Identification of Barriers that Affect Panama NDC Target

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Abstract

Panama defines its National Determined Contributions (NDC) in the energy sector in terms of an increase in the installed capacity of alternatives energy sources renewable (solar, wind and biomass). The literature review was used to define four categories of barriers that affect the development of renewable projects: technical, institutional, economic and social. The content analysis of the ASEP's resolutions allowed to identify the technical barrier as the main obstacle to the deployment of energy projects.

Introduction

Panama NDC (2016) defines the target of increasing the installed capacity of alternatives energy sources renewable (solar, wind and biomass) by 15% in 2030.

Suarez (2019, p. 5) determines that the effect of delays in four specific projects, equivalent to 1,365 MW, represent an increase of 27% in the annual average CO2 emissions.

ETESA (2019) identifies that five projects, equivalent to 370 MW, present an extension in their estimated operation dates comparing the National Interconnected System Expansion Plan 2019-2033 against the prior 2018-2032 plan. Therefore, the delay in the start of the projects is a recurring reality.

This paper identifies and ranks the barriers that affected the development of energy projects. It is organised as follow: The first section depicts the Literature Review. Content Analysis is presented in the second section, follows by the Discussion of Results. The last section provides conclusions and future research recommendations.

Literature Review

A barrier is an obstacle to reach a goal or mitigation potential (IPCC, 2007, p. 140). In this sense, the literature review presents studies conducted to identify and to group barriers that affect the expansion of renewable energy projects in a country, a region or worldwide.

Studies are divided into three types (see Tables in Exhibits): papers that have grouped barriers in categories under general contexts (see Table 1); published articles that identified barriers without prioritising the barriers that receive primary importance (see Table 2); and papers that identified and ranked barriers to the development of renewable energy in a country or region (see Table 3).

The following papers that group barriers are summarised:

• Painuly (2001) provides a framework for the identification of barriers to renewable energy penetration. The document formulates first to identify potential renewable energy technologies and second to identify barriers using literature survey, site visits, and the interaction with stakeholders. The paper explains to explore barriers at two primary levels, the first level is a broad category, and the second level are the specifics barriers within a category. It categorises the significant barriers into market failure, market distortions, economic and financial, institutional, technical, and social, cultural and behavioural.

• Yaqoot et al. (2016) identifies and classifies barriers that affect the dissemination of decentralised renewable energy systems. The document depicts the following hurdles categories: technical, economic, institutional, socio-cultural, and environmental. The paper presents a list of the research papers and articles analysed on barriers that are critical to the diffusion of solar, wind, and biogas decentralised technologies.

• Seetharaman et al. (2019) identifies and classifies barriers that affect the deployment of renewable energy. The document presents the following barriers categories: social, economic, technological, and regulatory. The paper tests the hypothesis about the significance of the factors that affect the deployment of renewable energy and the significance of a category over other categories.

The overview of the previous literature sources shows that the definition of a category and the assignation of barriers to that category is a flexible process. Researchers can classify a barrier under a particular category, even a category not defined in Table 1 or Table 2 and can assign a barrier to more than one

category. For example, the lack of information can be a market, institutional or social barrier. Besides, some obstacles have an impact on other barriers. For example, infrastructure constraints and permits delays that increase the project cost, are technical barrier and an institutional barrier, respectively, that influences a financial hurdle.

The variety of published articles in Table 2 allow to recognise familiar elements that affect the development of renewable energy technology around the world. Financing limitations (e.g. the lack of adequate long-term debt financing alternatives to fund high investment requirements at acceptable financial conditions) affects the development of renewable energy project. Technical restrictions (e.g. limited knowledge about technology, the lack of people with specialised skills and interconnection infrastructure issues) also impact the deployment of renewable energy. A weak institutional framework (e.g. bureaucracy accompanied by inadequate national regulations and policies, and by limited public awareness and information) disturbs the advance of renewable energy technologies in a country, too.

