and underdeveloped.

Objective 2: To investigate the critical renewable energy related business models' initiatives that have been or planned to be implemented in the Dominican Republic

Research Question 2. What business strategies have been used in the Dominican Republic for the implementation of renewable energy projects?

This study revealed, that before any implementation can take place a plan must be made to guide the design, development, construction, operation and maintenance of any renewable energy project and that plan is a business model. However, in the Dominican Republic the government even though it created the 57-07 law of renewable investments, has taken a business as usual approach and continued to rely on fossil fuel. While the private sector has taken a more active role in the implementation and has developed four successful projects, based on technology innovation business models.

However, the knowledge in the variety of renewable business models is very limited, as the interviews have a misconception regarding the different business models for renewable. The participant believed that the different types of renewable was the variety of business models themselves and did not know or understood the new business models for renewable which are: (1) Waste Regeneration, (2) Alternative energy-based, (3) ICT optimisation, (4) Green neighbourhoods and cities, (5) Industrial Symbiosis, (6) Functional sales and management and (7) Innovative financing schemes

Objective 3: To analyse and document the drivers for the implementation of renewable energy projects in the Dominican Republic.

Research question 3. What are the key motivations for implementing renewable energy projects in the Dominican Republic?

This research found twelve driving forces for the implementation of renewable energy in the Dominican Republic. From the literature review six drivers were found and in order of most important to least, these are: (1) Returns or revenue, (2) energy security, (3) electricity sector status, (4) international agreement and aid, (5) health and wellbeing and (6) environmental concerns.

From the interview also six drivers were found and in order of importance, these are (1) Business opportunity, (2) Business and renewable energy reputation, (3) Financial Returns, (4) International aid and recognition, (5) environmental conscience and funds and (6) energy diversity. Through ISM analysis the drivers from both the literature and the interviews were brought together to form a cohesive model of eight drivers in four levels of importance which are in order of most important to least:

a) Environmental conscience and funds
b) Energy diversity and business and renewable reputation possess the same importance
c) Health and wellbeing, electricity sector status and international aid and funds, also possess the same importance
d) Business opportunities and financial returns

This may seem contradictory, however, from a logical point of view, the environmental conscience and funds is the one that motivates the need for energy diversity and the improvement or creation of a renewable reputation or business reputation. This diversity and reputation will provoke changes in the electricity sector status along with impacts on the health and wellbeing of the population and in the international community therefore affecting the international aid and recognition of the entity or nation. All these drivers will culminate by creating financial returns and business opportunities.

Objective 4: To explore the essential renewable energy-related financial tools and policies initiatives that have been or planned to be implemented in the Dominican Republic

Research question 4. What essential financial policies and tools are available for implementing renewable energy projects in the Dominican Republic

The Dominican Republic possess a vast economic system. However, the lack of interest from the government in supporting the macro scale renewable energy projects has side-lined the financial entities and created a lack of trust in the financial sector regarding renewable energy projects. The main financial policies in the Dominican Republic are: Feed-in-tariff although it has never been implemented, renewable energy portfolio standards even though they have been created ambiguous and never been implemented and the financial incentives, this is the only policy in effect as the law 57-07. Regarding financial tools, the Dominican Republic has two main tools in effect which are hard loans and power purchase agreements.

Objective 5: To study and record the challenges of implementing renewable energy projects in the Dominican Republic

Research question 5. What challenges does the implementation of renewable energy projects face in the Dominican Republic?

The challenges found in this study were on a macro and micro scale. The literature provided a generalized view of the challenges in the Dominican Republic by grouping all the challenges into (1) Regulatory Framework, (2) Institutional and economic and (3) Technical and non-technical losses. While the interviews provided a more detailed and focus categorization of the challenges.

The analysis of the participants interviews provided eight challenges: (1) RE law implementation, (2) RE micro-macro Market, (3) Financing, (4) Technical and technological, (5) Leadership for RE, (6) Permit solicitation-acquisition-process, (7) RE knowledge and (9) Land Acquisition. Most of these challenges must be address by the government of the Dominican Republic. Others like renewable energy knowledge are for the academic sector to overcome. The permit solicitation has been addressed in this research as a guide of all the steps, entities cost and time frame has been created for the improvement of the implementation of renewables in the Dominican Republic.

Objective 6: To examine and detail the critical success factors of implementing renewable energy project in the Dominican Republic

Research Question 6. What are the factors that could guarantee the successful implementation of renewable energy projects in the Dominican Republic?

The critical success factors of the Dominican Republic were based on the interviews as the lack of documentation on the failed, and successful projects made it near impossible to identify them in the literature. From the participant's interviews analysis, the following critical success factors were highlighted: (1) Access to the Grid, (2) Implementation of the legal framework for RE (3) Coordination and communication, (4) Financial tools for RE projects, (5) Knowledge Creation and Exploitation (6) Transparency.

Objective 7: To investigate and document the benefits of implementing renewable energy projects in the Dominican Republic

Research question 7. What are the possible benefits that the Dominican Republic could achieve by implementing renewable energy projects?

The benefits identified in this research for the implementation of renewable energy business models in the Dominican Republic have been grouped into three categories: Social, economic and environmental. The literature provided 4 benefits: Socio-economic, Renewable goal achievement, Environmental and Energy security. However, these benefits are ambiguous and cover a broad area; for example, socio-economic benefits is a generic term that does not convey the needed information to the investors. The interviews, on the other hand, provided six benefits: Energy independence, Environmental and Public health, Economic Returns, Job Creation and

Social and tourist that was a mixture of generic and detailed benefits.

The analysis of the benefits provided that the most important one was: Energy independence and Environmental and Public health. These two benefits create the other benefits in the list as the energy independence or security as the literature calls it, is the one responsible for the economic returns or revenue, the job creation and both the public health and environmental and the energy independence affect the social and tourism of the country.

Objective 8: To develop and validate a strategic renewable energy management framework for the benefit of Dominican Republic organisations.

Research question 8. What process could be followed or implemented to guarantee the successful implementation of renewable energy projects in the Dominican Republic?

A systematic framework was created based on Kotter's eight steps process for leading change. Based on the data collected and the 8 steps 5 levels were created: (1) the driving forces that promote the implementation of renewable (2) on who does these forces apply pressure on (3) the inducers of change process based on the renewable energy portfolio, the transformation for change needs, the support for change system and the challenges, (4) are the benefits that can be obtained and level (5) is the knowledge management loop to record the lessons learned and created a database for old, current and new projects.

Also, to maintain the framework dynamic as it will change along with the new challenges and needs of the implementation of renewable energy projects in the Dominican Republic.

11.4 Contributions to knowledge

- This research contributes first with this body of work that will be added to the reports and documents available for the study of the Dominican Republic's renewable energy sector. This study can be used as a foundation for futures studies.
- The guide for permit solicitation created in this research will aid future investors in the steps to obtain the needs documentation for renewable energy projects in the Dominican Republic
- The discovery of the core drivers for renewable energy business models in the Dominican Republic: (1) Environmental conscience and funds and (2) climate change targets
- The determination of the critical driver for implementation of renewable energy projects in the Dominican Republic: Environmental conscience and funds
- The discovery of the main financial tool for implementation of renewable energy projects in the Dominican Republic: Loans
- Provided the key challenges for the implementation of renewable energy projects in the Dominican Republic: (1) leadership and (2) knowledge of RE
- The extraction of the key critical success factor for the implementation of renewable energy projects in the Dominican Republic: Transparency

- Yielded the critical benefit for implementing renewable energy projects in the Dominican Republic: (1) Environmental and public health and (2) energy independence
- The framework that will aid private, public and international investors in successfully implementing the renewable energy projects in the Dominican Republic.

11.5 Conclusions:

As Beltramello *et al.* (2013) explain:

"The global energy supply is facing an array of severe challenges regarding long-term sustainability, fossil fuel reserve exhaustion, global warming and other energy-related environmental concerns, geopolitical and military conflicts surrounding oil-rich countries, secure supply of energy and fuel price increase."

Renewable energy resources can support the present, and future energy demands with ease, regardless of the growth of the population. Furthermore, without perpetrating any significant damage to the global environment. Also, it aids in diminishing climate change symptoms that are affecting the present and future world. Renewable-based activities around the world are being undertaken on a national and international considerable level platform.

All the case studies point to a fundamental role of market demand in stimulating sustainable business models based on efficiency optimisation by ICT, new financial schemes, alternative energy sources, Functional sales and management services models.

New renewable business models are directly involved in the transition to renewable energy infrastructure. Developing new business models can, therefore, assist decrease environmental pollution, improve the usage of natural resources, enhance the production and energy efficiency, while at the same time, offer a new source of economic development. Even though the market for renewable products and services is increasing, the development of new renewable business models is hindered by a series of barriers, many of which can be addressed by well-designed policies. Also, the lack of research and practical case studies further obstructs the creation, development and implementation of new renewable business models.

Creating, developing Strengthening and maintaining the market demand for renewable energy products and services is one of the key features in a successful renewable business plan. This success can be achieved by offering constant long-term incentives to help the actors (Companies, enterprises, and more) increase the renewable energy business plan adoption. However, the government should create a well-designed regulatory framework and supportive demand-side policies that should enhance access to financial aid, including but not limited to. supporting renewable market development for investment risk and the development of innovative business skills.

Nevertheless, the government should also review the current policies and subsidies to remove any weak or diminishing subsidy support, improve governance and to ensure that national and regional policies for renewable energy are consistent and linked together to develop a successful outcome. Also, this will reduce the barriers to creating, develop and the growth of new and existing actors and sustainable business models. while at the same time improving the regulatory environment for new renewable business models. that would support the research and development of innovation.

Also, governments can help by creating the framework conditions that will promote actors (companies) into operating by a renewable business model through which the business objectives, generation of profits and environmental sustainability can be achieved.

Financial, Environmental and reputational benefits are a critical element of any business model, especially for renewable business plans, and as such have been thoroughly researching in many case studies to determine the influences of business models in the developing environment. However, the conclusion has led to mixed results.

The difference in the conception, approach, design and implementation of each of the case study previously studied is directly linked to the country, the economic situation, the government disposition and the consumer or population knowledge of the renewable energies and technologies.

In developing countries, the energy market is based on the laws and regulations imposed by the government, fossil fuel based electricity and the loans and aid from international entities (World Bank, OEA and more) for alternative energy projects. However, as can be seen in Chile, China, India and many other countries, this does not always imply that the renewable energy project will be successful. In developing countries, the sole responsibility for change is in the hands of the government as the absence of knowledge, deficiency of own qualifying personnel, lack of technology and funds to evolve or create the renewable energy market is dire.

The renewable market is the first step to the renewable energy economy. However, the tool to be able to develop the market is a well thought and strategies renewable business plan. To undertake a renewable business plan, first identify the drivers for the plan and as the drivers emerge so do the barriers that will need to be addressed in the business plan to be successful. Also, just as every country is unique and presents different and similar traits so does the Business plan as it is tailor to each country's situation and needs. The most important aspect of any Business plan is Flexibility. This flexibility will allow the business plan to adapt to the situation and any unexpected barrier or obstacle that may develop in the implementation of this.

In one of the case studies examined (Canada, The Erie Shores Wind Farm) the renewable business models contributed to a quicker introduction of renewable technologies (ICT), processes and products, such as the use of ICT for monitoring the wind farms.

As discussed in the previous section customer demand is an important driver of renewable business models. As highlighted by Sahoo (2016) and Beltramello *et al.* (2013), the size of an actual or potential market is directly proportionated to the demand of the new renewable products and services that will stimulate innovation. This stimulation will be Relative because the lucrativeness of an invention increases with the size of the market (other things being equal) and partially for the directed productivity to meeting demand in the market. This market growth will result in an invention matching a need. As Gross (2015) explains innovation depends on the relative profitability, which, consequently depends on demand.

Three actors (end users/consumers. businesses, and the public sector) mainly shaped the market conditions by their roles and behaviours. Consequently, businesses are dual actors as they can be innovators and users of renewable energy services and products, by their interactions with other companies in the supply chain. The private sector is important as customers for renewable services and products (goods and technologies). Also, depending on the scale of the sector, the demands for renewable products or services may create a significant driver and market demand that would motivate other actors to transform into the renewable energy business model. According to Ferruzzi *et al.* (2016), the potential to regain the initial renewable investments and create a profit will only increase with the growth of the renewable market size. Therefore, successful innovations have higher success rates in fast-growing economies (developed countries), predominantly in renewable markets where the demand is forceful and vibrant.

It is therefore concluded that transforming to a renewable business model and consequently to a renewable economy for developing countries is achievable, even with the barriers presented in this research.

Most developing countries, not to say all, have the same downstream business model, the feed-in tariff business model, for the country or all major electric demand areas. While developing countries have a rich variety of different traditional and new renewable business models. This is directly influenced by the stability in the country, not just economical but in the legal framework of such countries. Cooperation between actors, in the cases of developing countries it was always the same actors (Government and private sector). While for developed countries, the actors change and the customer have more of an interaction and in some cases, are the driven force for the renewable implementation of business models when applied to renewable energy acquire a new aspect (environmental reputation, global sustainable goals, social responsibility, renewable sources management) and transformed from a cost-efficient framework to an environmentally sustainable cost efficiency framework, without losing the core aspects that make a business model (customer interface, infrastructure, management and financials).

In many countries, the use of renewable energy business strategies for the energy infrastructure especially electricity could have a significant impact, both in the generation, distribution and consumer satisfaction per capita of electricity consumption. Due to some undeniable facts, such as:

- Global energy demands will continue to grow with the population
- Energy-related greenhouse-gas emissions will rise 14% in the next 20 years.
- Fossil fuels will dominate energy use through 2050
- Instability of the fossil fuel market due to the limitations of the resource.

Renewable energy business models might have a very high impact and contribution in providing electricity to citizens, especially in lessening the energy poverty in countries with low access to electricity and aid in the reduction of electricity consumption per capita.

The principal concepts in business models in developing countries are the promising principles of the pyramid and microfinance bottom. Because of this, drivers, challenges, barriers and opportunities for renewable energy business models are of high value and interest for policymakers (government and organisations).

