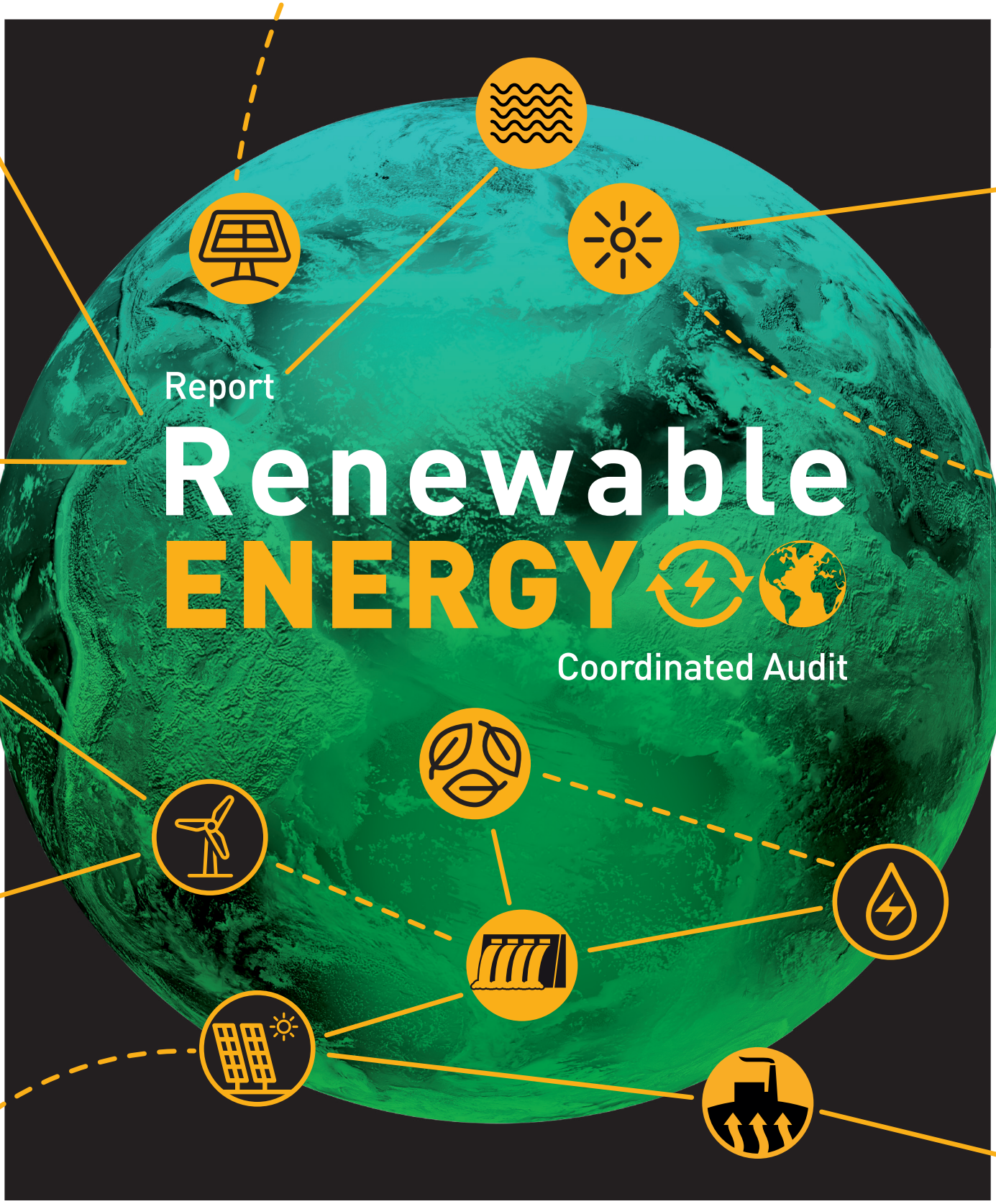

Report

Renewable ENERGY

Coordinated Audit

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Through:
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

OLACEFS
LATIN AMERICAN AND CARIBBEAN ORGANIZATION OF SUPREME AUDIT INSTITUTIONS

GTOP

FEDERAL COURT OF ACCOUNTS TCU

INTERNATIONAL COORDINATED AUDIT REPORT

EVALUATION OF PUBLIC POLICIES FOR THE INSERTION OF RENEWABLE ENERGY IN THE ELECTRICITY GENERATION MIX

Organization of Latin American and Caribbean Supreme Audit Institutions
Public Works Audit Working Group

OVERVIEW

Why was the audit performed?

Due to the predominance of fossil fuels in the worldwide energy mix, energy generation is primarily responsible for greenhouse gas emissions. Therefore, the replacement of these sources with renewable sources is one of the main ways of mitigating the process of climate change and its perverse effects. The establishment of international agreements to reduce emissions forces countries to adopt measures to promote the necessary energy transition.

In the electric power sector, specifically, the best opportunities for expansion of renewable sources are presented. The reduction of the costs of new sources, such as wind and solar photovoltaic, as well as the development of new technologies, has allowed a greater insertion of renewable sources for electricity production. In addition, a greater increase in clean energy can mean the expansion of the electricity supply without significant environmental impacts, also making it possible to expand access to electrical energy for the populations involved.

Based on this scenario, of unquestionable social and economic relevance for the region, the Organization of Latin American and Caribbean Supreme Audit Institutions (OLACEFS), through the Public Works Audit Working Group (GTOP), chose the topic of renewable energy in the electric power sector for a coordinated audit.

The Supreme Audit Institutions of twelve countries (Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala Honduras, Mexico, Paraguay and Venezuela) participated in the joint work. On this occasion, it was possible to promote an exchange of information on the energy policies adopted in each country and a subsequent consolidation of the results of the audit, in order to contribute to the improvement of strategies aimed at expanding clean sources in the electricity generation mix.

What was the objective of the audit?

The objective of the audit was to carry out a diagnosis on public policies and investments related to the expansion of renewable energy in the electric power sector in the participating countries of the Latin American and Caribbean region, especially identifying good practices and opportunities for improvement in these policies, so as to contribute to the achievement of the commitments assumed through the Sustainable Development Goals (SDG and Paris Agreement).

Results

As a conclusion of the work, findings were identified that can be summarized in the following groups: weaknesses in relation to government commitments and guidelines for the expansion of renewable sources; deficiencies in public policies for the sustainable expansion of the electricity generation mix; problems in the coordination between the actors involved and failures in the instruments for the adaptation of the electric power sector to the entry of renewable sources. Opportunities for improvement were also identified, as well as good practices that can serve to overcome verified weaknesses.

What are the main benefits expected from this joint work?

It is expected that the report of the deficiencies found will contribute to a greater effectiveness of public policies for the expansion of renewable sources in the mix and to the sustainable expansion of the electric power system, taking into account social, environmental and economic criteria. In this way, it contributes to the achievement of the goals set forth in the international agreements signed.

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1. WHAT IS A COORDINATED AUDIT?

Coordinated audits consist of a systemic and collaborative action carried out by a group of Supreme Audit Institutions (SAIs) in the exercise of external control over international or regional issues of common interest to the countries involved. In this context, they translate into an effective strategy of technical cooperation, capacity building and institutional strengthening aligned with the motto of the *International Organization of Supreme Audit Institutions* (INTOSAI) *"Experientia Mutua Omnibus Prodest"* - mutual experience benefits everyone.

The format of coordinated audits carried out by the Organization of Latin American and Caribbean Supreme Audit Institutions (OLACEFS) combines training actions, both online and face-to-face, with the performance of audits on relevant transnational issues of common interest, allowing the development of theoretical technical skills together with practical professional competences. They consist of three phases: 1st phase: joint planning of the work; 2nd phase: execution of audits by each of the participating Supreme Audit Institutions (SAIs); 3rd phase: consolidation of the results and subsequent preparation of the report.

Figure 1 - Phases of a coordinated audit

Figura 1 – Fases de una auditoría coordinada

It is necessary to mention that the performance of coordinated audits keeps the synergies foreseen in SDG 17 - "Strengthen the means of implementation and revitalize the global partnership for sustainable development."

2. INTRODUCTION

2.1. What is renewable energy?

This audit deals with the theme of renewable energy, which is defined as the energy in which the source (or fuel) for its production is replaced by nature in periods consistent with its energy demand (such as water, tidal, solar, wind and geothermal sources) or whose management by man can be carried out in a manner compatible with the needs of its energy use (as in the case of biomass: sugar cane, energy forests and animal, human and industrial waste). Because they have a lower environmental impact, at least in terms of greenhouse gas (GHG) emissions, they are also referred to in this report as clean or sustainable sources or energy. These types are in contrast to non-renewable energy, which cannot be replaced in a period compatible with its use by humans (fossil fuels, such as mineral coal, petroleum derivatives and natural gas, and nuclear fuel). Due to their GHG emission potential, in the case of fossil fuels, they are also known as polluting sources or energy. Regarding nuclear energy, some countries consider it sustainable; others do not.

Renewable energy is classified as conventional and non-conventional. Conventional energy was used decades ago and, therefore, has already reached a high level of technological maturity, as is the case of hydroelectric power plants. The non-conventional energy is that which had its technology developed recently and that still has enough expansion potential, especially the biomass, wind and solar photovoltaic sources, which have been presenting increasingly lower costs. Other non-conventional

types that can be mentioned are geothermal and tidal sources. The latter was not referred to in this report, as it is not representative of any of the countries audited.

Non-renewable sources, as well as conventional renewables, especially hydroelectric power plants with storage reservoirs, are classified as dispatchable, as they allow control over the moment of energy generation. Thermoelectric power plants powered by biomass are also considered dispatchable, although the seasonality in fuel production can sometimes mean a decrease in energy production in certain periods. Another non-conventional renewable source that is considered dispatchable and has representative production in some audited countries is geothermal. The wind and solar photovoltaic sources are called intermittent or non-dispatchable due to the lack of control in their generation, which entails new challenges for the operation of the system.