The following studies that rank barriers are summarised:

• Blechinger et al. (2015) examines the most critical barriers to the development of renewable energy technologies in the Caribbean. The paper defines a list of thirty-one barriers that they send over one hundred experts to rank the obstacles on a Likert scale from 0 (absolutely not critical) to 5 (highest importance). The mean of the responses was evaluated to define the most relevant barriers for the overall sample size and stakeholders. Results present discrepancies in the barriers perceived as necessary depending of the interviewed group, for instance, government gives the highest importance to lack of renewable energy experts on governmental level, the private sector to the gap between policies target and implementation, the international organisations to lack of legal framework for independent power producers and power purchase agreements, academia to the lack of regulatory framework, and the utilities to diseconomy of scale.

• Luthra et al. (2015) implements an Analytic Hierarchy Process to define the most relevant barriers to renewable energy technologies adoption in the Indian context. A workshop was used to obtain (eight) experts' prioritisation of the seven categories (dimensions) identified and the twenty-eight barriers listed. The overall ranking is calculated multiplying the weight obtained by the category by the weight of each specific barrier. The hierarchy places 'ecological and geographical' as the most relevant category, and 'ecological issues' barrier as the most crucial hurdle inside that category, however, the overall ranking is led by the 'lack of political commitment' barrier.

• Nasirov et al. (2016) analyses the significant barriers in the adoption of renewable energy technologies in Chile. The document applied a questionnaire survey among the major renewable project developers to rank eighteen barriers assigned into four categories. The researchers collected sixty responses from actors that represented small hydro, wind, solar, biotechnologies and geothermal projects. Respondents rate the importance of each barrier on a Likert scale from 1 (least significant) to 5 (extremely important). The highest average score is used to define the barrier with the highest significance. In this case, the most critical obstacle is the constraints of the connection system given by no distinction of the process between renewable and conventional technologies, access complications and delays for new entrants due to a market highly concentrated, and lack of clarity on costs to share to connect the grid.

• Karatayev et al. (2016) realises an Analytic Hierarchy Process to define the main factors that affect the scale-up of renewable energy in Kazakhstan. Literature review and expert interviews were applied to determine five categories (dimensions), and seventeen barriers. Using the weights given by the researchers in the priority matrixes, 'economic and financial' is the most significant category, and the 'low energy tariff' barrier is the most relevant barrier inside that category, but the 'fuel priority government fossils' is the most significant barrier of all.

The sources of literature cited above present different mechanisms (e.g. Likert Scale and Analytic Hierarchy Process) to rank the importance of a barrier. From these literatures reviewed it can be affirmed that a renewable energy technology in a country or region will have to face different high impact barriers, depending on the shareholder perspective (Blechinger et. al., 2015, p. 279), and the characteristics of the technology and the conditions of the country (Painuly, 2001, p. 75). It is crucial to provide a rank of barriers because listing the barriers from highest to lowest importance can help prioritise and improve solutions (Karatayev et al., 2016, p. 128).

Content Analysis

Columbia University (2019) explains that Content Analysis is used to determine the presence of words, themes, or concepts within texts. The process includes the coding of the text into code categories for analysis. It describes that the conceptual Content Analysis steps are: i) to decide the level of analysis, ii) to decide how

many concepts to code, iii) to decide to code the existence or the frequency of a concept, iv) to develop rules for coding the texts, v) to code the text, and vi) to analyse the results.

In this case, it is executed the Content Analysis of ASEP's resolutions that justified the postponements on the date defined to generate electricity of ten projects to identify barriers.

The following steps were applied to execute the conceptual Content Analysis in each ASEP's resolutions text: i) the level of phrases and sentences defined the analysis scope; ii) four concepts are preselected to code: social barrier, economic barrier, technical barrier, and institutional barrier; iii) it is decided to code the frequency of the concept, counting the number of times the barrier appeared in the text; iv) as a coding rule, it is defined to search for phrases or sentences in the resolutions, and such explicit words segment falls into a barrier category, assigned with the support of the literature reviewed; v) coding the text is done by hand; vi) and results are presented in Table 4.

Limitations

Columbia University (2019) also points among the disadvantages of the Content Analysis that the analysis frequently ignores the context that produced the text. In this case, it seems to be only a particular type of resolutions that can be solved by ASEP, as a supervisory entity. In other words, it does not take into account the regulatory context where ASEP produces the resolution texts. It also comments that when the coding is done by hand, as it is this case, the process could have more errors, such as typos or misspelling.