Developing countries should include at the core of their renewable energy business model additional education programs on renewable energies, to address the issue of the lack of a skilled workforce.

Policymakers need to encourage sustainable terms in economic and legal frameworks since in developing countries this is achieved through cooperation and knowledge management by the government and organisations in charge of the design and implementation of these frameworks. Also, developing countries should base their legal framework on recognised and established laws in developed countries. However, the need to ensure that these laws are appropriately adapted to the specific situations of the country or region.

Research shows that actors, especially investors, are most concerned about financial, regulatory and political risks. This demonstrates the high importance of a stable and fully implemented regulations, that should be the result of a transparent and efficient government body. Also, this will secure the investment into renewable energy capacities for the country, especially developing.

Renewable energy business models can be an essential aspect of increasing the implementation of renewable energy in developing countries. However, business models alone will not lead to an improvement in the implementation of renewable energy. they are a piece of the puzzle. Moreover, renewable energy business models cannot address all barriers alone. Therefore, a robust legal framework from policymakers is still required.

Renewable energy business models main aspects and attractiveness, not just for policymakers, but for investors of a private and industrial background, are:

- Flexibility: This refers to the diversity of the renewable business models, as they range from the renewable energy source used to the financial tools and ICT implemented on the project.
- Adaptability: Provides the actor with the possibility of implementing the business model by considering the situation of the country, organisation or industry that will use the renewable energy business model.
- Critical success factors: This is the elements that are not just necessary but will guide an organisation, business, country or project to achieve its mission and vision.
- Knowledge management: this will allow the correct flow of information and will improve the efficient managing of information and resources between the actors, allowing for better cooperation.
- Cooperation: As has been pointed out in the case studies 90% of the successful implementation of renewable business models were based or initiated because of the cooperation between actors.
- Value market. Business models, at its core, is regarding the value created for the actors. renewable business models are no different, and the value is one of the leading aspects that attract any investor. However, Renewable business models do not just focus on the value creation, but it is balanced by the social and

environmental goals, which have moved from being a marketing strategy to a core value.

However, even with all the benefits that a renewable business model could bring not just to a developing country but to any actor that could implement, and the new and upgraded renewable energy technologies, renewable business models face several main challenges, from least important to most:

- Lack of knowledge
- Lack of a renewable energy market
- Lack of initiatives and investment interest
- Lack of policies
- Lack of financial tools
- Lack of financial guarantee and perceive risk
- Lack of leadership
- Corruption or lack of transparency

These findings reveal that even though many new business models exist for the implementation of renewable energy in a global market in the Dominican Republic the only model in implementation is traditional. However, only 28% of the stakeholders had a clear understanding of the diverse business models and understood which one is implemented in the Dominican Republic, as EI12 explain:

"The strategy that we implement is economic interest."

Furthermore, the interviews reveal that 40% of the stakeholders had no knowledge of business models for renewable energy, as one of the interviewees explains:

“We don’t implement any renewable energy business plan.”

And 32% of the interviewees believe that the different types of renewable energy represent the different business plans, as one stakeholder said:

“going accord with the diversity of generation.”

The DR is a prime example of having all the natural resources and the need for a REBM, but not the leadership to implement this. The DR is faced with many challenges and even more drivers to transform from fossil fuel to a Renewable energy economy. The challenges that this country faces can be divided in two:

(1) Technical challenges that relate to the generation, distribution and overall system of the energy production in the DR (Distribution loses of 42%, poor connection of the grip, tariff system and more).

(2) Non-technical challenges that relate to the population and self-measures taken to provide illegal energy. (Theft of energy, illegal connections, none payment of the tariff bill and more).

However, this is specifically the areas to focus on to aid in implementing the REBM.

Despite the DR sustainable energy ambitions and policy statements, this country has been unable to comprehensively design, synchronize, implement and maintain a successful plan or REBM to promote the solutions to exploit the full renewable potential of the country.

The international community has an important spot in the DR as, the World Bank, United Nations and many other institutions have been aiding in the development of the country. Through, loans and international joint projects with the private sector and the government. However, since one of the main issues in the DR is continuity, the projects rarely are maintaining and there for the business plan is not adequate for the country's situation.

The benefits of a REBM are clear, as this would promote the creation of jobs, improve the competitiveness of renewable energy in the country, increase health and lower pollution cost among others. It is also clear that the country pays an enormous socioeconomic price for its reliance on imported fossil fuel.

In this instance, Costa Rica is an example to follow. Although the country's needs are half of what the DR requires, Costa Rica sets a precedent that the REBM is the channel to achieve a sustainable energy infrastructure.

Despite all the challenges and obstacles that the DR faces the country continues to try to better its existing energy business plan and there for the energy infrastructure itself.

Still, powerful barriers exist in the DR, based on the literature and case study:

a) Unavailability of capital
b) Lack of knowledgeable personnel
c) Continuity of a Plan, Project or REBM
d) Lack of detail, obligations and measures for the policies created
e) Lack of Vision and foresight of the potential of Renewable Energy in the country
f) Lack of implementation or proper instrument for the implementation of renewable energy
g) Lack of an impartial government for the implementation of the necessary

measures for the utilization of Renewable energy in the country.

These 7 barriers organized from least to most important represent the challenges that the country must face and overcome.

The country has a National Energy Plan and a Climate Compatible Development Plan and has committed to halving emissions, from 2010 levels, by 2030. Despite the government's commitment to increasing renewable energy, the country's energy diversification strategies are focused mainly on coal and natural gas. Recent visions and plans do not align with current energy sector activities.

Accomplishing renewable energy goals is stymied by a confusing make-up of electricity sector actors, laws, and mandates and a lack of adherence to established laws and mechanisms for running the sector.

The financial challenge was a barrier that 100% of the interviewees highlighted in one form or another. 16% of the interviewees point at the reduction of the tax due to the reform to the RE law 57-07 that cut the taxes from 75% incentive to 35%, while 12% believed that the cut in incentives was needed.

Eight financial tools were currently found in the DR financial framework for energy and even less for RE. This does not mean that the tools found are implemented to capacity, some are partially implemented, and others are implemented in the fossil fuel energy sector.

A difference exists between an ideal environment and the reality of this environment. For the DR the RE environment is not ideal. The country has made several commitments to the climate change agreements, yet the RE energy market is underdeveloped and under-promoted. This research shows the gaps that exist between the knowledge that the stakeholders should possess and the actual knowledge that exists in the country regarding the financial aspect of a RE project. This enterprise into RE as has been noted before is key for the continuous development of the DR. However, due to a lack of leadership, knowledge and market development the RE in the country is poor and the commitment to its development is not reflected in a direct manner in the countries financial policies and more specifically the financial tools available for enhancing RE as the country has committed to in previous agreements.

The research shows that the greatest financial tool that is known to the stakeholders is loans. These loans in the DR are normally commercial or personal loans, as no RE-loan exist in the country. New regulations are taking into consideration solar panels as asset-backed for loans. However, this is a measure only for personal or auto-consume projects. For larger projects, the financial requirements differ, as, without an energy reputation and PPA, the chances of acquiring local funds approach zero. Of the 800MW that have been approved in the last ten years since the 57-07 law was created, only 25% have been implemented and are currently in service.

As the interviewees highlighted the financial aspect of a RE project is closer to a paradox, as for financial approval could take up to 4 years to be reviewed and approved and the PPA has a life cycle of 5 years, making the financial procedure for a loan more than 80% of the time of the PPA. Taken into account the need to have a reputation in the country as 22.2% of the interviewees agreed that this particular barrier makes international investment hard to be acquired and limits the financial tools that the project have access to.

The DR has a goal of 25% of RE for 2025 as one of the measures in the national strategic plan. However, no measure to remove the old fossil fuel generation has been taken or planned. In fact, a project for two carbon plant was approved, and the projects currently are halfway to completion. This indicates that the business is as usual as there is lack of vision for the energy market in the country. Unless the problems are well addressed, renewable energy developments will continue to be hindered and underdeveloped.

A financial incentive motivates actions which otherwise might not occur without the monetary benefit. With the reduction of the incentives, the government showed a clear sign of where their RE goals and vision is located. Also, by the approval, finance and construction of new coal power plant the direction of the energy system is clear.

Several areas of interest were highlighted in this research: (1) the need to align the legal and financial framework (2) financial education regarding the available tools and difference between financial policies and tools (3) the adoption and implementation of innovative financial tools in the market (4) define the roles of the RE players in a financial context. These are indicators of the low level of maturity and preparedness that the RE market possess in the DR. Also, and this demonstrates the lack of engagement of the government in RE matters and the lack of a unified and sustainable vision for the future.

In the DR, the ABS is usually created by the government and are called “Bonos Soberanos” or sovereign bonds, this is awarded to different initiatives, usually for fossil fuel or other commercial utilities. However, this has not been used for RE. In this regard, again the reputation and lack of leadership of the government interferes with the financial institutions as many of the entities do not recognise the bonds due to lack of trust in government funds and promises of payment.

The DR as many countries face the issues of government aspirations and the factual reality. In the case of the DR several suggestions can be applied:

- The DR needs to stop reacting to climate change and the energy issue in the country and region and start pro-actively taking measures, such as:
    - A 10-15 years continuous plan to deface or dismantle fossil fuels in the country
    - Decentralization of the energy grid with a mix RE concentration in each region to guarantee the current and future energy demand
    - The change from a Radial grid network to a ring or to a mesh distribution as to guarantee a high level of penetration of the RE in the Grid
    - To ensure not just the creation of a RE financial law but the correct implementation and continuity of the law.
    - The assurance of assets creation for RE
    - The government participation to ensure that all financial institutions adhere to the financial and political RE laws.
    - The implementation of renewable portfolio standard (RPS) to enhance the production of energy from renewable resources by all the electricity supplier companies
    - A nationwide educational program in RE and not just in energy efficiency.

This measures along with the conclusions are time sensitives as the decisions of the DR government to invest in coal energy production could potentially lock the energy market in a fossil fuel-based economy for the next 10-20 years.

It can be deduced from the research each CSFs augments the possibilities of success. However, this is not a 100% guarantee that the project will, in fact, succeed there are cases where the project has failed, and on the contrary, others have succeeded. The important pieces of any project that must be taken into account is the identification of the CSFs, and measures for them that have been correctly implemented properly to achieve a higher possibility of success.

CSFs reveal areas that must be monitored over time. In the case of the DR, these areas are (a) Correct implementation of the legal Framework, as 72% of the key actors highlighted the country has sufficient laws. However, it is in the implementation of the renewable and energy legislation that the actors find insufficient. For this purpose, a re-check of the laws and how and who implements them is needed by the government in cooperation with the private sector (most affected by this CSFs) (b) Creation of financial tools for renewable energy projects.

An 84% of the actors explain that the tools or funds for large renewable energy projects do not exist in the DR. 90% of the successful projects in the country have been self-financed or internationally finance (International aid organisations) (c) Coordination between the different actors. The discombobulation of the system to obtain a project and then the communication between all the players involved leaves many gaps that have been unfulfilled, and that creates a state of confusion and generate a perceived risk for a renewable energy project that deters many investors and organisations from investing in renewables in the country. (d) Transparency in the legal and financial tools available. The interviews reveal that the lack of proper transparency in the financial instruments (banks) and on the legal aspects (PPA) creates, a perceived risk, that does not actually exist, but the uncertainty of the process for obtaining the project and the funds diminishes the importance and need of renewables in the country. Another of the general CSFs is (e) Update and provide access to the grid.

This particular CSFs is the cost of more than 20% of a project additional or expensive cost of any project in the DR, as the lines as not suitable for renewable injection on a large scale, the owners of the project most see fit to suit them and this presents a sure method to fail if not taken into account. This establishes that with the right legal and financial framework and technical solutions, the DR can be a key country in the region for attracting significant investment in renewable energy.

Interview analysis along with literature and document review lead to uncovering the potential success areas for future renewable energy projects for which an organisation can measure and monitor to ensure success. This CSFs, although they produce tangible results, also provide processes that help a project, institution and hopefully the country establish strong ways of thinking, communicating, and making decisions in regards to renewable energy.

The CSFs and KPIs will aid stakeholders, especially decision makers, to make the best decision to develop RE in the DR at the same time, will promote developers and investors into increasing the RE projects and economy in the country. This help will showcase to the government and the public that it is in the country's best interest to invest in RE.

The areas that should be further research are the diversification of the electricity generation portfolio, wind and solar are especially feasible and should be fundamental in the country's energy mix. This diversification could be essential to reduce the country dependence on fuel imports and improve the energy supply security considering the fast-growing energy demand. The decentralisation of the grid, as currently 80-88% of the country is connected to one grid, yet the unreliability and instability of the grid still cause several blackouts and grey-outs in the country.

11.6 Recommendations

- For the Dominican Republic, the solar study of the potential need to be redone as the last time it was measured was back in 2001.
- Recalculations of the efficiency, energy demand, purchase of energy, generation and distribution of energy need to be further studied as the reports from different organizations do not match
- The decentralization of the Energy grid could be a possible solution for developing countries, which should be researched and tested before a reasonable conclusion can be made.

11.6.1 Recommendations for government

- The creation of renewable energy portfolio standards is necessary for the Dominican Republic
- De-monopolizing, the Energy market in the DR, is a possible solution, as competition on the Energy business would help diversify the energy sources

and educate the population as to make an informed decision.

- Intelligent Grid solutions for the replacement of the current grid.
- The law 57-07 along with the electricity law showed be checked and expanded to include, tidal, wave, hybrid and storage for renewable energy
- The FIT should be recalculated based on the LCOE as to produce an actual applicable range of prices for the different renewable energies
- The entities in charge of renewable energy should have a clear understanding of their role, and the public should understand their role.
- The guide created in this study should be made into a webpage and database to function as a common point for all the information.
- The government's support should be more profound than just incentives. A whole programme of education of the population in renewable energy should be performed
- The decentralisation of the Energy grid could be a possible and conjoint solution for the country, which should be researched and tested before a reasonable conclusion can be made. Along with:
    - Improved System design for Renewable Energy
    - Build sustainable growth strategies.
    - Sustainability in supply chains

- Energy storage is a must for research into renewable energy. As many actors (Utilities, distribution, generation and the industry at hand) believed that affordable storage is the missing link for the reliability (24/7) of renewable energy, such as solar and wind. However, reservations still exist regarding the affordability of such storage. Even though, much progress has been achieved in the area.