The promotion of an electricity generation mix with a greater share of renewable sources has been growing on the world scene, either seeking to reduce greenhouse gas (GHG) emissions, reducing dependence on fossil fuels, or due to the technological evolution that makes these sources more competitive. Renewable energy contributes to the achievement of economic, social and environmental sustainability standards.

In this sense, two international agreements of great relevance to the topic stand out: the 2030 Agenda for Sustainable Development and the Paris Agreement. The objectives and goals established in these agreements directly or indirectly contemplate the increase in the proportion of renewable sources in the global electricity generation mix.

With regard to technological development related to clean sources, the significant progress of non-conventional energy stands out. This has led several countries to adopt incentives, making these sources increasingly economically competitive, and encouraging competitive processes with the objective of increasing their share in electricity production.

Considering the systematic operation of the electric power sector and the peculiar characteristics of renewable sources, the expansion of non-conventional sources adds several challenges to the planning and operation of national electric power systems, such as: overcoming technical, financial and institutional difficulties in defining strategies and mechanisms for the expansion of these sources; adaptation of the regulation of electric power systems; identification of alternatives to mitigate the impacts of high variation in the generation of wind and solar photovoltaic sources, which present the greatest opportunities for growth; etc.

2.2. Countries participating in the coordinated audit

This audit was developed within the work plan of the OLACEFS Public Works Audit Working Group (GTOP), under the coordination of the Federal Court of Accounts (TCU) with the full participation of the Supreme Audit Institutions of the following countries: Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Paraguay and Venezuela

2.3. Audit objectives

The purpose of the audit was to evaluate the public policies for the inclusion of renewable sources in the electricity generation mix of the participating countries, including the international commitments assumed, as well as related governmental guidelines. To achieve this purpose, the following objectives were established:

1) To identify the current situation of the electricity generation mix in each of the participating member countries of OLACEFS;

2) To assess if there are public policies established for the scope of the national and/or international commitments assumed for the expansion of renewable energy in the electric power sector, especially for the achievement of the Sustainable Development Goals and the Paris Agreement;

3) To analyze the investments in infrastructure for sustainable electric power

generation (water, wind, solar, biomass, tidal sources, etc.) and possible existing barriers to the insertion/expansion of this infrastructure, especially in relation to aspects related to operational challenges, regulatory issues, subsidy and promotion policies, energy security, energy prices, tariff modulation, among others.

In the context of the collaborative effort prompted by the aforementioned international agreements, this audit is also an important tool to detect opportunities for improvement and good practices in public policies related to the topic, results that can bring relevant contributions to the improvement of these policies in the participating countries and even in the international community.

2.4. Criteria

The audit criteria were based on the national and/or international commitments assumed by each country, such as the Sustainable Development Goals (SDGs) of the 2030 Agenda, the Paris Agreement and the Nationally Determined Contributions (NDCs), as well as other relevant legal and infra-legal regulations at the national level. Other criteria were extracted from the documents prepared by the *Working Group on Environmental Auditing from the International Organization of Supreme Audit Institutions* (WGEA/Intosai), called "*Sustainable Energy Auditing: A Guide for Supreme Audit Institutions*," 2010, and "*Renewable energy*," 2016, both available on the Internet at www.environmental-auditing.org/publication.

In addition, two benchmarkings produced by a specialized consultancy (Facto Energy) were used. The first one called "Expansion of electric power generation from renewable sources," contains information gathered from ten leading countries on the international scene regarding the expansion of electric power generation from renewable sources, especially wind, solar, biomass and tidal, and covers the identification of risks, opportunities and good practices. The second, called the SAI Benchmarking Report, aims to provide good control practices on the topic of renewable energy by relating a synthesis of the audits carried out by different SAIs. Both documents are available at www.tcu.gov.br/energiasrenovaveis.

It is highlighted that, in alignment with INTOSAI, the performance on the topic of this coordinated audit observes ISSAI 5130 (*Sustainable development: the role of the Supreme Audit Institutions*) and ISSAI 5140 (*Forms of collaboration of the SAIs in auditing international environmental agreements*).

2.5. Background

Faced with concerns about ecological issues, in 1993, the WGEA/INTOSAI was created, which is a working group aimed at offering contributions to improve the use of the SAIs' audit mandates and tools in the field of environmental protection policy. Since then, relevant guides and informative materials on the topic have been published for use by individual SAIs.

Since 2016, the Federal Court of Accounts (TCU), SAI of Brazil, in conjunction with OLACEFS, has been developing the project "Strengthening External Control in the Environmental Area" in cooperation with the German Federal Ministry for Economic Cooperation and Development (BMZ), through the *German Society for International Cooperation* (GIZ). In particular, initiatives aimed at the Renewable energy theme were included, as this is a fundamental issue for the mitigation of the perverse effects of climate change.

This coordinated audit was preceded by an audit in Brazil, considered as a pilot audit, conducted by the TCU for the definition of the planning mix.

2.6. Methodology

The first stage of the work included offering training in order to create or strengthen the technical capabilities of the audit teams. In this regard, an online performance audit course was

conducted focusing on the use of appropriate techniques and tools. There were also three webinars held (conferences transmitted over the Internet via streaming) on aspects related to the insertion of renewable energy in the electric power sector.

After this, the Training and Planning Workshop was held in Santiago, Chile, from September 24 to 28, 2018. The first two days were intended to complement the specific training on renewable energy. The last three days were reserved for discussion of the proposed planning mix prepared by the TCU audit team. The discussion was based on a collaborative approach, using the Design Thinking technique, with the intention of fostering broad and effective participation of all SAI representatives. This dynamic contributed to the identification of the necessary adjustments for the improvement of the planning mix, which, after the adjustments, was approved by consensus of all present.

In the mix, four audit questions were defined to achieve the proposed objectives:

Question 1: Are there clearly defined **government guidelines and commitments** to promote a substantial increase in the proportion of renewable sources in the electricity generation mix by 2030?

Question 2: Are there **public policies** for the sustainable increase of the effective share of renewable sources in the electricity generation mix?

Question 3: Do the **actors involved** in the policy of insertion of renewable sources in the electricity generation mix **act in a coherent and coordinated manner**?

Question 4: Are there **instruments or strategies designed to adapt the electric power sector** to the characteristics of renewable sources, guaranteeing access to reliable, sustainable and accessible energy?

The execution phase of the coordinated audit took place between October 2018 and May 2019. During this period, participating SAIs applied audit procedures within their respective national territories to obtain answers to the questions set out in the planning mix.

It was established that the data submitted by the audit teams should consider the period between 2013 and September 2018. However, Brazil, El Salvador, Mexico and Paraguay did not present their statistics in September 2018, which led to considering the effective generation data only up to 2017. Another warning is regarding the data presented by Venezuela, as the SAI reported that the information for the years 2014, 2017 and 2018 are approximate statistics, both in relation to installed capacity and effective generation.

Finally, the Results Consolidation Workshop was held in Quito, Ecuador, from May 8 to 10, 2019. On that occasion, the results were treated and discussed in groups to consider the regional context and, in the end, the consolidation document was approved by all participants. This report was prepared on the basis of the data and information contained in this consolidation.

The link of the mentioned webinars and audit documents can be found on the Internet at https://portal.tcu.gov.br/pt_br/energia/informacoes/energia-renovavel.htm.

In addition to the countries involved in the coordinated audit, it should be mentioned that the SAI of Nicaragua participated in the planning phase.

This report consolidates the audits carried out by the SAIs of the countries participating in the coordinated audit. Chapter 3 presents the overview of the objective. Chapter 4 describes the situations encountered, the audit findings, the opportunities for improvement and, where appropriate, the good practices found. Finally, chapter 5 summarizes the final considerations.

3. OVERVIEW

3.1. Global agenda for a clean energy mix

After the Industrial Revolution, energy exploitation models were based mainly on the use of fossil fuels such as coal and oil. For this reason, a global energy mix has been created that is extremely

fossil dependent.

However, concerns about economic and climate issues prompted a movement to develop sources that are less susceptible to changes in oil prices and less polluting. On the climate side, evidence of the effects of GHGs on global warming and their consequences contributed to the search for alternative sources.

The worldwide strategy to mitigate and address global warming led to the signing of international agreements, such as the Paris Agreement, signed at the 21st Conference of the Parties (COP 21) in 2015, which establishes the objective of its signatories to limit the increase in the average temperature of the planet to below 2°C, in relation to pre-industrial levels, with the adoption of efforts to limit this increase to 1.5°C, since it is recognized that this action would significantly reduce the risks and impacts of climate change.

To achieve this goal, each participating government is formulating its Nationally Determined Contributions (NDCs), which outline each country's strategies for reducing GHG emissions. The transition to a cleaner energy mix is considered one of the main ways to achieve the desired goals.

The expansion of renewable energy in the mix is also part of the United Nations (UN) 2030 Agenda, which, in December 2015, established an international action plan structured in seventeen Sustainable Development Goals (SDGs), broken down into 169 objectives and 232 indicators, which address fundamental issues to achieve sustainable development. These topics cover three dimensions: economic, social and environmental.

SDG 7 is directly related to the increase in renewable energy - “Ensure access to affordable, safe, sustainable and modern energy for all,” more specifically, goal 7.2 - “By 2030, significantly increase the proportion of renewable energy in all energy sources.” Other SDGs that relate to the topic of energy transition are 11 - “Make cities and human settlements inclusive, safe, resilient and sustainable” and 13 - “Take urgent measures to combat climate change and its effects.”