Discussion of Results

As can be seen in Table 4, the analysis of the ASEP's resolutions identified a total of thirty-three, specifically: sixteen technical barriers (e.g. interconnection constraints and projects change of design), nine institutional barriers (e.g. permissions revocation and delays in environmental impact assessment approvals), five economic barriers (e.g. difficulties in obtaining financing), and one social barriers (e.g. community opposition).

Decision-makers can use the ranking of barriers to prioritise measures to overcome the obstacles identified. For example, in term of interconnection issues, the government has pending and should be a priority, to solve the implementation of enhancements to the third transmission line Chiriqui-Panama (301 km) and to award the construction of a fourth transmission line Bocas del Toro-Panama (317 km) to improve the national interconnection system.
Concerning the analysis of ASEP's resolutions, it is less frequent to find socio-environmental or financial barriers there due to the nature of the regulatory body. However, these types of barriers should be reflected in a resolution sooner or later. Unfortunately, there is a critical delay to see these elements replicated in resolutions. For example, resolution dated 2019 that cancelled the concession rights for generation are linked to the cancellation of water concessions of hydro projects in 2015. Unfortunately, there is no free public access to database resolutions from the Ministry of Environment, the Ministry of Commerce and Industry, and the Ministry of Economy and Finance. Such ministries also approve or suspend permits for energy projects, so a cross-check of the Content Analysis with these other institutions could not be done.

Conclusions

The literature review detailed a wide variety of barriers that must be faced by the nations that promote an increase in the generation of electricity through renewable (non-conventional) energy sources. Economic, institutional, technical and socio-environmental hurdles affect the development of renewable energy technologies. Moreover, literature also shows that beyond quoting a list of barriers, these obstacles must be ranked by level of importance to find better solutions to overcome them.

In the particular case of Panama, the main category of barriers identified are the technical obstacles.

About the Content Analysis developed to identify barriers, future investigations could complement the identification of obstacles with the application of online surveys to interested parties. Besides, a sophisticated computer coding could be used to amplify the ability to cover more texts, to facilitate the process of cleaning the text, and to automate the identification of implicit categories within the information.

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Exhibits

Document Reference	Categories and Barriers	
	Categories	Barriers
Painuly (2001)	market failure	highly controlled energy sector; lack of information and awareness; restricted access to technology; lack of competition; high transaction costs; missing market infrastructure; high investment requirements.
	market distortions	favour to cnventional energy; taxes on RETs; non-consideration of externalities; trade barriers.
	economic and financial	economically not viable; high discount rates; high payback period; market size small; high cost of capital; lack of access to capital; lack of access to credit to consumers; high up-front capital costs for investors; lack of financial institutions to support RETs, lack of instruments.
	institutional	lack of institutions/mechanisms to disseminate information; lack of a legal/regulatory frammework; problems in realising financial incentives; unstable macro-economic environment; lack of involvement of stakeholders in decision making; clash of interests; lack of R&D culture; lack of private sector participation; lack of professional institutions.
	technical	lack of standard and codes and certification; lack of skilled personnel/training facilities; lack of O&M facilities; lack of entrepreneurs; system constraints; product not reliable.
	social, cultural and behavioural	lack of consumer acceptance of the product; lack of social acceptance for some RETs.
Yaqoot et al. (2016)	technical	resource availability is affected by intermittency and inadequacy; the need to use energy storage devices to improve energy dispatch and the inappropriateness of the technology or poor design; lack of standards, codes, certificacion that generates poor quality/reliability; lack of availability of skilled workers for desing and development, manufacturing, instalation, operation and maintenance services.
	economic	high cost, including high upfront costs and high transaction costs; and market issues including: low competitiveness due to subsidies to fossil fuels and non-internalization of externalities, inadequate incentives to promote renewables energy adoption among potencial users, a poor purchasing power of potential users, lack of access to credit facilities, long payback period, lack information among the stakeholders, and perception of financial or inversment risk.
	institutional	lack of consistent policies and regulations; lack of suitable legal and regulatory framework; underdeveloped extension services for spare parts supply and maintenance services; lack of reliable resource availability data; administrative barrier, including lack of coordination between various stakeholders, and tedious administrative and documentation procedures involved in the approval.
	socio-cultural	the societal strcuture, norms and value system; lack of information or awareness;perceived technology performance uncertainty, poor reliability and associated risks with respecto to the usage; behavioral or lifestyle issues such preference for traditional energy sources and resistance to change.
	environmental	competition for natural resources and pollution.