- The grid should be updated as to permit the penetration of renewable energy at a greater level. Also, a strategy for the decentralization of the grid should be designed and implemented to avoid load-shedding
- A dephasing strategy should be implemented, as new energy generator whether renewable or not are only built to deal with the growing demand. However, the existing fossil fuel generators are old and decaying a strategic plan show be to design and implemented to slowly remove the fossil fuel from operations and replace it with renewables.
- The education on the different international funds and aids available to the private sector should be carried out, or a webpage made with the information and links made available for the population to use.
- The potential and solar needs to be recalculated and for biomass, it needs to be performed along with tidal and waves energy. Continues systems need to be evaluated for energy storage.

11.6.1.1 *Policy Recommendations*

- The ministry of mine and energy should stablish a mandatory program for the use of renewable energy that equals the 20% of the energy demand by 2020. This program should be evaluated yearly and increased based on the demands and goals of the country.
- The different entities involved in the generation, transitions and distribution of energy should submit to the ministry the data of their operation for monitoring and calculations of dephasing of fossil fuel, LCOE and projections of the energy demand and supply.

- The LCOE should be calculated every 4 years to accommodate the change in government in the DR.
- The ministry should carry out an energy audit every month by a specific software and random in-situ visit to emerging projects and stablish project to ensure the regulations are being correctly implemented.
- The law and regulations should clearly state any sanctions that a project could incur if policies and regulations are not implemented correctly.
- The law should establish educational programs for the population in every stage from primary to postgraduates and add educational programs on the entity's web site, inside the institution and for the general population.
- A renewable energy growth plan should be created and implemented, along with a dephasing plan for fossil fuel.
- Competitive laws regarding renewable energy should be created.
- Financial involvement of the financial sector should be included in the law. Providing the sector with the needed guidance to participate in the renewable energy market.

11.6.2 Recommendation for the Public Sector

- Distribution company
  - The bill for electricity should show the sources of energy, not just the different price range
  - The option of what energy source does the population want their energy to come from should be given to the population

11.6.3 Recommendation for the private sector

- Industry

- The implementation of renewable energy business models is needed in the Dominican Republic
- Energy efficient tools and instruments need to be implemented to improve the monitoring of the existing energy and system.

    - Recommendation for the academic sector

- The inclusion of renewable energy subjects in the curriculum of all levels of study, from school to undergraduates to masters.
- Subjects to be included should cover more than just potential and efficiency.
- The calculations of LCOE
- The mechanics of the technology for renewable
- The financial aspect of renewable energy from technology to implementing projects
- The management and operations of a renewable energy project
- Integration and penetration to the grid
- The business model viewpoint of renewable energy
- Advantages and disadvantages
- The law and the impacts of implementing renewable energy laws and standards

11.6.4 Recommendation for consultants (Law, management, construction, engineers)

- Law:
    - The creation of the standards for renewable energy
    - Learned the process of the government in project solicitation
- Construction
- Education and training regarding the construction and maintenance of the different stages of a renewable energy project

11.6.5 Recommendation for auto-production (Consumers)

- Cooperation of population for the share ownership of macro scale renewable energy project then can guarantee the energy flow for the number of owners, and that can possibly create revenue for the cooperative.
- Crowdfunding to implement renewable energy projects.

11.7 Future Work

- Challenges of implementation of a renewable energy project: the case study of the Dominican Republic
- Drivers to implementation of renewable energy projects in developing nations
- Benefits of implementing renewable energy in a macro and micro scale in developing countries

- financial modelling of renewable energies
- storage alternatives for renewable energy
- Grid modification for renewable energy penetration
- evaluation of different grid combinations for effective grid management.

References.

[1]. Abraham, S. & Mills, M. P., (2013). Sovereign Energy Independence The geopolitical objective of “independence” is really about preventing one or a few.

[2]. Luthra, S., Garg, D. and Haleem, A., 2015. An analysis of interactions among critical success factors to implement green supply chain management towards sustainability: An Indian perspective. Resources Policy, 46, pp.37-50.

[3]. Betancourt, J.R., Green, A.R., Carrillo, J.E. and Owusu Ananeh-Firempong, I.I., 2016. Defining cultural competence: a practical framework for addressing racial/ethnic disparities in health and health care. Public health reports.

[4]. Lozano, R., 2015. A holistic perspective on corporate sustainability drivers. Corporate Social Responsibility and Environmental Management, 22(1), pp.32-44.

[5]. Luthra, S., Garg, D. and Haleem, A., 2016. The impacts of critical success factors for implementing green supply chain management towards sustainability: an empirical investigation of Indian automobile industry. Journal of Cleaner Production, 121, pp.142-158.

[6]. Bloche-Daub, K., Witt, J., Lenz, V. and Nelles, M., 2017. Global Markets and Trends for Renewables. In Marketing Renewable Energy (pp. 27-47). Springer, Cham.

[7]. Azzimonti, M., 2018. Partisan conflict and private investment. Journal of Monetary Economics, 93, pp.114-131.

[8]. Winnubst, J., 2017. Organizational structure, social support, and burnout. In Professional burnout (pp. 151-162). Routledge.

[9]. Ferruzzi, G., Cervone, G., Delle Monache, L., Graditi, G. and Jacobone, F., 2016. Optimal bidding in a Day-Ahead energy market for Micro Grid under uncertainty in renewable energy production. Energy, 106, pp.194-202.

[10]. Cerqueiro, G., Ongena, S. and Roszbach, K., 2016. Collateralization, bank loan rates, and monitoring. The Journal of Finance, 71(3), pp.1295-1322.

[11]. Yoder, W.R., Karyotaki, E., Cristea, I.A., van Duin, D. and Cuijpers, P., 2019. Researcher allegiance in research on psychosocial interventions: meta-research study protocol and pilot study. BMJ Open, 9(2), pp.bmjopen-2018.

[12]. Scoones, I., Leach, M. and Newell, P. eds., 2015. The politics of green transformations. Routledge.

[13]. Gandhi, S., Mangla, S.K., Kumar, P. and Kumar, D., 2015. Evaluating factors in implementation of successful green supply chain management using DEMATEL: A case study. International strategic management review, 3(1-2), pp.96-109.

[14]. ADEME/ Energie-Cités. (2005). Planning for Small Hydro Himachal Pradesh

[15]. Ahmed, B. A., (2018). Overcoming the Challenges of Financing Utility Scale. Issue 2011, pp. 21-24.

[16]. Sandberg, M., Klockars, K. and Wilén, K., 2019. Green growth or degrowth? Assessing the normative justifications for environmental sustainability and economic growth through critical social theory. Journal of Cleaner Production, 206, pp.133-141.

[17]. Uhl, A. and Gollenia, L.A. eds., 2016. A handbook of business transformation management methodology. Routledge.

[18]. Itskhoki, O. and Moll, B., 2019. Optimal development policies with financial frictions. Econometrica, 87(1), pp.139-173.

[19]. Grant, C. and Osanloo, A., 2014. Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house". Administrative Issues Journal, 4(2), p.4.

[20]. Pendse, A. and Inman, A.G., 2017. International student-focused counseling research: A 34-year content analysis. Counselling Psychology Quarterly, 30(1),

pp.20-47.

[21]. Vermeire, M., (2012) Everything you need to know about marine fuels. Chevron Global Marine Products.

[22]. Nasirov, S., Silva, C. and Agostini, C., (2015). Investors' perspectives on barriers to the deployment of renewable energy sources in Chile. Energies, 8(5), pp.3794-3814.

[23]. Zheng, Y., Hu, Z., Wang, J. and Wen, Q., (2014). IRSP (integrated resource strategic planning) with interconnected smart grids in integrating renewable energy and implementing DSM (demand side management) in China. Energy, 76, pp.863-874.

[24]. Bhattacharya, M., Paramati, S.R., Ozturk, I. and Bhattacharya, S., (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. Applied Energy, 162, pp.733-741.

[25]. Bouckaert, S., Mazauric, V. and Maïzi, N., (2014). Expanding renewable energy by implementing demand response. Energy Procedia, 61, pp.1844-1847.

[26]. Seymour, S., (2016). Assessing community forest resources to determine potential for biomass district heating in one rural and one remote First Nation of Northwestern Ontario (Doctoral dissertation).

[27]. Winfield, M. and Dolter, B., (2014). Energy, economic and environmental discourses and their policy impact: The case of Ontario′ s Green Energy and Green Economy Act. Energy Policy, 68, pp.423-435.

[28]. Mulvihill, P., Winfield, M. and Etcheverry, J., (2013). Strategic environmental assessment and advanced renewable energy in Ontario: moving forward or blowing in the wind?. Journal of Environmental Assessment Policy and Management, 15(02), p.1340006.

[29]. Bouckaert, S., Mazauric, V. and Maïzi, N., 2014. Expanding renewable energy by

implementing demand response. Energy Procedia, 61, pp.1844-1847.

[30]. Brimmo, A.T., Sodiq, A., Sofela, S. and Kolo, I., (2017). Sustainable energy development in Nigeria: Wind, hydropower, geothermal and nuclear (Vol. 1). Renewable and Sustainable Energy Reviews, 74, pp.474-490.

[31]. Madriz-Vargas, R., Bruce, A. and Watt, M., (2018). The future of Community Renewable Energy for electricity access in rural Central America. Energy research & social science, 35, pp.118-131.

[32]. Aune, F.R., Dalen, H.M. and Hagem, C., 2012. Implementing the EU renewable target through green certificate markets. Energy Economics, 34(4), pp.992-1000.

[33]. Schelly, C., 2014. Implementing renewable energy portfolio standards: The good, the bad, and the ugly in a two-state comparison. Energy Policy, 67, pp.543-551.

[34]. Mondal, M.A.H., Kamp, L.M. and Pachova, N.I., 2010. Drivers, barriers, and strategies for implementation of renewable energy technologies in rural areas in Bangladesh—An innovation system analysis. Energy Policy, 38(8), pp.4626-4634.

[35]. Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K. and Kyngäs, H., (2014). Qualitative content analysis: A focus on trustworthiness. SAGE open, 4(1), p.2158244014522633.Black, K. (2010) "Business Statistics: Contemporary Decision Making" 6th edition, John Wiley & Sons

[36]. Krippendorff, K., (2018). Content analysis: An introduction to its methodology. Sage publications.

[37]. Petrova, M.A., (2016). From NIMBY to acceptance: Toward a novel framework—VESPA—For organizing and interpreting community concerns. Renewable energy, 86, pp.1280-1294.

[38]. Ajayi, O.O., Fagbenle, R.O., Katende, J. and Okeniyi, J.O., (2011). Availability of wind energy resource potential for power generation at Jos, Nigeria. Frontiers in

Energy, 5(4), pp.376-385.

[39]. Nawaz-ul-Huda, S., Burke, F., Azam, M. and Naz, S., (2017). GIS for power distribution network: A case study of Karachi, Pakistan. Geografia-Malaysian Journal of Society and Space, 8(1).

[40]. Al-Amir, J. & Abu-Hijleh, B., (2013). Strategies and policies from promoting the use of renewable energy resource in the UAE. Renewable and Sustainable Energy Reviews, Volume 26, pp. 660-667.

[41]. Alexander Ochs, Xing Fu-Bertaux, Mark Konold, Shakuntala Makhijani, Sam Shrank, C. A. (2011) ‘Roadmap to a Sustainable Energy System: Harnessing the Dominican Republic’s Wind and Solar Resources’, p. 139.

[42]. Alrikabi, N. K. M. A., (2013). Renewable Energy Types. Journal of Clean Energy Technologies, 2(1), pp. 61-64.

[43]. Arnette, A. N. (2017) ‘Renewable energy and carbon capture and sequestration for a reduced carbon energy plan: An optimization model’, Renewable and Sustainable Energy Reviews. Elsevier, 70(November 2016), pp. 254–265. doi: 10.1016/j.rser.2016.11.218.

[44]. Sahoo, S.K., 2016. Renewable and sustainable energy reviews solar photovoltaic energy progress in India: A review. Renewable and Sustainable Energy Reviews, 59, pp.927-939.

[45]. Asif, M. and Muneer, T. (2007) ‘Energy supply, its demand and security issues for developed and emerging economies’, Renewable and Sustainable Energy Reviews, 11(7), pp. 1388–1413. doi: 10.1016/j.rser.2005.12.004.

[46]. Aslani, A. and Mohaghar, A. (2013) ‘Business structure in renewable energy industry: Key areas’, Renewable and Sustainable Energy Reviews. Elsevier, 27, pp. 569–575. doi: 10.1016/j.rser.2013.07.021.

[47]. Aspects, E. (2005) 'Planning for Small Hydro Himachal Pradesh (India)', (January 1995), pp. 1–4.

[48]. Atalay, Y., Kalfagianni, A. and Pattberg, P. (2017) Renewable energy support mechanisms in the Gulf Cooperation Council states: Analysing the feasibility of feed-in tariffs and auction mechanisms, Renewable and Sustainable Energy Reviews, Elsevier, 72(January), pp. 723–733.

[49]. Attri, R., Dev, N. and Sharma, V. (2013) Interpretive Structural Modelling (ISM) approach: An Overview. Research Journal of Management Sciences. 2(2), February 2013, pp. 3-8.

[50]. Auth, K., Konold, M., Musolino, E. and Ochs, A. (2013) 'Caribbean Sustainable Energy Roadmap (C-SERMS), Phase 1 Summary and Recommendations for Policymakers Executive Summary', (June 2013).

[51]. Avato, P. and Coony, J. (2008) Accelerating Clean Energy Technology Research , Development , and Deployment, Transport.

[52]. Awopone, A. K., Zobaa, A. F. and Banuenumah, W. (2017) Techno-economic and environmental analysis of power generation expansion plan of Ghana, Energy Policy, Elsevier, 104(January), pp. 13–22.