The renewable energy mentioned in the SDGs cover several sectors, such as electricity, industry and transport, for example. This is because, in the context of these objectives, renewable energy covers any energy source that has the characteristic of regenerating itself over a relatively short time horizon, without being restricted to a specific sector. However, the insertion of renewable energy has been carried out mainly in the worldwide electricity generation mix, especially due to the sharp decrease in the costs of sources such as wind and solar photovoltaic in recent years. In this sense, the concentration of this audit on electricity generation is justified.

3.2. Evolution in renewable sources of electricity production in the world

In recent years, the process of inserting renewable energy into the energy mix has intensified, especially in the electric power sector. The percentage of clean energy in this sector has been growing year after year, except in 2018, where there was a small increase in the percentage of non-renewable sources, as shown in Table 1.

Table 1 - Share of renewable energy in the worldwide production of electrical energy (2013-2018)

Source	Share %					
	2013	**2014**	**2015**	**2016**	**2017**	**2018**
Non-Renewable energy	77.90%	77.20%	76.30%	75.50%	73.50%	73.80%
Renewable Energy	22.10%	22.80%	23.70%	24.50%	26.50%	26.20%
Hydroelectric	16.40%	16.60%	16.60%	16.60%	16.40%	15.80%
Wind	2.90%	3.10%	3.70%	4.00%	5.60%	5.50%
Bioenergy	1.80%	1.80%	2.00%	2.00%	2.20%	2.40%

Solar photovoltaic	0.70%	0.90%	1.20%	1.50%	1.90%	2.20%
Geothermal, concentrated solar power (CSP), tidal	0.40%	0.40%	0.40%	0.40%	0.40%	0.40%

Source: REN21 (www.ren21.net, accessed: 7/31/2019)

According to data from the International Renewable Energy Agency (IRENA), in just over a decade, the installed capacity for electricity generation through renewable energy, including conventional types, more than doubled from 1,058 GW in 2008 to 2,356 GW in 2018. Although it is not yet possible to correlate the growth of installed capacity for electricity generation from renewable sources with the above-mentioned multilateral commitments, in the last three years, 163 GW in 2016, 167 GW in 2017 and 177 GW in 2018 were added to the worldwide electricity generation mix, as shown in Table 2.

Table 2 – World electricity supply capacity from renewable sources, including conventional sources (2008-2018)

Source	Electricity generation capacity (GW)										
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Hydroelectric	961	995	1,029	1,060	1,093	1,137	1,175	1,210	1,248	1,270	1,295
Tidal	0	0	0	1	1	1	1	1	1	1	1
Wind	115	150	181	220	270	302	349	417	467	514	567
Solar	15	23	40	70	98	137	174	224	297	391	486
Bioenergy	54	61	66	73	78	85	90	96	104	109	118
Geothermal	9	10	10	10	10	11	11	12	12	13	13
Total	**1,058**	**1,139**	**1,226**	**1.329**	**1,444**	**1,565**	**1,692**	**1,849**	**2,012**	**2,179**	**2,356**

Source: IRENA (http://resourceirena.irena.org/gateway/dashboard/?topic=4&subTopic=54, accessed on 7/31/2019)

The data in Table 2 also demonstrate an exponential growth of wind and solar sources over the last decade, which added, respectively, 452 GW and 471 GW to the worldwide installed capacity between 2008 and 2018. This represents 71.1% of all additional renewable energy supply in the period.

This evolution is largely explained by the concentration of investments in these two sources. In Table 3, the data on investments by technology in the period from 2013 to 2017 follow, which indicate that wind and solar generation received 92.60% of investments in renewable energy in that period.

Table 3 – World investments in renewable energy - 2013 to 2017 (billions of US$)

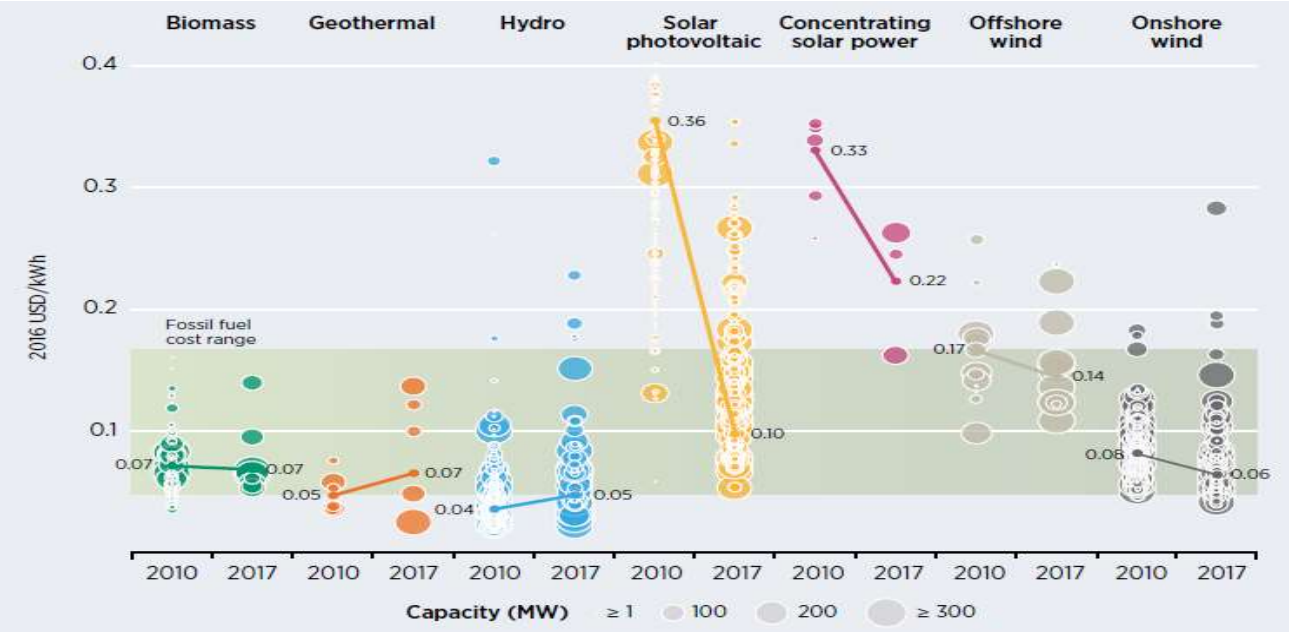
Investments for Technology	2013	2014	2015	2016	2017	Share% 2013-2017
Solar	119.9	145.3	179.3	136.5	160.8	53.15%
Wind	86.4	110.7	124.7	121.6	107.2	39.45
Biomass and transformation of waste into energy	14.0	12.7	9.4	7.3	4.7	3.45%
Hydro <50 MW	5.8	7.0	3.6	3.9	3.4	1.70%
Biofuels	5.2	5.2	3.5	2.1	2.1	1.30%

Geothermal	2.8	2,9	2.5	2.5	1.6	0.88%
Tidal	0.2	0.3	0.2	0.2	0.2	0.08%
New investments - total	**234**	**284**	**323**	**274**	**280**	**1.396**

Source: IRENA (http://resourceirena.irena.org/gateway/dashboard/?topic=4&subTopic=54, accessed: 7/31/2019)

The increase in electric power generation capacity from renewable sources has been accompanied by the decrease in the average cost of these sources, as shown in Figure 2.

Figure 2 - Worldwide average cost of electricity generated by large-scale renewable plants - 2010 and 2017



The figure analyzes the projects for the years 2010 and 2017. The size of the circles reflects the size of the undertaking according to the installed capacity, and the location of the circles indicates the cost of energy in US$/MWh. The weighted average energy price is calculated for each of the years (2007 and 2017). The line indicates the price trend from 2007 to 2017.

Source: IRENA, 2018 (International Renewable Energy Agency. **Statistics time series**. Available at: http://resourceirena.irena.org/gateway/dashboard/index.html. Accessed: Aug 20, 2018, p. 17).

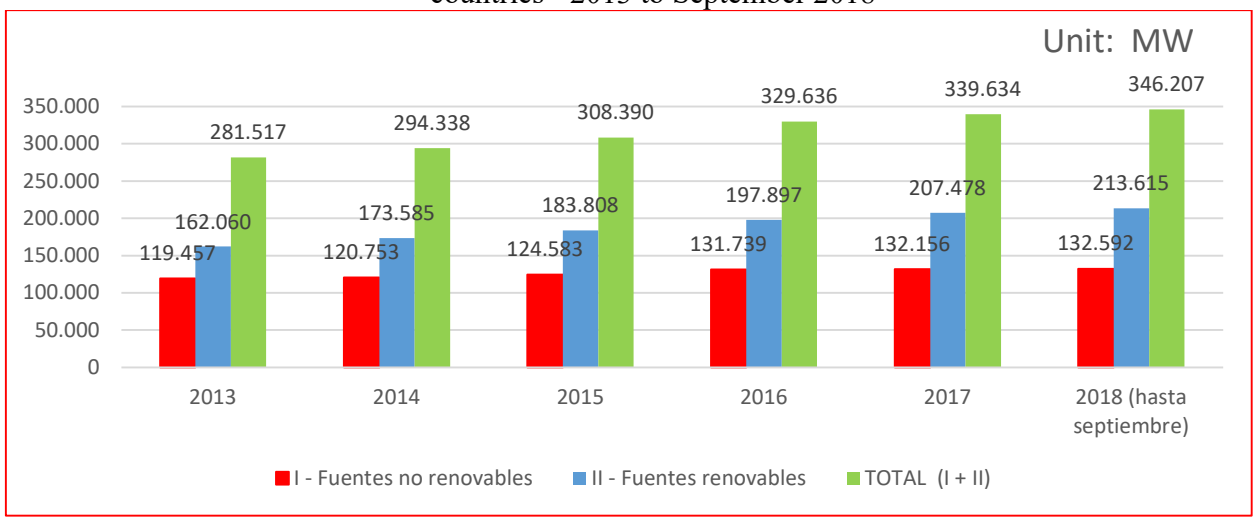
According to IRENA data, at the end of 2018, the five countries with the highest installed capacity of renewable energy sources were China, the United States, Brazil, Germany and India, in that order. China alone is responsible for 29.60% of the world's total renewable energy capacity, including conventional energy, with a total of 696 GW of installed capacity, compared to 136 GW installed in Brazil, which ranks third (Renewable Energy Statistics / IRENA 2019)

A summary of the main policies for the expansion of renewable energy used in the world, with a brief explanation of each one, is found in Appendix A of this report.