Document Reference	Categories and Barriers (continue)	
	Categories	Barriers
	social	insufficient information regarding ecological and financial benefits, inadequate awareness of renewable energy technoloies, and uncertainties about the financial feasibility of renewable energy projects; not in my backyard syndrome; the vast area of land required produces a loss of alternative incomes; lack of experienced professionals.
	economic	tough competition from fossil fuel; the amount of goverment subsidies provided to conventional energy is much higher than the subsidies awarded to renewable energy;difficulties in securing financing for projects and limited financial instruments and organizations for renewable project financing; high initial capital cost; cost of fuels does not include the cost of the damage it does to the environment and society.
	technological	limited availability of infrastructure and facilities; lack of operation and maintenance culture; lack of research and development capabilities; there are not enough standars, procedures and guidelines in renewable energy technolgies in terms of durability, reliability and perfromance; storage of energy is an major issue.
Seetharaman et al. (2019)	regulatory	ineffective policies by government; inadequate fiscal incentives; administrative and bureaucratic complexities; impractical government commitments; and lack of standards and certifications.

Table 1. Literature review that grouped barriers in categories

Document Reference	Number of Categories and Barriers by Country/Region		
	Number of Categories	Number of Barriers	Country/Region
Junfeng et al. (2002)	None	(9) high initial cost; high transaction cost; lack of product acceptability; inadequate and non-market-oriented research and development; lack of policy environment; underdevelop markets and market support infrastructure ; inadequate accessibility of credit; limited access to RE-based products and credit for consumers; lack of provision of high-quality energy services from renewables.	China
Pegels (2010)	None	(9) natural barries; bias in innovative capacity towards fossil fuel; lack the capacity basis at all levels of education for renewable energy technologies; young market with higher volatility and thus to greater risk; high cost of lending; lack of competition among financial institutions; lack of experience with renewable energy projects; uncompetitive cost of renewable energy technologies; require large investments in transmission lines.	South Africa
Kinab and Elkhoury (2012)	None	(8) lack of reliable data for resources; absence of a proper institutional agenda; lack of incentives; high cost of technologies; non-existence of local manufacturers; lack of clear norms; lack of trained technicians; unawareness of benefits of renewable energy sources.	Lebanon
Byrnes et al. (2013)	None	(6) administrative hurdles such as lengthy, regulatory approval and permit procedures; non-transparency and costly procedures for grid connection; policy instability with sudden policy changes and stop-and-go situations; lack of social acceptance; cost competitiveness; government support for existing electricity sources, institutional familiarity and acceptance.	Australia