[53]. Baez, J. E. and Lopez-Calva, L. (2014) When Prosperity is not Shared: The Weak Links between Growth and Equity in the Dominican Republic, (January).

[54]. Baharuddin A., Kamaruzzaman S., Chan Hoy Y., Sohif M. and Azami Z. (2008) Key success factors in implementing renewable energy programme in Malaysia. WSEAS Transactions on Environment and Development. 12(4) Dec-2008, pp. 1141-1150.

[55]. Bank, E. I. (2007) Mécanisme Financier pour le développement de l ' Efficacité Énergétique et des Énergies Renouvelables Dans les pays sud- et est-Méditerranéens, Revue, p. 210.

[56]. Behrangrad, M. (2015) ‘A review of demand side management business models in the electricity market’, Renewable and Sustainable Energy Reviews. Elsevier, 47, pp. 270–283. doi: 10.1016/j.rser.2015.03.033.

[57]. Bella, G. Di, Norton, L., Ntamatungiro, J., Ogawa, S., Samake, I. and Santoro, M. (2015) Energy Subsidies in Latin America and the Caribbean: Stocktaking and Policy Challenges.

[58]. Bellini, J.L., (2017). *Research in Rehabilitation Counseling: A Guide To Design, Methodology, And Utilization*. Charles C Thomas Publisher.

[59]. Beltramello, A., Haie-Fayle, L. and Pilat, D. (2013) ‘Why New Business Models Matter for Green Growth’, Paris, France: OECD, 01(February), pp. 1–107. doi: 10.1787/5k97gk40v3ln-en.

[60]. Betzold, C. (2016) Fuelling the Pacific: Aid for renewable energy across Pacific Island countries, Renewable and Sustainable Energy Reviews, 58(April), pp. 311–318.

[61]. Bilgili, F. (2015) Business cycle co-movements between renewables consumption and industrial production: A continuous wavelet coherence approach, Renewable and Sustainable Energy Reviews, Elsevier, 52, pp. 325–332.

[62]. Bidwell, D., (2013). The role of values in public beliefs and attitudes towards commercial wind energy. Energy Policy, 58, pp.189-199.

[63]. Biomass Energy Resource Center. (2009). the village of Oujé-Bougoumou, Quebec, Canada Waste Wood Helps Fuel a Native Community’s Development

[64]. Birf, R. D. E. L. (2010) Problemas energéticos: Obtención de energí Latina y el Caribe,.

[65]. Blair, N., Jenkin, T., Milford, J., Short, W., Sullivan, P., Evans, D., Lieberman, E., Goldstein, G., Wright, E., Jayaraman, K. R., Venkatesh, B., Namovicz, C., Smith, B.,

Palmer, K., Wiser, R. and Wood, F. (2009) Renewable Energy and Efficiency Modelling Analysis Partnership (REMAP): An Analysis of How Different Energy Models Addressed a Common High Renewable Energy Penetration Scenario in 2025 Gary Kleiman Northeast States for Coordinated Air Use Management,

[66]. Blazejczak, J., Braun, F. G., Edler, D. and Schill, W. P. (2014) Economic effects of renewable energy expansion: A model-based analysis for Germany, Renewable and Sustainable Energy Reviews, Elsevier, 40, pp. 1070–1080.

[67]. Bobinaite V, Tarvydas D. (2014). Financing instruments and channels for the increasing production and consumption of renewable energy: Lithuanian case. Renew Sustain Energy Rev 2014.38:259–76. doi: 10.1016/j.rser.2014.05.039.

[68]. Budzianowski, W. M. (2017) ‘High-value low-volume bioproducts coupled to bioenergy’s with potential to enhance business development of sustainable biorefineries’, Renewable and Sustainable Energy Reviews. Elsevier Ltd, 70(December 2016), pp. 793–804. doi: 10.1016/j.rser.2016.11.260.

[69]. Bonini, S. and Görner, S. (2011) The business of sustainability: Putting it into practice, Insights & Publications, p. 6.

[70]. Bonini, S. and Swartz, S. (2014) Profits with purpose: How organizing for sustainability can benefit the bottom line, McKinsey on Sustainability & Resource Productivity, pp. 1–15.

[71]. Bonini, S. and Swartz, S. (2014) Bringing discipline to your sustainability initiatives, Insights and Publication, McKinsey & Company, pp. 1–6.

[72]. Bonnett, M. (2017) Environmental Consciousness, Sustainability, and the Character of Philosophy of Education, Studies in Philosophy and Education, Springer Netherlands, 36(3), pp. 333–347.

[73]. Bordeianu, O. and Morosan-danila, L. (2013) Development And Validation Of Research Instruments For Cross-, (May).

[74]. Bradley, A. (2014) Accenture-Improving-Analysis-Decision-Making-Upstream, (March), pp. 34–35.

[75]. Brown, S. and Miller, W. R. (2006) Transformational change., Judeo-Christian perspectives on psychology: Human nature, motivation, and change., pp. 167–183.

[76]. Buchalska, J., Chmielewski, K. and Doczekalska, A. (2015) the Concept of Corporate Reputation in Marketing and Polish Law — the Search for Interdisciplinary Communication, Ekonomia i Prawo, 14(2), p. 189.

[77]. Budzianowski, W. M. (2017) High-value low-volume bioproducts coupled to bioenergies with potential to enhance business development of sustainable biorefineries, Renewable and Sustainable Energy Reviews, Elsevier Ltd, 70(December 2016), pp. 793–804

[78]. Bull G. (2009). IFC advisory services in Latin America and the Caribbean Sustainable Energy Finance (SEF) Program Contacts : 2009:2009–10.

[79]. Call, J. I., Open, R., Articles, A., Articles, M. D. and Articles, R. (2014) Renewable & Sustainable Energy Reviews, pp. 1–2.

[80]. Caneva, S. and Alonso, P. (2018) Crowdfunding Renewable Energy – A practical guide for Crowdfunding Platforms, Project Developers, Investors and Policy Makers.

[81]. Carter, N., Bryant-Lukosius, D., Blythe, J., Neville, A. J. and DiCenso, A. (2014) The Use of Triangulation in Qualitative Research, Oncology Nursing Forum, 41(5), pp. 545–547.

[82]. Central, B. and Bello, E. N. (2015) Determinantes del Riesgo Soberano en la República Dominicana Banco Central de la República Dominicana Gobernador

Héctor Valdez Albizu Clarissa de la Rocha de Torres Gerente Ervin Novas Bello Subgerente de Políticas Monetaria , Cambiaria y Financiera Joel, (14).

[83]. Chang, R. D., Zuo, J., Zhao, Z. Y., Zillante, G., Gan, X. L. and Soebarto, V. (2017) 'Evolving theories of sustainability and firms: History, future directions and implications for renewable energy research', Renewable and Sustainable Energy Reviews. Elsevier, 72(January), pp. 48–56. doi: 10.1016/j.rser.2017.01.029.

[84]. Chen, H., Kang, J. N., Liao, H., Tang, B. J. and Wei, Y. M. (2017) Costs and potentials of energy conservation in China's coal-fired power industry: A bottom-up approach considering price uncertainties, Energy Policy, Elsevier, 104(August 2016), pp. 23–32

[85]. Chernaev, I. and Thesis, M. (2014) A distinct market for renewable energy - evidence and practice Analysis of a possible narrow market definition and relevant competition law issues, pp. 1–61.

[86]. Cheung S, Sundaresan S. (2007). Lending Without Access to Collateral A Theory of Micro-Loan Borrowing Rates &amp. Defaults 2007.

[87]. Chien Bong, C.P., Ho, W.S., Hashim, H., Lim, J.S., Ho, C.S., Peng Tan, W.S. and Lee, C.T. (2017) Review on the renewable energy and solid waste management policies towards biogas development in Malaysia. Renewable and Sustainable Energy Reviews [online], 70pp. 988-998.

[88]. Chirambo, D. (2016) Addressing the renewable energy financing gap in Africa to promote universal energy access: Integrated renewable energy financing in Malawi, Renewable and Sustainable Energy Reviews, 62, pp. 793–803.

[89]. Cicea, C., Marinescu, C., Popa, I. and Dobrin, C. (2014) Environmental efficiency of investments in renewable energy: Comparative analysis at macroeconomic level, Renewable and Sustainable Energy Reviews, 30, pp. 555–564.

[90]. Closas, A. and Rap, E. (2017) Solar-based groundwater pumping for irrigation: Sustainability, policies, and limitations, Energy Policy, Elsevier, 104(January), pp. 33–37.

[91]. Comisión Nacional de Energía (2012) ‘Ley número 57-07’.

[92]. Comisión Nacional de Energía (2015) ‘Electricidad - Comisión Nacional de Energía’. Available at: https://www.cne.cl/estadisticas/electricidad/.

[93]. Comision Nacional De Energia (2017). Boletin 2017

[94]. Comisión Nacional de Energía. Ley número 57-07 2012.

[95]. Concessions, P. (2010) IBRD Results, (March), pp. 1–6.

[96]. Cooperation, A.-P. E. (2009) Successful Business Models for New and Renewable Energy Technology Implementation in APEC APEC Energy Working Group October 2009, (October).

[97]. Coady, D., Parry, I., Sears, L. and Shang, B. (2015) How Large Are Global Energy Subsidies?, IMF Working Papers, 15(105), p. 1.

[98]. Correia, J. C. and Tennfjord, M. N. (2014) Critical components of business models for renewable energy based rural electrification, (July).

[99]. Cosgrove-Davies, M. and Cabraal, A. (1994) Least Cost Analysis of Renewable Energy Projects, IEEE Photovoltaic Specialists Conference - 1994, 1994 IEEE First World Conference on Photovoltaic Energy Conversion, 1994., Conference Record of the Twenty Fourth., pp. 2387–2390.

[100]. CSC (2016) Payment Success Notice, Journal of Chemical Information and Modeling, p. 1.

[101]. Creswell, J. W. (2007) Qualitative Inquiry and Research Design: Choosing Among Five Approaches, Book.

[102]. Council, W. E. (2013) World energy resources: a survey, Energy Policy, 3(1), pp. 58–66.

[103]. D'Ortenzio, C. (2012) Understanding Change And Change Management Processes : A Case Study by Carlo D ' Ortenzio Thesis submitted in fulfilment of requirements for the degree of Doctor of Philosophy at the University of Canberra, (August).

[104]. Cunha, B. (2011) DR-CAFTA and the Environment, (October), p. 30, [online] Available from: http://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-5826.CSC (2016) Payment Success Notice, Journal of Chemical Information and Modeling, p. 1.

[105]. DEA (2015) 'The Danish Energy Model', Danish Energy Agency, p. 16.

[106]. Del Río, P. and Burguillo, M. (2009) An empirical analysis of the impact of renewable energy deployment on local sustainability.

[107]. Del, D. (2005) BANCO MUNDIAL Este documento es de dominio público Banco Internacional Para La Reconstruccion Y El Fomento En La Cantidad De Us $ 150 Millones Unidad de Gestión de Finanzas , Sector Privado , y Sector de Infraestructura Unidad de Gestión de Países del Car.

[108]. Demográfica de Salud, E. (2013) República Dominicana.

[109]. DEMPSEY, G., LENERO, O., BROWN, E., GOLD, A. and JAVETSKI, B. (2015) Sustainability & Resource Productivity, McKinsey&Company, (May).

[110]. Denner, L. And Blackman, T., (2013). Knowledge Management In The Public Sector: An Online Presence As A Tool For Capture And Sharing.

[111]. Dentinger, S. (2009) Drivers and Implementation of Change, Lnu.Diva-Portal.Org.

[112]. DETI, DoE and DARD (2012) 'Communities and Renewable Energy : a Study', Action Renewables. Centre for Sustainable Energy. Ricardo Aea, pp. 1–82.

[113]. Diamanti, K., Ioannou, L., Pouloudi, A. and Baglee, D. (2008) Supportive mechanisms for effective change management, International Journal of Information Systems and Change Management, 2(4), p. 307.

[114]. Dji. (2011) Country Classification System. Dow Jones Indexes 2011:1–3.

[115]. Dolezal, A., Majano, A. M., Ochs, A. and Palencia, R. (2013) 'The Way Forward for Renewable Energy in Central America', Worldwatch Institute, (June), pp. 1–88. Available at: http://www.worldwatch.org/system/files/The Way Forward for Renewable Energy in Central America_low-res2.pdf.

[116]. Dominicana, C. de la R. (2011) Ley 189-11 Para El Desarrollo Del Mercado, pp. 1–107.

[117]. Dominicana, R. (2004) Análisis de Tarifas y Subsidios en el Sector Eléctrico de la República Dominicana informe final.

[118]. Dominicana, R., La, C. D. E. and Distribución, G. D. E. (2007) E1788, pp. 1–92.

[119]. Donastorg A, Renukappa S, Suresh S. Financing Renewable Energy Projects in Developing Countries: A Critical Review. IOP Conf. Ser. Earth Environ. Sci., vol. 83, 2017. doi:10.1088/1755-1315/83/1/012012.

[120]. Dvořìk, P., Martinït, S., der Horst, D. Van, Frantïl, B. and Turečkovï, K. (2017) 'Renewable energy investment and job creation. a cross-sectoral assessment for the Czech Republic with reference to EU benchmarks', Renewable and Sustainable Energy Reviews, 69(November 2016), pp. 360–368. doi: 10.1016/j.rser.2016.11.158.

[121]. Ebeke, C. and Ngouana, C. L. (2015) Energy subsidies and public social spending: Theory and evidence, (15–101).

[122]. Elliott, D. L. (2001) Wind energy resource atlas of the Dominican Republic, p. 218 p. in various pages.

[123]. Emerson, R.W., 2015. Convenience sampling, random sampling, and snowball sampling: how does sampling affect the validity of research?. Journal of Visual Impairment & Blindness, 109(2), pp.164-168.

[124]. Énergie, C. M. D. E. L., Gadonneix, P., Kim, Y. D., Meyers, K. and Ward, G. (2013) 'World Energy Scenarios'.

[125]. Engelken, M., Römer, B., Drescher, M., Welpe, I. M. and Picot, A. (2016) Comparing drivers, barriers, and opportunities of business models for renewable energies: A review, Renewable and Sustainable Energy Reviews, Elsevier, 60, pp. 795–809.