3.3. Status of renewable energy in the electricity generation mix of the participating countries

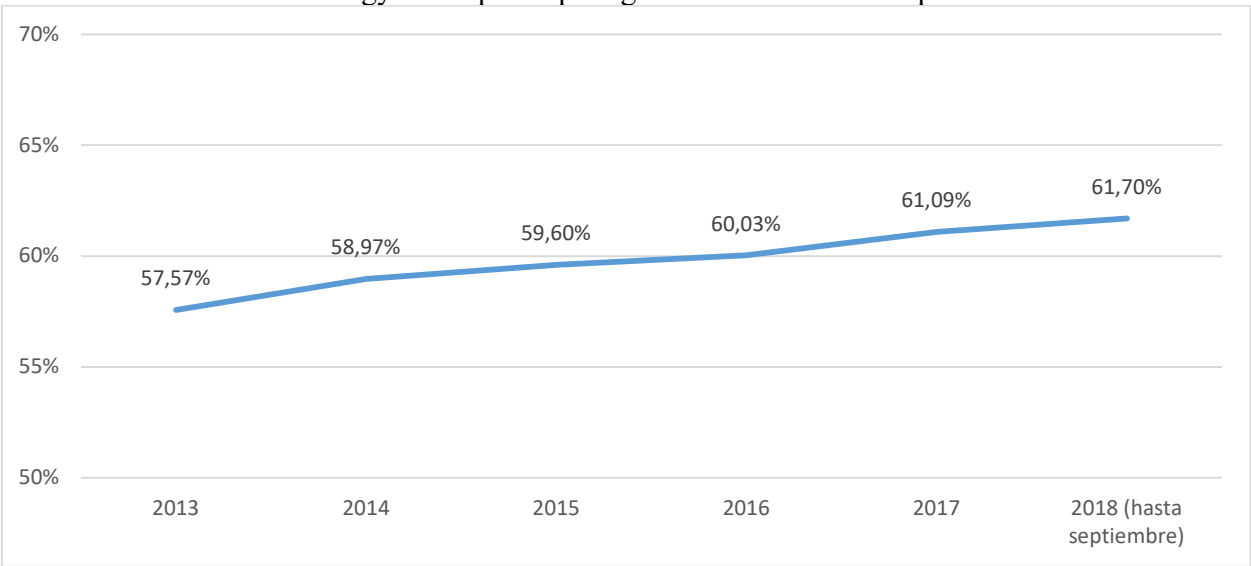
The consolidation of the evolution data of the installed capacity of the participating countries in the last five years shows the evolution of renewable and non-renewable sources, as shown in Figure 3.

Figure 3 - Evolution of the installed capacity for generation of electrical energy in the participating countries - 2013 to September 2018



It is also noted that the growth of renewable energy is higher than that of non-renewable sources. When comparing the percentage of clean energy in installed capacity in 2013 and in September 2018, an evolution of 57.57% to 61.70% is verified, according to Figure 4.

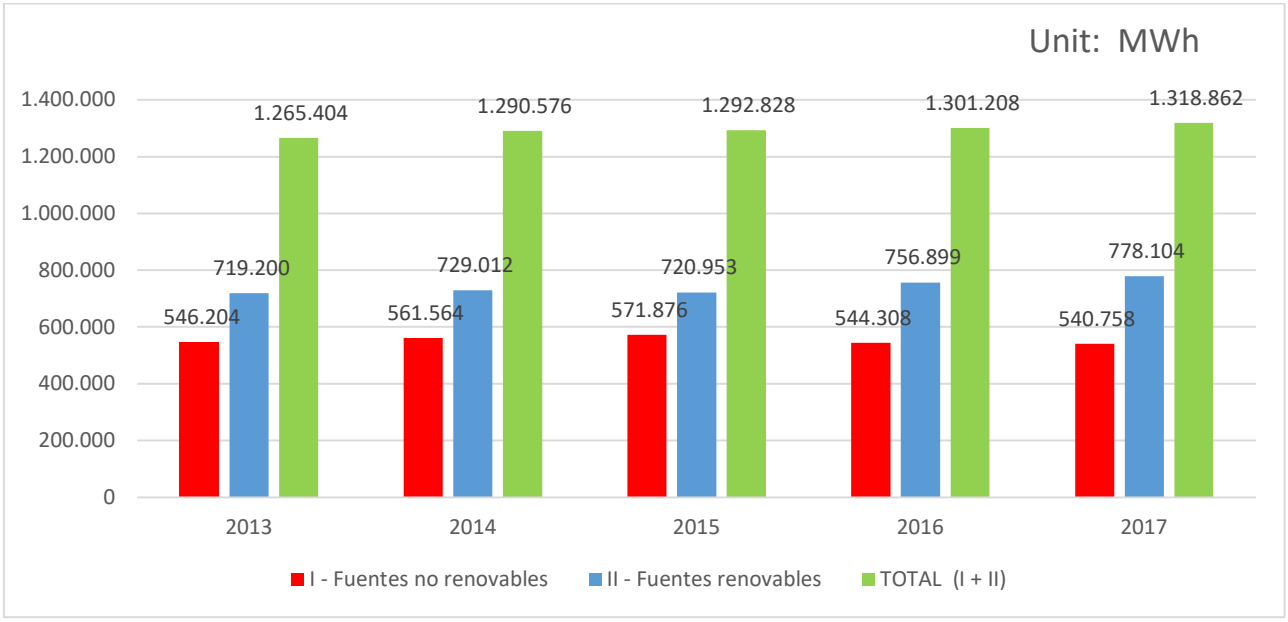
Figure 4 - Percentage evolution of renewable sources in installed capacity for the generation of electric energy in the participating countries - 2013 to September 2018



It should be noted that there is a small distortion in relation to the consolidated data of installed capacity since El Salvador and Mexico only reported the data up to June 2018 and Venezuela only reported approximate statistics of installed capacity for 2014, 2017 and 2018.

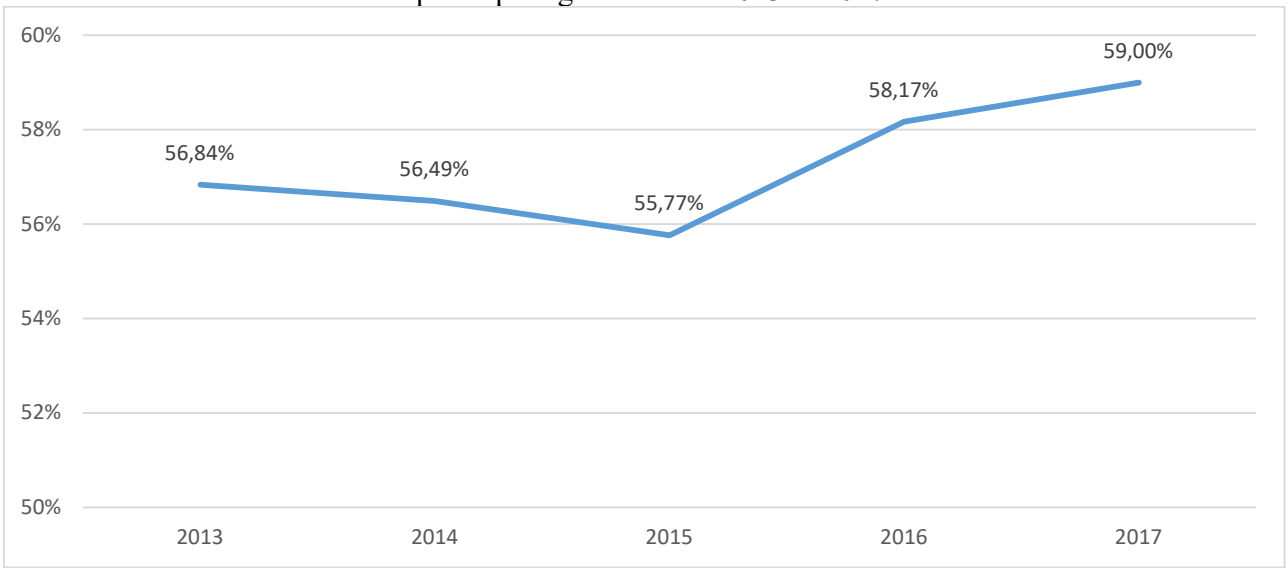
The effective electricity generation also grew continuously in the period from 2013 to 2017, according to Figure 5.

Figure 5 - Evolution of the effective generation of electric energy in the participating countries - 2013 to 2017



Although the percentage of installed capacity of renewable energy grew steadily over the period, it did not occur in terms of effective generation, as there was a slight decrease in 2014 and 2015. However, considering the entire period, there was an increase from 56.84% in 2013 to 59.00% in 2017, according to Figure 6.