Document Reference	Number of Categories and Barriers by Country/Region (continue)		
	Number of Categories	Number of Barriers	Country/Region
Fashina et al. (2018)	None	(8) lack of information and public awareness; huge initial investment cost; high operation and maintenance cost; inadequate attention to research and development; lack of human capacity and training; grid unreliability; ineffectual quality control of products; institutional barriers.	Uganda
Lidula et al. (2007)	None	(21) lack of experience and awareness; lack of funding; limited policy framework; lack of institutional, financial and technical structures; reliance on national grid; lack of private sector participation; inadequate data and information; reluctance to invest because of high investment cost; low efficiency or quality; insignificant utilization; lack of research personal or trained man power; lack of R&D; fossil fuel subsidies; taxes on imported equipment; inappropriate distribution facilities; political involvement in reform agenda; legislation issues in connecting to national grid; objections from the public to have power plants in the area; lack of government support; no economically viable; high total installed capacity.	Association of Southeast Asian Nations (ASEN)
Islam et. al. (2008)	(5) policy and regulatory; financial; institutional; technical; information.	(14) lack of clear, long-term and consistent policy; conventional energy sources are provided with subsidies hampering the competitiveness; lack of sufficient financial incentive policies to encourage renewable energy development; lack of legal, regulatory and policy framework for market oriented renewable energy programs; high initial cost; high market interest rates; lack of appropriate financing mechanisms; lengthy and difficult process for permission; dependency on the national budget for implementation of activities; limited spatial distribution of suppliers; lack of standards and quality control for renewable energy equipment; unexistence of technical infrastructure to support renewable energy development; limited technical capacity to design, install, operate, manage and maintain renewable energy services.	Bangladesh
Nalan et al. (2009)	(4) economic; cost of technologies; financing issues; scientific and technical.	(9) difficulties in obtaining financing; the failure to include externalities in the cost of generating electricity; investment in existing infrastructure; high upfront capital cost; the tax systems tend to penalize capital-intensive renewable energy investments; policy environments; the impact of government R&D funding and subsidies; initial transactions cost associated with reaching environmentally conscious consumers; failure to quantify the economic development benefits and national economic security provided by renewables.	Turkey
Mirza et al. (2009)	(6) policy and regulatory; institutional; fiscal and financial; market-related; technological; information and social.	(23) not sufficient incentives; lack of well-defined policies for private participation; lack of coordination and cooperation within and between various stakeholders; lack of legislations; lack of familiarity and awareness of technologies; high-risk perception and uncertainties regarding resource assessment; lack of financial resources and proper lending facilities; not attractive investment under high-discount rates and short-payback period requirements; lack of financial support for working capital requirements; market requirements and R&D are not matched; subsidies to conventional fossil fuel energy; market prices do not reflect environmental costs and damage; lack of successful and replicable business models; high energy generation cost; high transaction costs; minimum standards affects commercialization; non-availability of physical infrastructure; unstable electricity grids; inadequate servicing and maintenance of equipments; lack of trained personnel; restricted participation of community and local capacity building; limited general information and public awareness in relation to new technologies; insufficient networking.	Pakistan

Document Reference	Number of Categories and Barriers by Country/Region (continue)		
	Number of Categories	Number of Barriers	Country/Region
Patlitzianas et al. (2006)	(3) market technology; policy legislation; cost.	(9) lack of commercial skills and information; non-existence of country assistance strategies; absence of relative legal and policy framework; high utility interconnection requirements; high liability insurance requirements; no subsidies for competing fuels; high initial capital cost, high difficulty of fuel risk assessment; exclusion of environmental externalities in the cost.	Arab States of the Gulf
Mezher et al. (2012)	(3) market technology; policy legislation; cost.	(16) accessibility to credit problems; lack of technical skills and information; lack of commercial skills and information; non-existence of country assistance strategies; low awareness/experience in social, rural, environment sectors; absence of relative legal and policy framework; restrictions on sitting and construction; accessibility to transmission system problems; high utility interconnection requirements; high liability insurance requirements; no subsidies for competing fuels; high initial capital cost; high difficulty of fuel risk assessment; unfavorable power pricing assessment; high transaction costs; exclusion of environmental externalities in the cost.	United Arab Emirates (UAE)
Rabat and Sauni (2015)	(3) financial; infraestructure; regulatory.	(7) high initial cost; dedicated funding needed; limited availability of infrastructure and grid interconnections; lack of coordination between incentives and state programs; incentives that hinder the economic development; blocking of land; bureaucratic processes for clearances and approvals.	India
Susuki (2013)	(3) technological; financial; and institutional.	(11) limited capacity to assess, adopt, adapt and absorb technological options; lack of knowledge of technology operation and management; lack of skilled personnel/training facilities; lack of standard and codes and certification; lack of access to financing; potential lack of commercial viability; lack of financial institutions to support renewable energy technologies; uncertain governmental policies; lack of infraestructure; lack of information and awareness; lack of consumer acceptance.	Asia
Sen and Ganguy (2017)	(4) market failures; informational and awareness; socio-cultural; policy.	(11) underinvestment in research and development; unpriced environmental impacts; monopoly in energy sector; high initial investment cost; financial risks due to uncertainties in future electricity prices; lack of detailed dataset; requirement of skilled human resources with specific trainings; limited awareness regarding the technical and financial aspects of implementing a sustainable transition; resources can hinder multiple land usages; modification of existing laws and regulations is needed; and technologies should be protected by patents.	World