[126]. EREC (2011) Mapping Renewable Energy Pathways towards 2020, European Renewable Energy Council, p. 28.

[127]. Esteves J., (2005) Definition and analysis of critical success factors for ERP implementation projects. Thesis for fulfilment of Doctor of philosophy degree. Universidad Politecnica de Catalunya, spain.

[128]. Etikan, I. (2016) Comparison of Convenience Sampling and Purposive Sampling, American Journal of Theoretical and Applied Statistics, 5(1), p. 1.

[129]. Fernando, Y. and Yahya, S. (2015) Challenges in Implementing Renewable Energy Supply Chain in Service Economy Era, Procedia Manufacturing, Elsevier B.V., 4(Iess), pp. 454–460.

[130]. Ferroukhi, R., Lopez-Peña, A., Kieffer, G., Nagpal, D., Hawila, D., Khalid, A., El-Katiri, L., Vinci, S. and Fernandez, A. (2016) 'Renewable Energy Benefits: Measuring the Economics', IRENA International Renewable Energy Agency, p. 92.

[131]. Flick, U. (2009) An Introduction to Qualitative Research, Sage Publication, p. 581p.

[132]. Franco-Santos, M., Kennerley, M., Micheli, P., Martinez, V., Mason, S., Marr, B., Gray, D. and Neely, A. (2007) Towards a definition of a business performance

measurement system, International Journal of Operations and Production Management, 27(8), pp. 784–801.

[133]. Frankel, D., Ostrowski, K. and Pinner, D. (2014) The disruptive potential of solar power, McKinsey Quarterly, (April), pp. 1–7.

[134]. Frantzis, L., Graham, S., Katofsky, R. and Sawyer, H. (2008) Photovoltaics Business Models, Renewable Energy, (February).

[135]. Galuccio, M. (2014) Leading a Latin American shale revolution, (December).

[136]. Gardner, D. (2015) ‘Caribbean Sustainable Energy Roadmap and Strategy’, IRENA – Martinique conference on island energy transitions, p. 19. doi: 10.13140/RG.2.1.4351.1922.

[137]. Garg, A., Naswa, P. and Shukla, P. R. (2015) Energy infrastructure in India: Profile and risks under climate change, Energy Policy, 81, pp. 226–238.

[138]. Gintschel A, Hackethal A. (2004). Multi-bank loan pool contracts: enhancing the profitability of small commercial banks 2004.

[139]. Girard, J. (2015) Defining knowledge management: Toward an applied compendium, Online Journal of Applied Knowledge Management, 3(1), pp. 1–20.

[140]. Golusin, Mirjana., Popov, Stevan., And Dodic, Sinaa. (2013). Sustainable Energy Management. 1st Ed. Amsterdam .: Elsevier, Academic Press, 2013. Print.

[141]. González, A. M., Sandoval, H., Acosta, P. and Henao, F. (2016) On the acceptance and sustainability of renewable energy projects-a systems thinking perspective, Sustainability (Switzerland), 8(11).

[142]. Gouvello, C. (2010) Brazil Low-carbon Country Case Study, Brazil Low-carbon Country Case Study, p. 270.

[143]. Granade, H. C., Creyts, J., Derkach, A., Farese, P., Nyguist, S. and Ostrowski, K. (2009) Unlocking Energy Efficiency in the U.S. Economy, McKinsey Global Energy and Materials, pp. 1–165.

[144]. Group WB (2016). Building a Better Future Together 2016:185.

[145]. Group WB (2015). Doing Business in Central America and the Dominican Republic, 2015. World Bank Other Oper Stud 2015.

[146]. Grusenmeyer, D. (2012) Mission, Vision, Values & Goals, Retrieved May.

[147]. Guerrero-Liquet GC, Sánchez-Lozano JM, García-Cascales MS, Lamata MT, Verdegay JL. (2016). Decision-making for risk management in sustainable renewable energy facilities: A case study in the Dominican Republic. Sustain 2016.8. doi:10.3390/su8050455.

[148]. Hansen, B. H. and Kautz, K. (2010) Knowledge Mapping: A Technique for Identifying Knowledge Flows in Software Organisations, (January), pp. 126–137.

[149]. Harshman, C. (2006) Mission – Vision – Values : Toward Common Definitions, Online Journal, pp. 1–6.

[150]. Hartmann Anja; Huhn Wolfgang (2009) Energy: A key to competitive advantage -, McKinsey Germany, (April).

[151]. Hastings-Simon, S., Pinner, D. and Stuchtey, M. (2014) Brave new world : Myths and realities of clean technologies, McKinsey & Company, pp. 31–35.

[152]. Hoffman, I. M., Goldman, C. A., Rybka, G., Leventis, G., Schwartz, L., Sanstad, A. H. and Schiller, S. (2017) Estimating the cost of saving electricity through U.S. utility customer-funded energy efficiency programs, Energy Policy, 104(December 2016), pp. 1–12.

[153]. Holsman, R. H. and Bradley, A. (n.d.) How does social collaboration support the energy industry ?, p. 35.

[154]. Hossain, M. F., Hossain, S. and Uddin, M. J. (2017) ‘Renewable energy: Prospects and trends in Bangladesh’, Renewable and Sustainable Energy Reviews, 70(August 2014), pp. 44–49. doi: 10.1016/j.rser.2016.11.197.

[155]. Hughes, C. D., Requejo, F., Laurent, V., Karev, A. and McCue, J. (2015) The future of the global power sector Preparing for emerging opportunities and threats Contents, Deloitte Global Services Limited, p. 32.

[156]. Hsiang-Yung F., (2012) Key Factors influencing users intentions of adopting renewable energy technologies. Academix research International, 2(2) March 2012. Pp. 156-168.

[157]. IEA and World Bank (2014) Sustainable Energy for All: Global Tracking Framework, The world bank. doi: 10.1787/dcr-2013-20-en.

[158]. IEA (2015) Energy and Climate Change, World Energy Outlook Special Report, pp. 1–200.IEA and World Bank (2014) Sustainable Energy for All: Global Tracking Framework, The world bank

[159]. Imenda, S. (2017) Is There a Conceptual Difference between Theoretical and Conceptual Frameworks?, Journal of Social Sciences, 38(2), pp. 185–195.

[160]. IMF (2004) Chapter 5 . Classifications : Financial Instruments, Functional Categories, Maturity, Currency and Type of Interest Rate, (April), pp. 58–92.

[161]. Ince, D., Vredenburg, H. and Liu, X. (2016) Drivers and inhibitors of renewable energy: A qualitative and quantitative study of the Caribbean, Energy Policy, Elsevier, 98, pp. 700–712.

[162]. International Renewable Energy Agency (2016) ‘REmap, Renewable Energy Prospects: Dominican Republic, executive summary’, (July).

[163]. International Renewable Energy Agency, 2016. REmap, Renewable Energy Prospects: Dominican Republic. (July).

[164]. IRENA (2015) ‘Renewable energy prospects: United States of America’, (January), p. 243.

[165]. IRENA (2016), Renewable Energy Prospects: Dominican Republic, REmap 2030, International Renewable Energy Agency (IRENA), Abu Dhabi.

[166]. IRENA (2018) Renewable Energy Benefits: Leveraging Local Capacity for Offshore Wind.

[167]. IRENA (2017) Renewable energy benefits: Understanding the socio-economics, pp. 1–16.

[168]. IRENA (2015) Renewable Power Generation Costs in 2014 : An Overview, Irena, (January), p. 92.

[169]. IRENA (2014) Renewable Energy Prospects: China, REmap 2030 analysis, International Renewable Energy Agency (IRENA), (November).

[170]. IRENA (2015) Renewable energy prospects: United States of America, (January), p. 243.IRENA (2012) Renewable Energy Technologies: Cost Analysis Series, Biomass for Power Generation, 1(1/5), p. 60.

[171]. IRENA (2012) Hydropower, Renewable Energy Technologies: Cost Analysis Series, 1: Power s(3/5), p. 44.

[172]. IRENA (2012) Renewable Energy Technologies Cost Analysis Series: Concentrating Solar Power, Comprehensive Renewable Energy, 3(2), pp. 595–636.

[173]. IRENA (2012) RENEWABLE ENERGY TECHNOLOGIES: COST ANALYSIS SERIES Wind Power, Power Generation Technologies, 1(5), pp. 223–242.

[174]. Jebaraj, S. and Iniyan, S. (2006) A review of energy models, Renewable and Sustainable Energy Reviews, 10(4), pp. 281–311.

[175]. Jamasb, T., Newbery, D. and Pollitt, M. (2005) Core indicators for determinants and performance of the electricity sector in developing countries, pp. 1–36.

[176]. Jenkins M, Miguel Guevara L. (2014). Financing renewable energy: La Esperanza Hydroelectric Project. Manag Decis 2014.52:1724–49. doi:10.1108/MD-11-2013-0585.

[177]. Nesamalar, J., Venkatesh, P. and Raja, C.S. (2017) The drive of renewable energy in Tamilnadu: Status, barriers and future prospect, Renewable and Sustainable Energy Reviews, Elsevier, 73(January), pp. 115–124.

[178]. Salvatore, J. (2013) World Energy Perspective - Cost of Energy Technologies, World Energy Council, p. 48.

[179]. Kahia, M., Aïssa, M. S. Ben and Lanouar, C. (2017) Renewable and non-renewable energy use - economic growth nexus: The case of MENA Net Oil Importing Countries, Renewable and Sustainable Energy Reviews, Elsevier, 71(December 2016), pp. 127–140.

[180]. Karatayev, M., Hall, S., Kalyuzhnova, Y. and Clarke, M. L. (2016) Renewable energy technology uptake in Kazakhstan: Policy drivers and barriers in a transitional economy, Renewable and Sustainable Energy Reviews, Elsevier, 66, pp. 120–136.

[181]. Kavanagh M. (2016) A world map of subsidies for renewable energy and fossil fuels. Finance Times, 2016.:1.

[182]. Kenneth D. Strang. (2015). The Palgrave Handbook of Research design in business and management. First. Palgrave Macmillan. 2015.

[183]. Kempener, R., Lavagne d'Origue, O., Saygin, D., Skeer, J., Vinci, S. and Gielen, D. (2015) Off-grid renewable energy systems: Status and methodological issues (IRENA report).

[184]. Konold M., Lucky M., *et al.*, (2015) Roadmap to a Sustainable Energy System: Harnessing the Dominican Republic's Sustainable Energy Resources (Washington, DC: Worldwatch Institute, 2015).

[185]. Kothari, C., Kumar, R. and Uusitalo, O. (2014) Research Methodology, New Age International.

[186]. Lacy, P., Keeble, J., McNamara, R., Rutqvist, J., Haglund, T., Cui, M., Cooper, A., Pettersson, C., Eckerle, K., Buddemeier, P., Sharma, A. and Senior, T. (2014) 'Circular Advantage: Innovative Business Models and Technologies to Create Value in a World without Limits to Growth', Accenture Strategy, p. 24.

[187]. Lee CW, Zhong J. (2015) Financing and risk management of renewable energy projects with a hybrid bond. Renew Energy 2015.75:779–87. doi:10.1016/j.renene.2014.10.052.

[188]. Lee, C. Y. and Huh, S. Y. (2017) 'Forecasting new and renewable energy supply through a bottom-up approach: The case of South Korea', Renewable and Sustainable Energy Reviews. Elsevier, 69(November 2016), pp. 207–217. doi: 10.1016/j.rser.2016.11.173.

[189]. Lepper, P., Robinson, S., Theobald, P., Wang, L. and Wood, M. (2012) 'Theoretical determination of the long term contributions to ambient noise levels from offshore wind farm con- struction.', Bioacoustics, 33(5), pp. 1–8. doi: 10.1080/09524622.2008.9753825.

[190]. Lucas H, Ferroukhi R, Hawila D. (2013). About IRENA. 2013.

[191]. Martin, S., (2011). The sustainability case for community power: Empowering communities through renewable energy (Doctoral dissertation, York University).

[192]. Martinot, E., Cabraal, A. and Mathur, S. (2001) 'World Bank / GEF solar home system projects : experiences and lessons learned 1993 – 2000 1', Renewable and Sustainable Energy Reviews, 5, pp. 39–57.

[193]. Mathur, S. (2014) ‘Energy Transition Initiative: Island Energy Snapshot - Dominican Republic (Fact Sheet), U.S. Department of Energy (DOE), NREL (National Renewable Energy Laboratory)’.

[194]. McCusker, K. and Gunaydin, S., (2015). Research using qualitative, quantitative or mixed methods and choice based on the research. Perfusion, 30(7), pp.537-542.

[195]. McNabb, D.E., (2019). The Population Growth Barrier. In Global Pathways to Water Sustainability (pp. 67-81). Palgrave Macmillan, Cham.

[196]. Merenson C. (2001) Estrategia Nacional de Desarrollo Sustentable 2001:50.

[197]. Miller, L., Carriveau, R. and Harper, S., (2018). Innovative financing for renewable energy project development–recent case studies in North America. International Journal of Environmental Studies, 75(1), pp.121-134.

[198]. Mortensen, L., Hansen, A.M. and Shestakov, A. (2017) How three key factors are driving and challenging implementation of renewable energy systems in remote Arctic communities. Polar Geography, 40(3), pp. 163-185 .

[199]. Ng TH, Tao JY. (2016). Bond financing for renewable energy in Asia. Energy Policy 2016.95:509–17. doi:10.1016/j.enpol.2016.03.015.

[200]. No LEY, Nacional ELC. Ley no. 112-00 1 Government of the Dominican Republic, 2000.:1–7.

[201]. Ochs, A. Konold, M., Auth, K., Musolino, E. and Killeen, P. (2015). Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS): Baseline Report and Assessment. Washington, DC: Worldwatch Institute.

[202]. O'Connor, M., Lewis, T. And Dalton, G., (2013). Operational Expenditure Costs For Wave Energy Projects And Impacts On Financial Returns. *Renewable Energy*, *50*, Pp.1119-1131.