Figure 6 - Percentage evolution of renewable sources in effective generation of electric energy in the participating countries - 2013 to 2017



It is noteworthy that much of the evolution of installed capacity and the effective generation of electricity is explained by the behavior of the electric power sectors of Brazil and Mexico, given their high representativeness in the consolidated results of the countries, as shown in Table 4

Table 4 - Share of each country in the installed capacity and total effective generation

INSTALLED CAPACITY	EFFECTIVE GENERATION

	In MW	Relative share of participating countries, in%	GWh	Relative share of participating countries, in%
BRAZIL	161,019	46.47	587,962	44.57%
CHILE	23,655	6.83%	74,136	5.62%
COLOMBIA	17,313	5.00%	66,667	5.05%
COSTA RICA	3,545	1.02%	11,210	0.85%
CUBA	6,479	1.87%	20,148	1.53
ECUADOR	8,162	2.36%	28,033	2.12%
EL SALVADOR	1,969	0.57%	6,652	0.50%
GUATEMALA	4,074	1.18%	11,490	0.87%
HONDURAS	2,637	0.76%	8,629	0.65%
MEXICO	76,825	22.17	329,162	24.95
PARAGUAY	8,883	2.56%	59,212	4.49%
VENEZUELA	31,958	9.22	115,961	8.79
TOTAL	346,519	100%	1,319,262	100%

Note: The installed capacity data refer to September 2018 and the effective generation data correspond to energy production in 2017. This data includes all sources of electricity production, whether renewable or non-renewable.

Appendix B of this report shows the list of the main incentive policies and strategies for the insertion of renewable sources in the electricity generation mix of the participating countries.

With regard to the data on GHG emissions, it was not possible to consolidate them since some countries did not present complete emissions data for all sectors, which makes it difficult to analyze the relevance of both the energy sector as a whole and specifically the electric power sector in terms of overall representativeness. In addition, some countries have very outdated data that do not allow for a reflection of the current situation or have presented data with great variability for the year of reference (variation between 2002 and 2016), which prevents adequate consolidation. Consequently, GHG emissions data will be treated separately by country.

Similarly, consolidating investments in renewable sources was not feasible, as several countries did not provide complete information, while others did not even send data. Therefore, investment data will also be processed individually by country.

3.3.1. Brazil

Given the country's great hydroelectric potential, the Brazilian electricity generation mix has historically developed through the exploitation of hydroelectric energy, which led to the achievement of a fairly renewable energy mix. The composition of the installed capacity was complemented by thermoelectric power plants, both biomass and fossil fuels, which led to the formation of a hydrothermal mix. However, since the massive introduction of the wind source in recent years, the mix has changed its characteristics, although conventional hydroelectric generation prevails. The evolution of new renewable sources in the country was driven by holding auctions.

In September 2018, the installed capacity of renewable energy reached 132,159 MW, which corresponds to 82.08% of the country's total. In addition to the hydroelectric power plant with 63.55%, biomass and wind sources stand out with 9.15% and 8.31% of the total, respectively. The most notable

feature is the low use of solar energy in relation to the country's potential - only 1,749 MW installed, which is equivalent to only 1.09% of the total capacity. Regarding effective generation, in 2017, total production was 587,962 GWh, of which 79.15% came from renewable sources.

With respect to GHG emissions, according to 2015 data, the energy sector reached a 32.8% share of the total. Given the renewable nature of the Brazilian electricity generation mix, only 14.7% of the energy sector emissions come from electricity generation, which corresponds to 4.8% of total emissions.

With respect to investments, from 2013 to September 2018, US$ 37 billion were invested in renewable sources. The investments in wind and solar generation stand out, with 51.89% and 22.43% of this total, respectively.

3.3.2. Chile

The formation of the Chilean electricity generation mix was based on the use of thermoelectric power plants powered by fossil fuels, especially mineral coal and natural gas. More recently, the need to expand electricity supply and reduce greenhouse gas emissions, either through international agreements or duly legislated internal commitments, has forced the development of renewable energy in the country, especially wind and solar photovoltaic sources. This latter source has stood out even worldwide since, given the existing public policies, along with the excellent geographical and territorial conditions, the country managed to achieve one of the lowest prices for solar energy production.

In September 2018, renewable energy reached 10,933 MW, equivalent to 46.22% of the country's total installed capacity. Wind and solar sources represent, respectively, 6.44% and 9.61% of the electricity generation mix. Although these two sources have developed strongly in recent years, the country's main renewable energy is still hydroelectric, with 28.05% of the total. In terms of effective generation, the total electricity produced in the country in 2017 was 74,136 GWh, of which 42.93% came from renewable sources.

With respect to GHG emissions, according to 2016 data, the energy sector accounted for 78.02% of the total emissions. Electricity generation alone accounted for 30.96% of the total, indicating that greater substitution of fossil fuels in the electric power sector can be very effective in the reductions.

Investments from 2013 to September 2018 reached US$ 22 billion in renewable sources, most of which came from the private sector, with 95.74% of the total.

3.3.3. Colombia

The Colombian electricity generation mix has historically been formed by taking advantage of the country's water resources through the construction of a predominantly hydroelectric system with a significant part of the thermoelectric power plants powered by fossil fuels, which eventually constituted a hydrothermal system. Non-conventional renewable energy such as biomass, wind and solar have not been meaningfully exploited yet. However, there is an ambitious government goal for 2022 that indicates 1,500 MW of non-conventional renewable sources in the country.

The installed capacity of renewable energy reached 12,010 MW in September 2018, which represents 69.37% of the total. Hydroelectric energy continues to stand out with 68.37% of the total, while combined non-conventional renewable energy - wind, solar and biomass - reaches only 0.97%. With respect to the production of electrical energy, in 2017 there were 66,667 GWh, of which 86.98% of that amount came from clean sources.

With respect to GHG emissions, according to 2012 data, the energy sector reached a 32% share of the total. Given the renewable characteristic of the Colombian electricity generation mix, only 14.63% of energy sector emissions come from electricity generation, which corresponds to 5% of total emissions.

No data were presented on investments in renewable sources.

3.3.4. Costa Rica

The development strategy of the Costa Rican electric power sector, since its inception, was based on the use of renewable sources, consolidating a predominantly hydroelectric mix. Shortly after, other clean sources, such as geothermal, wind, solar and biomass, were added, with a small part of thermal generation from fossil fuels. Even with a greater share of intermittent sources, the safety and quality of service aspects were not neglected. It is noteworthy that virtually the entire population of the country has access to electricity (99.39% of the population).

In September 2018, the installed capacity of renewable energy reached 2,973 MW, which corresponds to 83.86% of the country's total. In addition to hydroelectric energy with 65.98%, wind and geothermal sources, with 10.66% and 5.84% of the total, respectively, should be noted. As for the effective generation, in 2017, the figure was 11,210 GWh, of which 99.67% was produced from renewable sources. Given the high percentage of renewable energy already achieved, the greatest challenge facing the Costa Rican electric power sector is to optimize the use of available sources.

With respect to GHG emissions, according to 2012 data, the energy sector accounted for 64% of the total. No specific data were presented on emissions from the electric power sector. However, given the large proportion of renewable energy in electricity production, it can be stated that this sector's share in emissions is not relevant.

With regard to investments, from 2013 to September 2018, US$ 3.3 billion were invested in renewable sources, with the amounts invested in hydroelectric power plants with a capacity of over 50 MW, and in wind power plants with 77.44. % and 17.98% of the total, respectively.

3.3.5. Cuba

There has not yet been a significant evolution in renewable energy sources in Cuba. The electric power system is based on thermoelectric power plants driven mainly by imported fossil fuels. However, given the country's renewable energy potential, there is a forecast for the addition of clean energy. Government planning includes the construction of 19 thermoelectric power plants using biomass produced from sugar cane (approximately 755 MW); 13 wind farms (633 MW); 700 MW from solar photovoltaic energy, as well as 74 small hydroelectric power plants, representing a total addition of 2,144 MW of clean sources.

Currently, the total installed capacity of renewable energy reached 682 MW in September 2018, the equivalent of only 10.53% of the total. Sugarcane biomass stands out among the clean sources, with 7.53% of the total. In relation to effective generation, in 2017, production reached 20,148 GWh. Of this amount, only 3.56% came from electricity production from renewable energy.

Energy is the sector most responsible for GHG emissions in the country, reaching 45.13% of the total, according to 2015 data. Due to the fossil-fuel predominant thermoelectric power system, electricity generation accounted for a fairly significant part of the emissions - 25.13% of the total.

Total investments in renewable sources during the period from 2013 to September 2018 were US$ 222 million. The values applied in solar energy stand out, which represented 81.66% of this total.

3.3.6. Ecuador

Thermoelectric power plants based on fossil fuels predominated in the formation of the Ecuadorian electric power system. However, the addition of more than 2 GW of hydroelectric energy in 2016, mainly as a result of the completion of the construction of the Coca Codo Sinclair hydroelectric power plant, has changed this perspective and made the electricity generation mix predominantly renewable. However, non-conventional renewable sources have not yet taken off in the country.

In September 2018, the country reached 4,779 MW of installed energy from renewable sources, equivalent to 58.55% of the total. Hydroelectric energy represents almost the entire renewable potential of the country with 54.93% of the total. In terms of effective electricity production, 28,033 GWh were

generated in 2017, with renewable generation representing 73.69% of this total.

According to data from 2012, energy production was most responsible for GHG emissions in the country with 83% of the total. Electricity generation alone represented 23.24% of total emissions, which can be considered relevant.

From 2013 to September 2018, US$ 4.14 billion were invested in renewable energy. Almost all this amount went to the installation of large hydroelectric power plants, to which US$ 4.01 billion were allocated.

3.3.7. El Salvador

El Salvador has a predominantly renewable electricity generation mix, although thermoelectric power plants based on fossil fuels have an important share. There is a good diversification of clean sources, with a significant share of biomass, geothermal plants and the recent growth of solar energy. However, wind power has not been introduced in the country yet.

In June 2018, renewable capacity reached 1,212 MW, which corresponds to 61.55% of the total installed. Among the clean sources, hydroelectric, biomass and geothermal stand out, with 29.21%, 15.09% and 10.38% of the total, respectively. Although the wind source has not prospered in the country, solar photovoltaic energy has already reached 6.52% of total capacity with increases made since 2015. With regard to electric power generation, in 2017 there were 6,652 GWh, of which 56.99% came from renewable energy. The country's strategic planning foresees an even greater increase in the share of clean sources in electricity production, forecasting a 15% increase in relation to all energy produced.