Table 2. Literature review that identifies barriers without ranking them

Document Reference	Top 5 Major Barriers	Country/Region
Blechinger et al. (2015)	lack of regulatory framework and legislation for private investors; gab between policy targets and implementation; high initial investment; lack of legal framework for independent power producers and PPAs; and diseconomy of scale.	Caribbean
Luthra et al. (2015)	lack of political commitment; ecological issues; scarcity of natural and renewable resources; lack of adequate government policies; and geographic conditions.	India
Nasirov et al. (2016)	grid connection constraints and lack of grid capacity; longer processing time for large number of permits; problems with land or water lease securement; limited access to financing; and difficulty in PPA negotiations.	Chile
Karatayev et al. (2016)	government fossil fuels priority; weak legal and regulatory framework; low electricity tariffs; inefficient technologies; and lack of infrastructure.	Kazakhstan

Table 3. Literature review that identifies barriers ranking them

		Barrier Category			
Project	Document Reference	Social	Economic	Technical	Institutional
Solar Perenome I	12811 Elec 2018 10 09			interconnection point arbitrage	
OOD: Jan. 2017					
EOD: Feb. 2020					
Pando	Adenda #3. 6507 Elec 2013 08 26			a natural phenomenon blocked tunnel and damage equipment	
OOD: Apr. 2013	Adenda #4. 8198 Elec 2014 12 26			geological and geomorphological issues caused delays	
EOD: May. 2020	Adenda #6. 11548 Elec 2017 08 17			breach of contract of tunnel contractor	
San Andres	Adenda #2. 7146 Elec 2014 03 06			redesign of the project	
OOD: Nov. 2014	Adenda #3. 8197 Elec 2014 12 24			machine house flood	
EOD: Jan. 2020	Adenda #4. 9540 Elec 2016 01 12			transformer suffered considerable blows	
	Adenda #5.11122 Elec 2017 04 10		inconvenience with financing	breach of contract of civil works contractor	
Don Felix II	12906 Elec 2018 11 13		conditioned the credit by ensuring		
OOD: Jul. 2016			the sale under PPA		
EOD: Feb. 2020					
Jaguito	13205 Elec 2019 03 20			change in the layout of the interconnection line	new procedures with the required
OOD: Dec. 2018					authorities
EOD: Jul. 2021					
Chuspa	Adenda #1. 8662 Elec 2015 06 04			modifications to optimize the project	
OOD: Aug. 2016	Adenda #2. 10865 Elec 2017 01 17				provisional suspension of the water concession
EOD: Jun. 2021	Adenda #3. 12073 Elec 2018 01 26	road closure			
	Adenda #4. 13355 Elec 2019 05 13		syndicated loan search		
Colorado	Adenda #1. 12240 Elec 2018 05 28			landsides / project redesign	
OOD: Nov. 2017					
EOD: May. 2021					
Viento Sur	10312 Elec 2016 08 17			change in interconnection point	pending approval of updated EIA
OOD: Mar. 2015					
EOD: June. 2021					
NG Power	7369 Elec 2014 05 21			delay in the construction of transmission line by ETESA	
OOD: Mar. 2017	8061 Elec 2014 11 20		syndicated loan search		cancellation of license
EOD: Jan. 2023	10381 Elec 2016 08 31				license (re)validity declaration
	11885 Elec 2017 12 06		syndicated loan search		cancellation of license
	12594 Elec 2018 08 03				license (re)validity declaration
Martano	9342 Elec 2015 11 24			request to increase installed capacity	
OOD: Mar. 2020	10612 Elec 2016 11 01				extension to present EIA
EOD: Jan. 2023	11173 Elec 2016 04 18			project site change	license (re)validity declaration
	11566 Elec 2017 08 23				extension to present EIA
	15541 Elec 2019 07 17			interconnection point arbitration	license (re)validity declaration

Leyend OOD: Original Operational Date EOD: Indicative Operational Date

Table 4. Barriers identified in ASEP's resolutions