[203]. Parker L. (2010) Strategic Planning with Critical Success Factors and Future Scenarios: An integrated Strategic Planning Framework. Technical Report. Software Engineering institute

[204]. Parmenter D., (2008) Finding your organization's critical success factors. Waymark solutions limited.

[205]. Project, R. and Project, B. H. (1998) 'Real project biomass heating project', Power.

[206]. Qin, Q., Liang, F., Li, L. and Wei, Y. M. (2017) 'Selection of energy performance contracting business models: A behavioural decision-making approach', Renewable and Sustainable Energy Reviews, 72(January), pp. 422–433. doi: 10.1016/j.rser.2017.01.058.

[207]. Renewable, I. and Agency, E. (2015) 'REmap 2030, Renewable Energy Prospects: Germany', (November).

[208]. Richter, M. (2012) 'Utilities' business models for renewable energy: A review', Renewable and Sustainable Energy Reviews. Elsevier Ltd, 16(5), pp. 2483–2493. doi: 10.1016/j.rser.2012.01.072.

[209]. Richter, M. (2013) 'Business model innovation for sustainable energy: German utilities and renewable energy', Energy Policy. Elsevier, 62, pp. 1226–1237. doi: 10.1016/j.enpol.2013.05.038.

[210]. Sahin, O., Stewart, R. A., Giurco, D. and Porter, M. G. (2017) 'Renewable hydropower generation as a co-benefit of balanced urban water portfolio management and flood risk mitigation', Renewable and Sustainable Energy Reviews. Elsevier, 68, pp. 1076–1087. doi: 10.1016/j.rser.2016.01.126.

[211]. Scarlat, N., Motola, V., Dallemand, J.F., Monforti-Ferrario, F. and Mofor, L. (2015) Evaluation of energy potential of Municipal Solid Waste from African urban areas. Renewable and Sustainable Energy Reviews [online], 50pp. 1269-1286

[212]. Scott, I. (2017) ‘A business model for success: Enterprises serving the base of the pyramid with off-grid solar lighting’, Renewable and Sustainable Energy Reviews. Elsevier, 70(January 2016), pp. 50–55. doi: 10.1016/j.rser.2016.11.179.

[213]. Scott, I., (2017). A business model for success: Enterprises serving the base of the pyramid with off-grid solar lighting. Renewable and Sustainable Energy Reviews, 70(January 2016), pp.50–55. Available at: http://dx.doi.org/10.1016/j.rser.2016.11.179.

[214]. Sector, E. and Assistance, M. (2005) ‘Renewable Energy Potential in Selected Countries Volume I : North Africa , Central Europe , and the Former Soviet Union and Volume II : Latin America Final Report’, I.

[215]. Springer, R., (2013). A Framework for Project Development in the Renewable Energy Sector, Available at: http://www.osti.gov/bridge [Accessed October 11, 2018].

[216]. Stainforth D. and Staunton G., (1996) Critical Success Factors for Renewable Energy Technologies. IEEE, 96(3), pp. 7-12

[217]. Ahlborg, H. and Hammar, L., 2014. Drivers and barriers to rural electrification in Tanzania and Mozambique–Grid-extension, off-grid, and renewable energy technologies. Renewable Energy, 61, pp.117-124.

[218]. Stein, P., Ardic, O.P. And Hommes, M., (2013). Closing The Credit Gap For Formal And Informal Micro, Small, And Medium Enterprises.

[219]. Stuggins, Gary Krishnaswamy V. (2007). Closing the Electricity Supply-Demand Gap 2007:141.

[220]. Sushil, P. (2012). Interpreting the Interpretive Structural Model. Global Journal of Flexible Systems Management. June 2012.

[221]. Tampier, M. and Beaulieu, J. (2006) 'Renewable Energy Financing Case Studies : Lessons to be Learned from Successful Initiatives', Renewable Energy, (March), pp. 1–65.

[222]. The World Bank, (2013). Climate Investment Funds. Financing Renewable Energy: Options for Developing Financing Instruments Using Public Funds. Energy Dev 2013:1–60.

[223]. Tsai, S. B., Xue, Y., Zhang, J., Chen, Q., Liu, Y., Zhou, J. and Dong, W. (2017) 'Models for forecasting growth trends in renewable energy', Renewable and Sustainable Energy Reviews. Elsevier, 77, pp. 1169–1178. doi: 10.1016/j.rser.2016.06.001.

[224]. UN (2015) 'World Population Prospects 2015', p. 66. doi: Working Paper No. ESA/P/WP.241.

[225]. Lorek, S. and Spangenberg, J.H., (2014). Sustainable consumption within a sustainable economy–beyond green growth and green economies. Journal of cleaner production, 63, pp.33-44.

[226]. WHO (2000) 'World Population Growth', Beyond Economic growth, pp. 1–6.

[227]. Willis, J.W., 2008. Qualitative research methods in education and educational technology. IAP.

[228]. Winchester, C. and Salji, M. (2016) Writing a literature review. Journal of Clinical Urology. 9(5) April 2016 pp. 308–312.

[229]. World Bank (2005). World Development Report 2005: A Better Investment Climate for Everyone

[230]. World Bank (2015) World Development Indicators 2015, World Bank. doi: 10.1596/978-0-8213-7386-6.

[231]. Wright, K.L., (2002). *Transformation And Change Management For Strategic Leaders*. army war coll carlisle barracks pa.

[232]. Würtenberger, L., Bleyl, J. W., Menkveld, M., Vethman, P. and van Tilburg, X. (2012) ‘Business models for renewable energy in the built environment’, Construction Management and Economics, (April), p. 131. doi: 10.4324/9780203083178.

Appendix

Appendix A

Research Presentation Information

<u>Evaluation of Renewable Energy Infrastructure in the Dominican Republic</u>

Dear Potential Participant,

My name is Angelines Donastorg Sosa. I am a research student at the University of Wolverhampton. At the moment I am carrying out interview's studies into the drivers and challenges of developing the Renewable energy infrastructure in the Dominican Republic, as a part of my programme. I would like to invite you to participate in the above research project, as you might a key figure in the development of a successful frame work for the renewable energy infrastructure in the Dominican Republic.

If you agree to participate you will be asked to:

- Take part in a voice recorded interview (of maximum 30 minute's duration) to answer questions regarding how your organisation has handle the renewable energy infrastructure. The interview will be professional and topic oriented. The questions will be specific of the research topic and will be handle with the up most respect and discretion. You can choose not to answer questions that are of a sensitive nature to the organization or information that is not for public interest disclosure.

- Please complete the attached consent form and return.

With your agreement the interviews will be recorded then transcribed. If you wish your interview recording and transcripts can be reviewed, edited or erased. The information provided will be treated as confidential and computer transcripts will not contain references to any persons (including yourself) or organisations. Such references will be replaced by codes known only to me, and all data will be stored securely.

Once completed a summary of results will be available at the conclusion of the academic year. If you wish to obtain a copy of these results, please provide your contact details. Please note that all data gathered for this research will be stored securely and destroyed after the dissertation has been submitted. The Supervision team and myself will be the only individuals who will have access to this data.

Thank you for taking time to consider this invitation and if you choose to participate in this research. I would like to express my gratefulness for your contribution as it is greatly appreciated.

Consent form for pilot and main study

Evaluation of Renewable Energy Infrastructure in the Dominican Republic

Consent Statement

- I agree to participate in the above research project and give my consent freely.
- I understand that the project will be conducted as described in the "Research Presentation Information", a copy of which I have retained.
- I understand that I can withdraw from the project at any time and do not have to give a reason for withdrawing.
- I consent to participate in an interview with the researcher.
- I understand that my personal information will remain confidential to the researcher.
- I understand that my organization will not be identified either directly or indirectly.
- I have had the opportunity to have questions answered to my satisfaction.

Print Name: ___________________________________

Signature: ______________________________ Date: ___________________

Contact Address:

____

____

Phone Number:____________________

Fax Number:_________________________

Email Address: _____________________________

INTERVIEW QUESTIONS

Date	
Time of interview	
Name of organisation	

Aim: the aim of this interview is to collect in depth information regarding renewable energy from the entities in charge of its development and implementation.

Section 0: Introductory Data of the Interviewee to be filled out before the interview by the interviewer.

- Name of the Interviewee
- Position of the Interviewee
- Organization's total employee size
- What is the purpose of the organization or institution? (Define the level of the organization: local, regional, national or international)
- What renewable energy does the organization focus on?
- Please describe your position and functions in the organization? (relevance to the organization)

Section 1: Introductory Data of the Interviewee

1. Please describe your position and functions in the organisation? (relevance to the organisation)

Section 2: Core Questions regarding Business plans for implementing Renewable energy projects.

2. Based on your role, what would you consider as a renewable energy project in the DR?

3. About the institution that you belong to, What Renewable Energy project have been designed, involved and/or implemented by this institution or company?

4. Considering your position, what would you consider is the renewable energy focus of the business/institution/government of the DR? (e.g., solar, wind, water, etc.) moreover, what energy business plan or strategy would you consider is being implemented by the enterprise/institution/government in the DR?

5. Considering your position, at what stage of development would you believed the renewable energy market in the DR is at? And what measures can be taken to improve the renewable energy market?

6. What do you believe, in relation to your position, are the main reasons that the DR has not fully exploited the renewable energy sources in the country? Why/why not?

Section 3: Drivers for implementing renewable energy projects.

7. What renewable energy aims, goals or motivation does the institution/ company that you belong to have and which goals have been and will be achieved?

8. Can you describe in accordance with your position, the drivers that have motivated the DR to invest/implement in renewable energy projects/initiatives? And which drivers have been or do you considered are/will be the most important ones?

Section 4: Challenges of implementing renewable energy projects.

9. Given your role and responsibility, kindly explain what do you considered have been the challenges that the DR companies/institutions/government faced or will face by implementing renewable energy initiatives/projects?

Section 5: Financial tools for implementing renewable energy projects.

10. Regarding your station could please provided what financial support and tools do you believe that a renewable energy project/initiate needs in the DR? How would you evaluate the current financial tools available in DR for renewable energy projects?

Section 6: Legal Framework for implementing renewable energy projects.

11. could you please elaborate, based on your role and responsibilities, on the laws and regulations that govern and support the renewable energy projects in the DR? (Are they enough, do they server the purpose) Is the renewable energy legal framework applicable or is it more theoretical?

Section 7: Benefits of implementing renewable energy projects

12. Can you elaborate based on your position on the benefits and possible benefits that renewable energy projects bring or could bring to the institution/Company/country?

Appendix B

Research Presentation Information

Evaluation of Renewable Energy Infrastructure in the Dominican Republic

Dear Participant,

My name is Angelines Donastorg Sosa. I am a research student at the University of Wolverhampton. At the moment I am carrying out focus group studies into the feasibility and use of a Framework for the implementation of renewable energies in the Dominican Republic, as a part of my programme. I would like to invite you to participate in the above research project, as you might be a key figure in the validation of a successful framework for the renewable energy strategies in the Dominican Republic.

If you agree to participate you will be asked to:

- Take part in a presentation of the Framework (of maximum 10 minutes) and a voice recorded focus group (of maximum 30 minute's duration) to answer questions regarding the presented framework. The questions will be specific of the research topic and will be handle with the up most respect and discretion.

With your agreement the focus group will be recorded then transcribed. If you wish the focus group recording and transcripts can be reviewed, edited or erased. The information provided will be treated as confidential and computer transcripts will not contain references to any persons (including yourself) or organisations. Such references will be replaced by codes known only to me, and all data will be stored securely.

Once completed a summary of results will be available at the conclusion of the academic year. If you wish to obtain a copy of these results, please provide your contact details. Please note that all data gathered for this research will be stored securely and destroyed after the dissertation has been submitted. The Supervision team and myself will be the only individuals who will have access to this data.

Thank you for taking time to consider this invitation and if you choose to participate in this research. I would like to express my gratefulness for your contribution as it is greatly appreciated.

University of Wolverhampton

Wulfruna Street, City Campus

WV1 1LY

Consent form for Validation

Evaluation of Renewable Energy Infrastructure in the Dominican Republic

Consent Statement

- I agree to participate in the above research project and give my consent freely.
- I understand that the project will be conducted as described in the "Research Presentation Information", a copy of which I have retained.
- I understand that I can withdraw from the project at any time and do not have to give a reason for withdrawing.
- I consent to participate in an interview with the researcher.
- I understand that my personal information will remain confidential to the researcher.
- I understand that my organization will not be identified either directly or indirectly.
- I have had the opportunity to have questions answered to my satisfaction.

Print Name: ________________________________

Signature: ___________________________ Date: _________________

Contact Address:

____

____

Phone Number: ___________________

Fax Number: ________________________

Email Address: ___________________________

Focus group questionnaire for strategic validation of a framework for implementing renewable energy in the Dominican Republic

Purpose of the interviews:

The interview seeks to validate the developed framework for the implementation of renewable energy projects in the Dominican Republic energy sector.

Participants details:

- Name: ....………………………………………………………
- Position / Area of expertise: ………………………………………………
- Organisation: …………………………………………………………………
- Date: ……………………………………………………………………….

Evaluation of the proposed framework:

1. What is your opinion on the comprehensiveness in terms of contents of the proposed framework?

2. In terms of logical flow of the Framework, what is your opinion?

3. What is your opinion on the subject covered by the proposed framework?

4. In regards, to the understanding of the presented Framework, what is your opinion?

5. Do you have further comments/suggestions regarding any areas that need to be improved/included/deleted within the proposed framework?