According to 2014 data, the energy sector had a relevant share in emissions with 30.70% of the total. However, given the renewable characteristic of the electric power system, electricity production accounted for only 8% of total emissions.

From 2013 to June 2018, US$ 919 million was invested in renewable sources in the country. Investments in hydroelectric and solar energy stood out, with 43.61% and 38.81% of the total, respectively.

3.3.8. Guatemala

Guatemala’s electricity generation mix is predominantly renewable, but with a relevant share of thermoelectric power plants based on fossil fuels. The addition of renewable energy in recent years has reduced the dependence on fossil fuels for electricity production, which means that there has been an evolution towards clean sources in the mix. The national energy policy foresees that, by 2027, 80% of the electricity generation mix will be made up of renewable energy.

To get an idea of the evolution in the analyzed period, the share of clean sources in the Guatemalan electricity generation mix increased from 55.46% in 2013 to 69.44% in September 2018 of the total installed capacity. This was the result of a 71.53% increase in installed renewable capacity in this period, with an increase of 1,180 MW. Among the clean sources, hydropower and biomass stand out, with 36.80% and 26.36% of the total installed, respectively. However, the installed capacity of other renewable energy is not yet representative, since geothermal, wind and solar sources together represent only 6.11% of the total. Regarding electricity generation, 11,490 GWh were produced in 2017. Of this amount, 69.89% came from the production of renewable plants.

Regarding GHG emissions, the energy sector accounted for 90% of the total, and electric power generation also participated with 26.89% of the total, according to 2005 data. Therefore, although the electricity generation mix is mostly renewable, given the large share of energy in emissions, electricity production is ultimately relevant to the country’s reduction targets.

US$ 3.3 billion were invested in renewable sources between 2013 and June 2018. The main source of benefit was hydroelectric energy, with 78.82% of the total.

3.3.9. Honduras

The increase in clean energy in recent years has considerably reduced the dependence on fossil fuels in the electricity generation mix. It should be noted that this increase was due to the greater diversification of sources, since the insertion of non-conventional clean energy, such as solar, wind and biomass, was quite representative in the period analyzed. The country's planning is even more ambitious, as it estimates the share of renewable energy will reach 80% of total electricity generation by 2038.

The percentage of renewable energy in the installed capacity of the electric power sector increased from 43.80% in 2013 to 61.69% in September 2018. The growth of solar energy stands out, which did not exist in the country until 2014, but which, since 2015, was responsible for adding 451 MW to the mix and now corresponds to 17.10% of the total installed capacity. Other notable types of renewable energy are hydroelectric, biomass and wind sources with 26.77%, 7.96% and 8.53% of the total, respectively. Regarding electricity generation, 8,629 GWh of electricity were produced in 2017, of which 61.20% came from renewable generation.

With respect to GHG emissions, the energy sector contributed 41% of the total emitted, according to 2015 data. Electricity production participated with 32% of the emissions in this sector, which is equivalent to 13.1% of the total.

No data were presented on investments in renewable sources.

3.3.10. Mexico

Although non-conventional renewable sources such as wind and solar have grown considerably in recent years, the electricity generation mix remains predominantly fossil-fuel based. The main fuel for electricity generation is natural gas since the thermoelectric power plants that work with this energy represent more than half of the country’s installed capacity.

The country’s renewable capacity represented 26.56% of installed capacity, according to data from June 2018. Among the clean sources, hydroelectric, wind and solar stand out with, respectively, 16.40%, 5.68% and 2.14% of the total. Already, nuclear energy, also considered clean in this country, represents 2.09%. In relation to generation, 329,161 GWh of electrical energy were produced in 2017, the second largest production among the countries analyzed. The share of renewable energy in this total was 15.55%. However, in the Mexican NDC, a goal was established to increase clean energy generation to 37.7% of the total in 2030.

Energy production is the prominent sector in GHG emissions, since according to 2015 data, it accounted for 85% of the total. Due to the predominantly fossil fuel characteristic of the electricity generation mix, electric power generation accounted for 22.1% of the total, a figure that demonstrates the relevance of the energy transition in this sector to reduce emissions.

From 2013 to June 2018, investments in clean sources totaled US$ 6 billion. The values applied in solar and wind sources, respectively, 58.82% and 39.28% of the total, were highlighted.

3.3.11. Paraguay

Paraguay’s electricity generation mix is practically formed by conventional renewable energy (water) due the country’s participation in the binational hydroelectric dams of Itaipú and Yacyreta, which are among the largest in the world, and for the use of the Acaray national hydroelectric plant. It is noteworthy that, even with the large installed energy capacity available from these hydroelectric plants, the energy consumption per inhabitant is low due to the lack of adequate infrastructure (transmission and distribution) that allows better utilization of this great potential.

The country has plans to make improvements to the system of transmission and distribution of electrical energy to allow access to energy at all social levels, as well as the expansion of other clean energy, such as solar photovoltaic and the installation of small hydroelectric plants.

The energy sector is not very representative in terms of GHG emissions: according to 2012 data, only 3.41% of the total, and the electric power sector made practically no contribution. Therefore, the

reduction of energy production emissions in this country is going through a transition in the transport sector. It is worth mentioning that there is a governmental plan for a greater incorporation of public transport that runs on electricity.

There were virtually no investments in renewable sources from 2013 to 2017 - only US$ 10 million in hydroelectric energy.

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3.3.12. Venezuela

Venezuela has a well-divided electricity generation mix between fossil fuel thermoelectric power plants and large hydroelectric power plants. Non-conventional renewable energy has not yet gained ground in the country. The existence of subsidies for fossil fuels, which make these sources more competitive, together with the lack of private market participation and the economic blockade suffered by the country, limit investments in new technologies and slow down a larger diversification of clean sources in the Venezuelan electric power system. There are goals for the installation of photovoltaic wind and solar systems, mainly to serve isolated communities.

In 2016, renewable sources reached 47.53% of total installed capacity. Hydroelectric energy stands out with 47.36% of the total, that is, practically all of the installed renewable potential. In terms of electricity generation, Venezuela had a production of 115,961 GWh in 2016, of which 54.12% came from hydroelectric generation.

Regarding emissions, according to 2017 data, the electric power sector accounted for 16% of total emissions. The share of the energy sector as a whole was not presented.

From 2013 to September 2018, US$ 257 million was invested, highlighting the amounts invested in small hydroelectric power plants, with 52.53% of this total.

4. AUDIT RESULTS

This chapter presents the main results of this audit grouped into subchapters, according to the four Audit Questions indicated in the Methodology. In addition to the results of the audit and the respective opportunities for improvement, the good practices identified in some countries that can serve as inspiring examples, when found, will also be listed. However, for a better delineation of the topic relevant to each question, a brief initial overview will be made in each of the subchapters.

4.1. Government commitments and guidelines for the expansion of renewable sources in the electricity generation mix

All countries participating in the audit are signatories of the 2030 Agenda for Sustainable Development and the Paris Agreement. These countries formulated their NDCs at the national level and presented them to the United Nations Framework Convention on Climate Change.

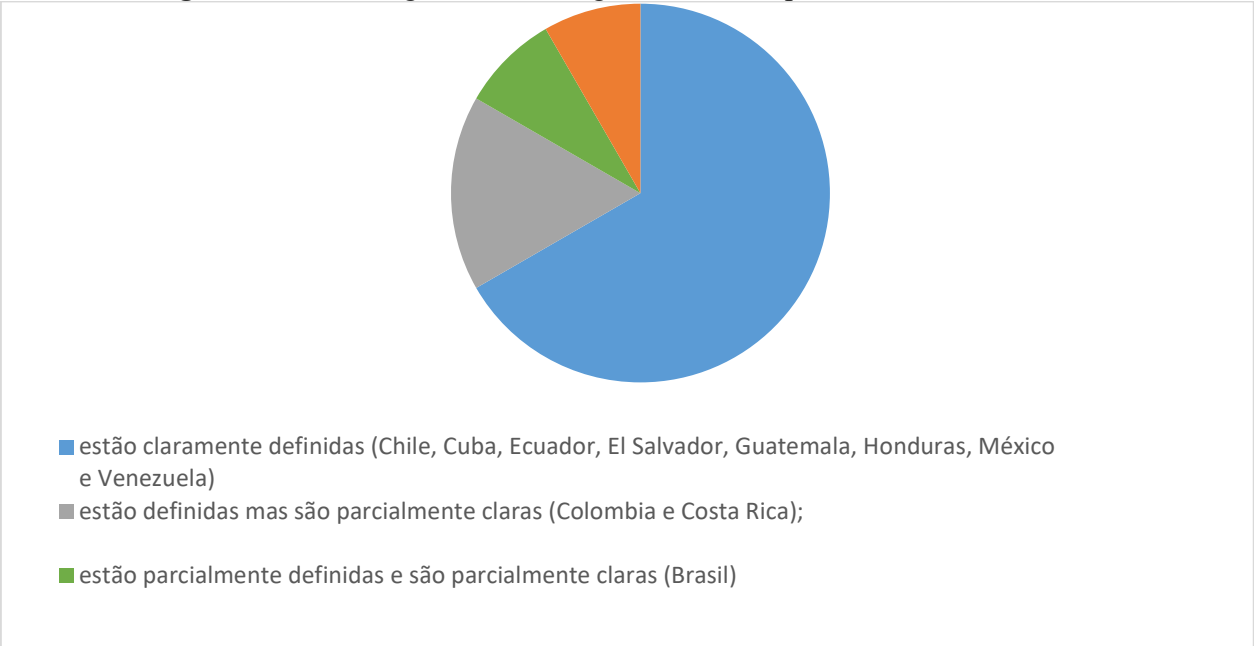
In general, each country has assumed GHG reduction commitments through one or more global goals, that is, goals that are transversal to the entire economy. Regarding the specific contribution of the electric power sector to the NDCs, Cuba, El Salvador and Venezuela presented mandatory goals. Brazil, Colombia, Guatemala and Mexico, in turn, have established only optional/indicative goals to achieve the planned total reduction, which means that failure to meet the objective related to the electric power sector can be compensated by exceeding the guidelines of other sectors. Chile, Costa Rica, Ecuador, Honduras and Paraguay did not set specific goals in the text of their NDCs, however, they established them in national plans, programs and laws.

Concerning the relevance of the electric power sector for the reduction of GHG emissions, it is considered that, in the cases of Cuba, Chile, Ecuador, Guatemala, Honduras, Mexico and Venezuela, the greater substitution of fossil fuels by renewable sources in electricity production is important, since more than 10% of total emissions come from this sector. In the other countries - Brazil, Colombia, Costa Rica, El Salvador and Paraguay – electricity generation does not reach this percentage of share in emissions. However, in a likely scenario of an increase in the fleet of electric vehicles, with the

consequent increase in electricity consumption, the transition to renewable energy in this sector may gain greater importance in the future in terms of GHG reduction.

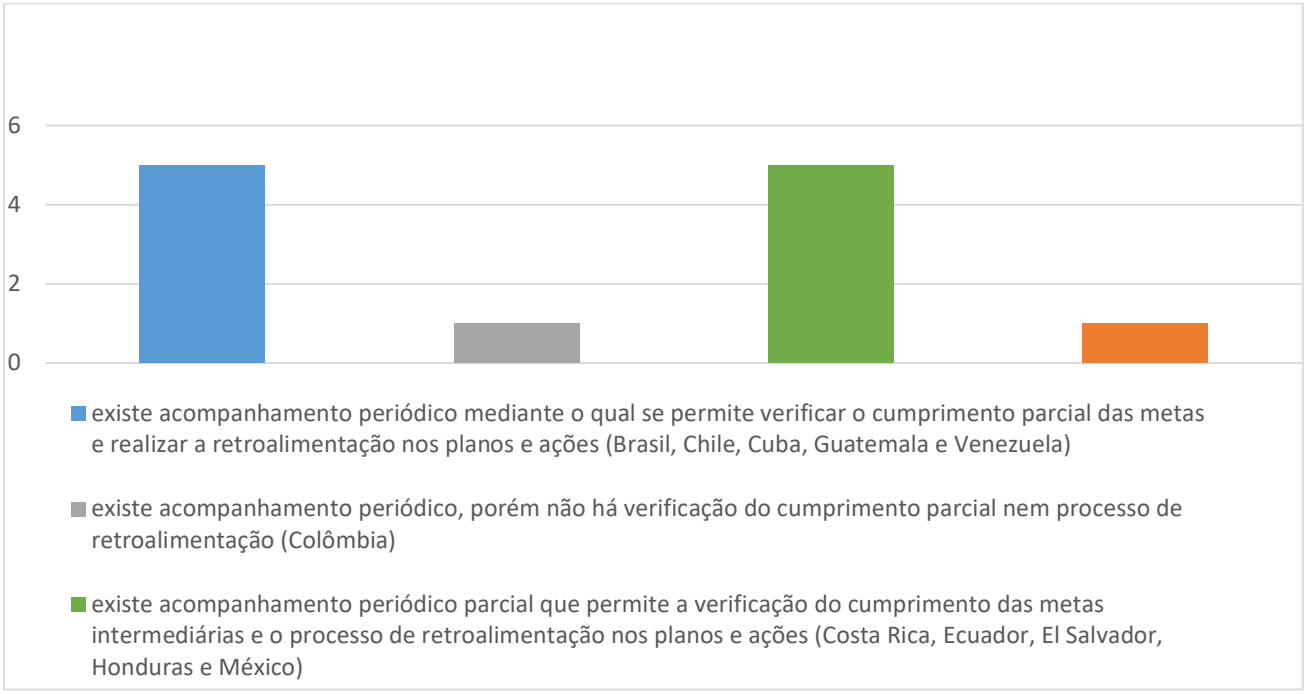
Regarding the existence of national guidelines and goals for the expansion of renewable sources, Figure 7 shows four different situations identified in the audited countries, namely: clearly defined goals; defined but partially clear goals; partially defined and partially clear goals; partially defined goals; and unclear goals.

Figure 7 - National guidelines and goals for the expansion of renewable sources



Regarding the periodic follow-up of the objectives and goals established in SDG 7.2, NDC and national targets, as shown in Figure 8, the following situations were found: there is a periodic follow-up through which it is possible to verify partial fulfillment of goals and carry out feedback on plans and actions; there is periodic follow-up, but there is no verification of partial fulfillment or feedback process; there is a partial periodic follow-up that allows for verification of the fulfillment of the intermediate goals and the feedback process in the plans and actions; Currently, there is no periodic follow-up.

Figure 8 - Periodic follow-up on objectives and goals



Concerning the effort related to the established goals, it was considered that Colombia, Cuba, El Salvador, Honduras, Mexico and Venezuela adopted commitments that portray a real governmental effort for a greater introduction of renewable sources in the electric power sector, which means that the guidelines are bold in the sense of providing substantial progress in the sector concerning the increase in renewable sources in the mix and, therefore, demand relevant action from the government for their achievement. In the cases of Brazil, Ecuador, Guatemala and Paraguay, it was verified that the established goals portray only a partial government effort since the established goals will probably be reached, demanding a reasonable participation of the government to make them concrete. In the case of Costa Rica, given its almost 100% renewable electricity generation mix, it was considered that the commitments established do not represent a government effort, which should be more to optimize existing capacity rather than a greater addition of clean sources per se.

In addition to this overview of guidelines and goals, the following audit findings were found: i) outdated data; ii) deficiencies in the definition of guidelines and goals; and iii) deficiencies in the periodic follow-up of goals and guidelines.

4.1.1. Outdated data

With the exception of Chile and Venezuela, the data presented on the evolution of GHG emissions are outdated since they are prior to 2016. This makes it difficult to verify the follow-up of possible progress due to the increase in renewable energy in the electricity generation mix.

In general, it was observed that the absence of updated data is due to the lack of coordination or articulation between government actors or the lack of prioritization of state entities to estimate emissions.

Due to this failure, an opportunity to improve would be the adoption of estimation procedures and the publication of emission data by sector to allow the evaluation of the results of GHG reduction initiatives. In particular, it would be advisable to reveal the evolution of the share of electric power generation in total emissions in order to identify the effectiveness of policies for increasing renewable energy in the electricity generation mix.

GOOD PRACTICES

Chile: Preparation of the national inventory of the evolution of GHG emissions with a long-term series (1990-2016) including methodologies, activity data and emission factors used for the estimation in all the sectors analyzed.

4.1.2. Failure to define guidelines and goals

In several countries, gaps were identified in the establishment of guidelines and goals that are critical to the further increase of renewables in the electricity generation mix. In Ecuador, for example, the planning instruments, although they offer objectives for the inclusion of renewable sources, do not provide specific goals to increase non-conventional renewable energy. As a result, there are only specific governmental strategic lines for hydroelectric energy generation projects, which may result in failure to take advantage of this country's potential for other sources, such as solar photovoltaic and wind energy. In this sense, it would be important that governmental plans also bring objectives in relation to those other energy sources to optimize renewable energy in their mix, since their increase presents several challenges that must be overcome, especially with regard to the operation of the system due to the high variability or intermittency of these sources.

In Honduras, the lack of definition of an energy policy due to the recent restructuring of the sector prevents better planning of actions in the electric power sector for the insertion of renewable energy. The government body responsible for the energy sector was just created in 2017 and is still in the process of organization and formation, which delayed the formulation of the necessary initiatives. With the formulation of a national policy for the evolution of the energy mix, it will be possible to establish the strategies and alignments necessary for the establishment of guidelines and goals for the achievement of the energy transition.

In El Salvador, although there is a national energy policy, it is outdated. The revision of this policy, which focuses on identifying the problems and challenges of the sector and aligning with established international commitments, is an opportunity to establish guidelines and goals for the further expansion of renewable energy in the mix.

In Brazil and Paraguay, explicit guidelines for the expansion of distributed generation in planning instruments were lacking. Given the importance of this mode of distribution for the expansion of renewable sources, especially solar photovoltaic energy, it is understood that the establishment of a national policy that brings clear goals would provide greater legal certainty to the different actors in the electric power sector to adopt measures necessary for the largest increase in clean sources. It is noteworthy that distributed generation also presents new challenges with respect to system adaptation, even in terms of complexity of system operation.

In the case of Costa Rica, the weakness of the planning instruments is not related to the increase in renewable energy – even though the country's mix is already practically totally renewable - but rather to the lack of guidelines and goals for a better utilization of the installed capacity and consequent optimization of the system. A better definition in this sense would bring various benefits such as tariffs, the reduction of the tariffs practiced, and the postponement of the need to expand the generation, with the reduction of environmental impacts due to the construction of new plants.

GOOD PRACTICES

Ecuador: the establishment of a pilot project by the Ecuadorian government in the isolated system of the Galapagos Islands. In this project, called the "*Zero Fossil Fuels Initiative in Galapagos,*" a set of goals and guidelines are designed for the replacement of electric power generation based on thermoelectric power plants powered by fossil fuels for energy production through renewable sources, especially for the use of solar and wind energy.

4.1.3. Deficiencies in the periodic follow-up of goals and guidelines

In some countries, problems were found in the follow-up of established goals and guidelines due to the lack of adequate monitoring or due to deficiencies in established indicators. These problems end up making it difficult to monitor the effectiveness of established policies and make it impossible to provide proper feedback on planning instruments.