6. Would you recommend the framework for use in the DR? For the public or private sector?

Appendix C

Guide for permit solicitation process in the Dominican Republic

Step no. 1 Authorization for performing the potential study of a cite

- Entity: National Energy Commission (CNE)
- Duration: 15 working days
- Cost: 10,000 Dominican pesos (RD$)
- Requirements:
    - Letter addressed to the CNE asking for the permit
    - A project proposal of the description of the organization, technical and economic profile and the details of the study to be done
    - Receipt of payment of the RD$10,000

Step. No. 2 Provisional concession

- Entity CNE
- Duration 30 days processing and 90 days for the signature of the director of the CNE
- Cost RD$425,000
- Requirements:

Letter address to CNE requesting the concession, with the information of who will developed the project, who represents the organization during the process, a description of the project, the renewable energy potential to be installed in MW, the area of the proposed project, with cadastral marking, GPS coordinates, justification of why this plot of land, chronogram of the proposed activities and description of the work in that period and estimated date of start and end date of project

Corporate documents of the organization:

If national: Certificate of official registry of the name of the organization in the national office of industrial property (ONAPI), Certified copy of the current mercantile registry, issued by the corresponding Chamber of Commerce and Production. Current Certification of the National Taxpayer Registry (RNC). Social statutes. Minutes of general assembly constitutive of the company. last minutes of the company's annual meeting. likewise, in the cases that apply according to the type of company, in accordance with the special regulations in force in the matter of commercial companies, act of transformation or adaptation or list of subscribers of shares of the company or payroll of shareholders of the company, of each assembly as appropriate, duly registered and sealed by the corresponding Chamber of Commerce and Production, and stamped and initialized by the manager / secretary / president of the company. Present the financial statements of the company for the last three (3) years, audited by a firm of recognized auditors, if it is less than three (3) years old or is recently constituted to present the available financial statements or the last three (3) financial statements of the shareholders, which allow evaluating the economic capacity of the applicant to execute the project.

If it is a Foreign Company: Certificate of legal existence and validity of the country of origin, duly legalized by the Dominican Consul accredited in the country of origin of the company and subsequently certified (apostilled) by the Ministry of Foreign Affairs. Certified copy of the current mercantile registry issued by the corresponding Chamber of Commerce and Production. Current certification of the national taxpayer registry (RNC). Social statutes. Minutes of the general assembly constituting the company. last minutes of the company's annual meeting. likewise, in the cases that apply according to the type of company, in accordance with the special regulations in force in the matter of commercial companies, act of transformation or adaptation or list of subscribers of shares of the company or payroll of shareholders of the company, of each assembly as appropriate, duly registered and sealed by the corresponding Chamber of Commerce and Production, and stamped and initialized by the manager / secretary / president of the company. Present the financial statements of the company for the last three (3) years, audited by a firm of recognized auditors, if it is less than three (3) years old or is recently constituted to present the available financial statements or the last three (3) financial statements of the shareholders, which allow evaluating the economic capacity of the applicant to execute the project.

If it is a Consortium: In addition to the requirements outlined above, you must submit the following documentation: A) Original of the Notarial Act by which the consortium is formalized, including its purpose, the obligations of the parties, their duration, the exercise capacity of each member of the consortium, as well as their generals. B) Special power of appointment of the representative or sole manager of the Consortium authorized by all the companies participating in the consortium. C) Copy of the Identity and Electoral Card of the Legal Representative.

Updated certification, issued by the Treasury of the Social Security, where it is stated that the applicant is up to date in the payment of his Social Security obligations.

Special power granted to the legal representative of the petitioner for representation before the CNE, duly legalized and registered in the Attorney General's Office or meeting minutes in which these powers are granted to the representative.

Legal Designation of the properties in relation to the use of the land by the petitioner:

In the case of amicable agreement, the act of land lease agreement, a lease agreement under the private signature of the land, lease contract or lease, or any document by which the owner of the property right authorizes the use or usufruct of the land or in case of conflict between parties, judgment of the competent justice of the peace, of the jurisdiction where the property is located. A copy of the title certificate of the land, or document that demonstrates the ownership of the property, possession or lease or act of sale of the property. In addition:

About the property (s): I. Certification of non-overlap, issued by a duly registered or registered land surveyor, in case the land is not demarcated. II. Location plans, issued by a duly registered or registered surveyor containing coordinates in Universal Transversal de Mercator (UTM) of the polygonal line that circumscribes the installation and specific geographic location of the land. III. Certification that expresses the current state of the property, issued by the Title Registrar of the jurisdiction where the property is located.

About the Owner (s): I. Certification of Real Estate Property Tax (IPI), issued by the General Directorate of Internal Taxes (DGII).

Proof of payment of the administrative fee (RD $ 425,000.00) of services issued by the CNE.

Step No. 3 Register at the superintendence of electricity in the Dominican Republic as a non-regulated user

- Entity: superintendence of electricity
- Cost RD$ 90,000
- Duration: 30 working days
- Requirements:

A provisional form of the request of service, letter of application for authorization of Non-regulated user from the petitioner addressed to the council of the superintendence. specify:

generals of the petitioner and the legal representative (if applicable). location of the work or facilities. and possible class and type of the petitioner, in accordance with the provisions of the articles 7 and 8 of this regulation. signature and stamps of the legal representative of the petitioner and sealed with the seal of the latter. or, appointed representative of the petitioner and sealed with the seal of the latter.

corporate documents: copy of the bylaws, with certification that says, "according to the original ", and authenticated by one of the following means: signed and sealed by the secretary of the company. or, with original seal of registration in the chamber of commerce and production that correspond copy of the following documents: copy of the minutes of the last assembly in which the manager (s) and / or members of the administrative council of the society, with certification that says "according to the original", and authenticated by one of the following means: signed and sealed by the secretary of the company. or, with the original stamp of registration in the chamber of commerce and production that corresponds. copy list of payrolls of the presence of the assembly. copy of the mercantile registry of the company issued by the chamber of commerce and production that corresponds and that is in force on the date of submission of the Non-regulated user authorization application in accordance with commercial company's law no. 479-08, dated December 11, 2008, and its modifications. copy of the national taxpayer registry (RNC) of the company petitioner, issued by the directorate general of internal taxes. original certification in force at the time of the application for authorization of Non-regulated user issued by the directorate general of internal taxes, if the petitioner is up to date with the payment of his fiscal obligations.

In representation of the petitioner: if the non-regulated user authorization application is submitted by a legal representative: Minutes of the shareholders' meeting of the company where the appointment of the legal representative of the company for such purposes, with certification of "according to the original", given by the secretary of the company or stamp original registration in the chamber of commerce and production that correspond identity document of the legal representative of the company petitioner: copy of the certificate or passport if the non-regulated user authorization application is submitted by a powered representative: Minutes of the shareholders' meeting of the company where the appointment of the legal representative of the company for such purposes, with certification of "according to the original", given by the secretary of the company or stamp original registration in the chamber of commerce and production that correspond original power of attorney granted by the representative legal of the petitioner duly signed, stamped, notarized and legalized before the attorney general of the republic, designating the person to act as his appointed representative before the superintendence and identity document of the company's representative petitioner: copy of the certificate or passport. Documents proving the ownership of real rights over the lands and interconnection facilities: property or usufruct of the land: copy of property titles or official documents that demonstrate the property right of the petitioner of the lands in which the electricity consumption facilities are located.

in case the petitioner is a lessee or tenant: (i) copy "original" of the lease contract, showing the usufruct by part of the tenant of the land in which the electricity consumption facilities and, (ii) copy of the certificate title that justifies the property right of the landlord. collegiate surveyor certification: certification in original signed by a certified land surveyor, in which it is recorded that the property title or document that is provided to demonstrate the ownership of the land, and the location of the consumption facilities of the petitioner correspond to each other. Right over interconnection facilities: copy of the contract, agreement or documentation evidencing ownership or the right to use or usufruct of the interconnection facilities to the network.

Step No. 4 Ministry of the environment certificated of environmental impacts

- Entity: Ministry of the Environment
- Cost RD$5,000
- Duration: 30 to 190 days
- Requirements

Letter of request for Environmental Authorization addressed to the Ministry of Environment and Natural Resources.

Registration form for environmental authorization of project, work or activity, duly completed by computer or typewriter.

Copy of the identity and electoral card or passport (if you are a foreigner), the promoter and representative.

Copy of the National Taxpayer Registry (RNC), for the company name.

Copy of the Commercial Registry.

Copy of property title. When the property title (s) are not in the name of the developer, in addition to the title, the purchase and sale or lease contract must be attached, between the owner and the project promoter, notarized and legalized by the Attorney General of the Dominican Republic, that relates the promoter and the deposited documents. For government projects, the present decree of public utility.

Copy of the Cadastral Plan or Measure stamped and / or certified by the National Direction of Cadastral Measurements. It is not mandatory in case of

Letter of No objection of land use of the corresponding City Council (original mandatory), does not apply to forestry projects, except for sawmills in urban areas.

Executive summary of the description of the project, work or activity and its components, depending on the nature of the project: type of infrastructure, quantity and sources of general services (water, electricity, solid waste, etc.), detailed description of the system sewage treatment.

The topographic sheet at 1: 50,000 scale, in colour, with the polygon in UTM coordinates, mandatory for projects or mining, tourist and forestry works. *

Location map, scale 1: 1000 to 1: 5000, legible, in colour, where the UTM coordinates of the polygon of the project, work or activity are shown. *

Overall plan and a plant dimensioned at a readable scale, size 11 x 17. If contemplated Wastewater Treatment Plant (WWTP) attach plans.

Attach the last three (3) reports of the benefits or losses (IR-2 or IR-1) as appropriate, which includes Annex A1, endorsed by the Directorate General of Internal Taxes (DGII). If you are not registered with the DGII, attach a financial analysis that shows the total assets, certified by an Authorized Public Accountant (CPA). (In case of being operating before the promulgation of the General Law of Environment and Natural Resources (64-00) of August 18, 2000).

Annex the projected budget analysis.

A certified check in the name of the Ministry of Environment and Natural Resources for an amount of five thousand pesos (RD $ 5,000.00)

Step No. 5. Definitive concession

- Entity: CNE
- Cost: DR$ 350,000
- Duration 45-90 working days
- The requirements will depend on the type of renewable energy
    - Wind:

A.) Request letter addressed to the President of the Republic, via the National Energy Commission (CNE) to obtain the Definitive Concession and obtain the qualification as the recipient of the benefits and incentives of the Law of Incentives for Renewable Energies No. 57-07, and its amendments, containing: the description of the project. the number of powers to be installed in MW. the area and polygonal shape proposed, and the grid with the cadastral designation or coordinates in Universal Transversal Mercator (UTM) of the polygonal line that circumscribes the installation and specific geographic location of the land.

B.) Copy of the current Provisional Concession resolution, granted by the CNE.

C.) In relation to the use of the land by the Petitioner, for the specific use of the facility: i) In the case of amicable agreement, act of agreement of land leases, lease agreement under private signature of the land, contract of assignment of right of lease, or any document by which the owner of the right of property authorizes the use or usufruct of the land. and ii) In case of conflict between parties, judgment of the competent justice of the peace, in the jurisdiction of the location of the property.

D.) Copy of the land title certificate, or document proving the ownership of the property or possession rights of the tenant or seller on the property. Likewise:

i. **About the property (s):**

• Certification of no overlap issued by a duly registered or registered surveyor.

• Location Plans issued by a duly registered or registered land surveyor.

• Certification Charges and Lien issued by the Registrar of Titles of the jurisdiction of the property.

ii. About the Owner (s):

• Certification of Real Estate Property Tax (IPI), if it is a natural person, issued by the Internal Revenue Department (DGII).

E.) Constitutive documents of the company: If it is a national company, certificate of registration of the commercial name issued by the National Office of Industrial Property. if it is a foreign company, certificate of legal existence and validity of the country of origin, duly legalized by the Dominican consul accredited in the country of origin of the company and subsequently certified by the Ministry of Foreign Affairs. certified copy of the current mercantile registry issued by the corresponding Chamber of Commerce and Production. current certification of the national taxpayer registry (RNC). social statutes. Minutes of general assembly constitutive of the company. last minutes of the company's annual meeting. likewise, in the cases that apply according to the type of company, according to the special regulations in force in the matter of commercial companies, transformation or adaptation act, and / or list of subscribers of shares of the company, and / or list of shareholders of the company, of each assembly as appropriate, duly registered and sealed by the corresponding Chamber of Commerce and Production, and stamped by the manager / secretary / president of the company.

F.) Updated certification, issued by the General Directorate of Internal Taxes (DGII), of Compliance with Fiscal Obligations, in which it is established that the applicant is up-to-date in complying with its obligations.

G.) Special power granted to the legal representative of the Petitioner for representation before the CNE, duly legalized and registered in the Attorney

General's Office or meeting minutes in which these powers are granted to the representative. (In the case of individual producers, their personal identification containing their generals and establishment of their address is required).

H.) Copy of the Environmental Impact Study (EIA) with a copy of the administrative act issued by the Ministry of Environment and Natural Resources (MIMARENA), stating that there are no environmental conditions that hinder the installation of electricity generation from renewable energy sources and with the definition of the correct or mitigation measures, and the express validation of the competent authority.

I.) Site location plans and detail of the vertices of the park polygon in UTM coordinates, duly designated.

J.) Copy of the Resolution issued by the CNE where it authorizes the entity or company designated by the concessionaire company, to carry out the technical studies of the project resource.

K.) Technical analysis of the wind resource and energy carried out by the company authorized by the CNE, in accordance with the characteristics established by the Regulation of Application of Law No. 57-07, and its modifications.

L.) Study of the evacuation of electric energy produced, in accordance with the characteristics established by the Regulation of Application of Law No. 57-07, and its modifications.

M.) Definition of wind turbines, accompanied by their certification documents. In accordance with the regulations listed in Art.39, Item 11, of the Regulations for the Application of Law No. 57-07, and its amendments.

N.) Wind turbine supply agreement, according to number, type and quality of the submitted project.

Ñ.) Agreement that is guaranteed, for ten (10) years after the implementation of the assembly and maintenance services with technical resources and training of human resources installed in the country.

O.) List or list of equipment and parts of the system to be imported by the concessionaire for the realization of the project.

P.) No objection document issued by the Dominican Corporation of Electricity and State Companies (CDEEE) where it states that it does not encounter technical difficulties in negotiating a PPA contract.

Q.) Financing scheme and justification of the financial capacity to approach the project, accompanied by the documents of the entity or financial entities that certify their commitment to financing the project.

R.) Proof of payment of an administrative fee (RD $ 350,000.00) of services issued by the CNE.

- Solar

A.) Request letter addressed to the President of the Republic, via the National Energy Commission (CNE) to obtain the Definitive Concession and obtain the qualification as the recipient of the benefits and incentives of the Law of Incentives for Renewable Energies No. 57-07, and its amendments, containing: the description of the project. the number of powers to be installed in MW. the area and polygonal shape proposed, and the grid with the cadastral designation or coordinates in Universal Transversal Mercator (UTM) of the polygonal line that circumscribes the installation and specific geographic location of the land.

B.) Copy of the current Provisional Concession resolution, granted by the CNE.

C.) In relation to the use of the land by the Petitioner, for the specific use of the facility: i) In the case of amicable agreement, act of agreement of land leases, lease agreement under private signature of the land, contract of transfer of lease right, or any document by which the owner of the property right authorizes the use or usufruct of the land, for an expandable period, not less than 20 years. and ii.) In case of conflict between parties, judgment of the competent justice of the peace, in the jurisdiction of the location of the property. In both cases, it will be necessary to detail the plots affected by the installation, all the steps taken to reach an agreement with the owner and the result thereof.

D.) Copy of the land title certificate, or document proving the ownership of the property or possession rights of the tenant or seller on the property. Likewise:

i. About the property (s):

• Certification of no overlap issued by a duly registered or registered surveyor.

• Location Plans issued by a duly registered or registered land surveyor.

• Certification Charges and Lien issued by the Registrar of Titles of the jurisdiction of the property.

ii. About the Owner (s):

• Certification of Real Estate Property Tax (IPI), if it is a natural person, issued by the Internal Revenue Department (DGII).

E.) Constitutive documents of the company: If it is a national company, certificate of registration of the commercial name issued by the National Office of Industrial Property. if it is a foreign company, certificate of legal existence and validity of the country of origin, duly legalized by the Dominican consul accredited in the country of origin of the company and subsequently certified by the Ministry of Foreign Affairs. certified copy of the current mercantile registry issued by the corresponding Chamber of Commerce and Production. current certification of the national taxpayer registry (RNC). social statutes. Minutes of general assembly constitutive of the company. last minutes of the company's annual meeting. likewise, in the cases that apply according to the type of company, according to the special regulations in force in the matter of commercial companies, transformation or adaptation act, and / or list of subscribers of shares of the company, and / or list of shareholders of the company, of each assembly as appropriate, duly registered and sealed by the corresponding Chamber of Commerce and Production, and stamped by the manager / secretary / president of the company.

F.) Updated certification, issued by the General Directorate of Internal Taxes (DGII), of Compliance with Fiscal Obligations, in which it is established that the applicant is up-to-date in complying with its obligations.

G.) Special power granted to the legal representative of the Petitioner for representation before the CNE, duly legalized and registered in the Attorney General's Office or meeting minutes in which these powers are granted to the representative. (In the case of individual producers, their personal identification containing their generals and establishment of their address is required).

H.) Copy of the Environmental Impact Study (EIA) with a copy of the administrative act issued by the Ministry of Environment and Natural Resources (MIMARENA), stating that there are no environmental conditions that hinder the installation of electricity generation from renewable energy sources and with the definition of the correct or mitigation measures, and the express validation of the competent authority.

I.) Site location plans and detail of the vertices of the park polygon in UTM coordinates, duly designated, at a scale of 1: 50,000 or greater.

J.) Copy of the Resolution issued by the CNE where it authorizes the entity or company designated by the concessionaire company, to carry out the technical studies of the project resource.

K.) Technical analysis of the solar resource and production carried out by the company authorized by the CNE, in accordance with the characteristics established by the Regulations for the Application of Law No. 57-07, and its amendments.

M.) Definition of the type of photovoltaic panels and DC / AC inverters, according to the regulations contained in the Regulations for the Application of Law No. 57-07, accompanied by the certification documents of the photovoltaic panels made by an accredited laboratory, according to the International Electrotechnical Commission (IEC) regulations.

N.) Presentation of the agreement for the supply of photovoltaic panels, according to the number, type and quality of the submitted project.

Ñ.) List or list of the equipment and parts of the system to be imported by the concessionaire for the realization of the project.

O.) No objection document issued by the Dominican Corporation of Electric and State Companies (CDEEE) where it states that it does not encounter technical difficulties in negotiating a PPA contract.

P.) Financing scheme or financial statement of the company, which justifies the financial capacity to approach the project, accompanied by the documents of the entity or financial entities that certify their commitment to the financing of the project.

Q.) Proof of payment of an administrative fee (RD $ 350,000.00) of services issued by the CNE.

- Mini-hydro

A.) Request letter addressed to the President of the Republic, via the National Energy Commission (CNE) to obtain the Definitive Concession and obtain the qualification as the recipient of the benefits and incentives of the Law of Incentives for Renewable Energies No. 57-07, and its amendments, containing: the description of the project. the number of powers to be installed in MW. the area and polygonal shape proposed, and the grid with the cadastral designation or coordinates in

Universal Transversal Mercator (UTM) of the polygonal line that circumscribes the installation and specific geographic location of the land.

B.) Copy of the current Provisional Concession resolution, granted by the CNE.

C.) In relation to the use of the land by the Petitioner, for the specific use of the facility: i) In the case of amicable agreement, act of agreement of land leases, lease agreement under private signature of the land, contract of transfer of lease right, or any document by which the owner of the property right authorizes the use or usufruct of the land, for an expandable period, not less than 20 years. and ii) In case of conflict between parties, judgment of the competent justice of the peace, in the jurisdiction of the location of the property. In both cases, it will be necessary to detail the plots affected by the installation, all the steps taken to reach an agreement with the owner and the result thereof.

D.) Copy of the land title certificate, or document proving the ownership of the property or possession rights of the tenant or seller on the property. Likewise:

i. About the property (s):

• Certification of no overlap issued by a duly registered or registered surveyor.

• Location Plans issued by a duly registered or registered land surveyor.

• Certification Charges and Lien issued by the Registrar of Titles of the jurisdiction of the property.

ii. About the Owner (s):

• Certification of Real Estate Property Tax (IPI), if it is a natural person, issued by the Internal Revenue Department (DGII).

E.) Constitutive documents of the company: If it is a national company, certificate of registration of the commercial name issued by the National Office of Industrial Property. if it is a foreign company, certificate of legal existence and validity of the country of origin, duly legalized by the Dominican consul accredited in the country of origin of the company and subsequently certified by the Ministry of Foreign Affairs. certified copy of the current mercantile registry issued by the corresponding Chamber of Commerce and Production. current certification of the national taxpayer registry (RNC). social statutes. Minutes of general assembly constitutive of the company. last minutes of the company's annual meeting. likewise, in the cases that apply according to the type of company, according to the special regulations in force in the matter of commercial companies, transformation or adaptation act, and / or list of subscribers of shares of the company, and / or list of shareholders of the company, of each assembly as appropriate, duly registered and sealed by the corresponding Chamber of Commerce and Production, and stamped by the manager / secretary / president of the company.

F.) Updated certification, issued by the General Directorate of Internal Taxes (DGII), of Compliance with Fiscal Obligations, in which it is established that the applicant is up-to-date in complying with its obligations.

G.) Special power granted to the legal representative of the Petitioner for representation before the CNE, duly legalized and registered in the Attorney General's Office or meeting minutes in which these powers are granted to the representative. (In the case of individual producers, their personal identification containing their generals and establishment of their address is required).

H.) Copy of the Environmental Impact Study (EIA) with a copy of the administrative act issued by the Ministry of Environment and Natural Resources (MIMARENA), stating that there are no environmental conditions that hinder the installation of electricity generation from renewable energy sources and with the definition of the correct or mitigation measures, and the express validation of the competent authority.

I.) Site location plans and detail of the vertices of the park polygon in UTM coordinates, duly designated.

J.) Copy of the Resolution issued by the CNE where it authorizes the entity or company designated by the concessionaire company, to carry out the technical studies of the project resource.

K.) Technical analysis of the hydraulic resource, performed by the company authorized by the CNE, in accordance with the characteristics established by the Regulations for the Application of Law No. 57-07, and its amendments.

L.) Study of electric energy evacuation produced, in accordance with the characteristics established by the Regulation of Application of Law No. 57-07, and its modifications.

M.) Definition of the type of generator, regulation and control systems and flow regulation mechanisms, according to the regulations contained in this Regulation, accompanied by the equipment certification documents, carried out by an accredited laboratory according to the IEC standard.

N.) Agreement for the supply of the equipment of the generation and control equipment that is part of the hydraulic mini-plant, according to the presented project's number, type and quality.

Ñ.) List or list of the equipment and parts of the system to be imported by the concessionaire for the realization of the project.

O.) No objection document issued by the Dominican Corporation of State Electric Companies (CDEEE) where it states that it does not encounter technical difficulties in negotiating a PPA contract.

P.) Financing scheme and justification of the financial capacity to approach the project, accompanied by the documents of the entity or financial entities that certify their commitment in the financing of the project.

Q.) Proof of payment of an administrative fee (RD $ 350,000.00) of services issued by the CNE.

- Biomass

A.) Request letter addressed to the President of the Republic, via the National Energy Commission (CNE) to obtain the Definitive Concession and obtain the qualification as the recipient of the benefits and incentives of the Law of Incentives for Renewable Energies No. 57-07, and its amendments, containing: the description of the project. the number of power to be installed in MW. the area and polygonal shape proposed, and the grid with the cadastral designation or coordinates in

Universal Transversal Mercator (UTM) of the polygonal line that circumscribes the installation and specific geographic location of the land.

B.) Copy of the current Provisional Concession resolution, granted by the CNE.

C.) In relation to the use of the land by the Petitioner, for the specific use of the facility: i) In the case of amicable agreement, act of agreement of land leases, lease agreement under private signature of the land, contract of transfer of lease right, or any document by which the owner of the property right authorizes the use or usufruct of the land, for an expandable period, not less than 20 years. and ii) In case of conflict between parties, judgment of the competent justice of the peace, in the jurisdiction of the location of the property. In both cases, it will be necessary to detail the plots affected by the installation, all the steps taken to reach an agreement with the owner and the result thereof.

D.) Copy of the land title certificate, or document proving the ownership of the property or possession rights of the tenant or seller on the property. Likewise:

i. About the property (s):

• Certification of no overlap issued by a duly registered or registered surveyor.

• Location Plans issued by a duly registered or registered land surveyor.

• Certification Charges and Lien issued by the Registrar of Titles of the jurisdiction of the property.

ii. About the Owner (s):

• Certification of Real Estate Property Tax (IPI), if it is a natural person, issued by the Internal Revenue Department (DGII).

E.) Constitutive documents of the company: If it is a national company, certificate of registration of the commercial name issued by the National Office of Industrial Property. if it is a foreign company, certificate of legal existence and validity of the country of origin, duly legalized by the Dominican consul accredited in the country of origin of the company and subsequently certified by the Ministry of Foreign Affairs. certified copy of the current mercantile registry issued by the corresponding Chamber of Commerce and Production. current certification of the national taxpayer registry (RNC). social statutes. Minutes of general assembly constitutive of the company. last minutes of the company's annual meeting. likewise, in the cases that apply according to the type of company, according to the special regulations in force in the matter of commercial companies, transformation or adaptation act, and / or list of subscribers of shares of the company, and / or list of shareholders of the company, of each assembly as appropriate, duly registered and sealed by the corresponding Chamber of Commerce and Production, and stamped by the manager / secretary / president of the company.

F.) Updated certification, issued by the General Directorate of Internal Taxes (DGII), of Compliance with Fiscal Obligations, in which it is established that the applicant is up-to-date in complying with its obligations.

G.) Special power granted to the legal representative of the Petitioner for representation before the CNE, duly legalized and registered in the Attorney General's Office or meeting minutes in which these powers are granted to the representative. (In the case of individual producers, their personal identification containing their generals and establishment of their address is required).

H.) Copy of the Environmental Impact Study (EIA) with a copy of the administrative act issued by the Ministry of Environment and Natural Resources (MIMARENA), stating that there are no environmental conditions that hinder the installation of electricity generation from renewable energy sources and with the definition of the correct or mitigation measures, and the express validation of the competent authority.

I.) Site location plans and detail of the vertices of the park polygon in UTM coordinates, duly designated.

J.) Analysis of the main Biomass Resource, in accordance with the characteristics established by the Regulation of Application of Law No. 57-07, and its modifications.

K.) Study of the evacuation of the electric power produced, in accordance with the characteristics established by the Regulation of Application of Law No. 57-07, and its modifications.

L.) Specific study of the supply of raw material, own production, subcontracted production and supply agreements that ensure the stability of the production and the economic viability of the project.

M.) Specific report on the selection criteria of the technologies to be used in the different processes and international references. Technologists, engineers and preselected consultants for the purposes of studies, both technical and economic.

N.) Analysis of the capacity of the plant to maintain and ensure the quality of the product, in accordance with current international regulations.

Ñ.) Technical, economic analysis of the viability of the plant.

O.) Definition of the combustion system used (low pressure, high pressure, cogeneration, etc.) and auxiliary control systems, water treatment and gas treatment.

P.) Agreement for the supply of generation and control equipment, which are part of the Electric Generation plant, according to the type and quality of the submitted project.

Q.) Agreement with the supplier of equipment and facilities to ensure and guarantee for ten (10) years of technical assistance and maintenance services with technical means and training of human resources installed in the Dominican Republic.

R.) Agreement for the supply of the primary biomass, subscribed between the Petitioner and the provider (public or private), after signing the definitive concession contract.

S.) List or list of the equipment and parts of the system to be imported by the concessionaire for the realization of the project.

T.) No objection document issued by the Dominican Corporation of Electric and State Companies (CDEEE) where it states that it does not encounter technical difficulties in negotiating a PPA contract.

U.) Financing scheme and justification of the financial capacity to approach the project, accompanied by the documents of the entity or financial entities, certifying their commitment to the financing of the project.

V.) Proof of payment of an administrative fee (RD $ 350,000.00.) Of services issued by the CNE.

Step No. 5 Assignation of the time of the concession

- Entity: Ministry of mines and energy
- Cost: Not yet determined
- Duration: 30-90 days
- Requirements
    - o Deposit all the documents from steps 2,3 and 4.