In Colombia, for example, there is a mismatch between the establishment of indicators and national goals. Although the indicators are consolidated annually, the goals are formulated over a four-year period, which limits the annual verification of the achievement of the established objectives. Therefore, the indicated solution would be the establishment of annual goals so that more precise follow-up of the achievement of the established guidelines can be made. It should be noted that the bill containing the national development plan, which can meet this need, is being discussed in parliament.

Cuba, in turn, has several instruments with different methodologies to measure indicators, which harms the process of follow-up on the goals. In this sense, an opportunity for improvement is the elaboration of a single regulatory instrument for the systematization of the process of follow-up, review and feedback of the goals and guidelines related to the insertion of renewable energy in the electric power sector.

In Ecuador, the entity that was tracking the targets was extinct and the policy that established a new structure for the electric power sector did not provide for the monitoring of the SDGs. As a result, it was not possible to measure the results achieved, including SDG 7.2, which deals with the insertion of renewable energy into the energy mix, which also impaired the adoption of corrective actions precisely due to the lack of a correct identification of the evolution of the situation in the country.

In Honduras, Mexico and Paraguay, insufficient follow-up was identified both for fulfillment of SDG 7.2 and for commitments made in national NDCs. In Mexico and Paraguay, poor articulation of government bodies was the main factor that impaired monitoring. In Honduras, the regulation on how to follow-up on the SDGs was recently approved, which delayed the start of this process. It is also noted that the NDCs of Honduras and Paraguay are still under review.

An opportunity for improvement for Ecuador, Honduras, Mexico and Paraguay, at this point, is to strengthen the articulation between government bodies to achieve a convergent understanding. This better articulation will facilitate the implementation of appropriate technical instruments and methodology for follow-up, monitoring, evaluation of results, as well as the feedback of planning instruments.

With respect to Costa Rica, it was observed that the indicators established for the measurement of SDG 7.2 only include percentages of electricity coverage, and there is no defined indicator for the optimization of the use of renewable sources for electricity generation. It is understood that, in the case of this country, which already has a fairly renewable electricity generation mix, the establishment of indicators that measure the optimization of installed capacity would comply with the evolution of the main point that matters for the evolution of the national electric power sector. It is noteworthy that the optimization of the electric power system has economic, social and environmental benefits for the country.

4.2 Public policies for the sustainable increase of renewable sources in the electricity generation mix

Regarding the definition of incentive policies and strategies for the insertion of renewable sources, it was observed that in most countries - Brazil, Chile, Colombia, Costa Rica, Guatemala, Honduras and Mexico - these initiatives are correctly regulated, structured and systematized. On the other hand, in Ecuador, El Salvador, Cuba and Venezuela, there was an absence of a better structuring of these policies.

In the case of attributions and responsibilities for the implementation of public policies, it was observed that, in all audited countries, there is already a clear definition of the role of each governmental body or entity in the process of increasing renewable sources for electricity production.

Concerning the alignment of incentive policies with the established strategies, in the following countries there is a provision of their initiatives with the positive guidelines: Chile, Colombia, Costa Rica, Cuba, Honduras, Mexico and Venezuela. In the other countries - Brazil, Ecuador, El Salvador and Guatemala - this provision was found to be partial.

Similarly, it was detected that policies and incentives are coherent among themselves in the following countries: Chile, Colombia, Costa Rica, Cuba, Honduras and Mexico, while in the rest - Brazil, Ecuador, El Salvador, Guatemala and Venezuela - inconsistencies were found among the established strategies since there are contradictory incentives regarding a greater insertion of renewable sources in the electricity generation mix.

On access to information, it was found that in most of the participating countries - Brazil, Chile, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras and Mexico - there is already technical information available to those interested in developing public policies in the energy area. Colombia and Venezuela were the only countries in which some kind of hindrance was found in the access to information required by government measures to increase transparency.

Regarding the influence of citizens in the processes of formulation and review of public policies, it was found that Brazil, Chile, Costa Rica, Cuba, Ecuador, El Salvador, Paraguay and Venezuela have already adopted transparency practices that stimulate such participation. However, in Colombia, Guatemala, Honduras and Mexico, partial citizen engagement practices have been adopted, indicating the need for measures to expand these practices.

It was verified that the definition of incentives for the increase of renewable sources was made according to studies or objective criteria in: Chile, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala and Venezuela, while in others - Brazil, Costa Rica, Honduras and Mexico - not all incentives started from studies or objective criteria, exposing the opportunity for improvement in the processes of policy definition.

Another important situation perceived was the lack of mechanisms of progressive reduction in the incentives established in a large number of countries, which can culminate in an undue perpetuation since policies established today may prove to be unnecessary or inefficient in the future. Honduras was the only country in which there was, systematically, the concern with the establishment of mechanisms of progressive reduction of incentives for the increase of renewable sources in the mix.

Regarding the evaluation of the results of the incentives, three different situations have been found, illustrated in Figure 9: the results are adequately evaluated; the results are partially evaluated; the results are not adequately evaluated.

Figure 9 - Evaluation of incentive results

It is emphasized that the lack of an adequate evaluation results in problems in the process of monitoring and reviewing the incentives since it prevents knowledge of the effectiveness of the established strategies.

Finally, it is highlighted that, in the case of Paraguay, the evaluation was impaired in relation to this topic, since there are no standardized incentive policies that seek to increase the number of renewable sources in the electricity generation mix.

In addition to the initial outlook, the following audit findings related to public policies for the sustainable increase of renewable sources in the electricity generation mix were observed: i) scarcity of incentive policies for the sustainable expansion of the electricity generation mix; ii) lack of agreement between government policies and guidelines; iii) incentive policies with little transparency and low citizen engagement; iv) lack of evaluation of results of incentives.

4.2.1. Lack of incentive policies for the sustainable expansion of the electricity generation mix

Several situations were noted that indicate a shortage of public policies for a greater insertion of renewable sources in the mix.

In Brazil, for example, the lack of objective criteria for the definition of the types of sources that will be offered in the auctions was identified, which causes risks of external interference when choosing technologies and, therefore, the possibility that Selected sources are not the most appropriate according to economic, social and environmental criteria. Therefore, the definition of the criteria is presented as a guarantee that the expansion of the supply of electrical energy takes place in a sustainable way.

In Colombia and Honduras, on the other hand, it was detected that the established strategies or policies are not based on criteria that take into account efficiency or other factors that support the technical decision. Consequently, there is uncertainty in the cost-benefit of the planned actions. The opportunity for improvement in this matter would be the performance of previous studies that measure advantages and disadvantages of each strategy so that these aid in decisions to be made. It is noteworthy that, in the case of Honduras, the entity responsible for energy policies was recently created and, being in an organizational process, it has not yet been possible to correctly establish delineated strategies.

In Ecuador, El Salvador, Mexico and Venezuela, there was a situation of insufficient incentives for further development of non-conventional renewable energy such as solar, photovoltaic and wind sources. Thus, it is perceived that the establishment of specific strategies for said energy is presented as an opportunity to increase clean sources in these countries, even with a greater diversification of electricity mixes. Especially in Venezuela, the economic blockade further aggravates the situation of renewable energy development because it makes it difficult to import equipment and parts.

Another problem observed in Ecuador, Honduras and Mexico is the lack of policies for the expansion and improvement of the distribution and transmission system, which disfavors both the expansion of renewable energy and the level of confidence and optimization of resources in the electric power system. A greater number of electrical grid interconnections between regions is one of the ways to mitigate variability, mainly from wind and solar sources, since it allows for eventual surpluses to be compensated with generation reductions in other locations, avoiding other more polluting and costly backup resources.

Similarly, it is noted that, in Mexico, the creation of incentives for distributed generation, Efficient Cogeneration, technologies moved to biofuel, smart grids and tax collection in the production of fossil fuels, are measures that could help in the increase of renewable sources.

Cuba is still in the process of approving fiscal and tax incentives for the expansion of renewable sources. The regulations are currently being reviewed by Parliament. Ecuador is in a similar situation since the approval of complementary standards is necessary for a greater effectiveness of the legislated policies. In both countries, the positive impact of these strategies is seen as crucial for a greater promotion of clean energy in the country.

In the case of Costa Rica, considering the high percentage of renewable energy, policies are needed for a greater optimization of the use of sources already available in its installed capacity. One of the problems is the excess of installed capacity, mainly in rainy seasons, due to the high availability of hydroelectric resources. As an aid in the development of such strategies, technical studies are needed to seek the best use of sources.

GOOD PRACTICES

Brazil: the creation of mechanisms to value and encourage the adoption of cheaper and less polluting solutions in auctions for contracting energy for isolated systems, such as the possibility of building hybrid systems that use two or more sources.

Venezuela: the implementation of a government program called "Sembrando Luz" (Sowing Light) for the electricity supply in isolated communities by means of hybrid wind and solar energy systems.

Chile: the inclusion of hourly blocks in the tender criteria, which allows certain intermittent renewable sources to be favored, such as solar photovoltaic, which can offer better prices in optimal production hours. Another exemplary measure was the consolidation of an integrated and long-term national energy policy called Agenda 2050, built through the collaboration of a wide range of relevant actors and which favors the sustainable expansion of the electricity supply.

4.2.2. Lack of consistency between government policies and guidelines

Some situations were verified that show inconsistency between established public policies and government guidelines for increasing the percentage of renewables in the electricity generation mix.

The existence of incentives for the electric power generation from fossil fuels was verified in the following countries: Brazil, Ecuador, El Salvador, Mexico and Venezuela. This constitutes a contradiction with the effort of these countries to increase the percentage of renewable energy in the mix, considering that fossil fuels become artificially more competitive. Therefore, it is necessary to

revise the rules that establish these incentives.

In Guatemala, on the other hand, the lack of an update of the legislation makes it difficult to implement strategies for the fulfillment of the goals, since the current policies are contradictory to the guidelines established above. Therefore, the revision and approval of laws consistent with the government's goals for increasing renewable energy are essential for a more effective energy transition in this country.

In Paraguay, although there are guidelines for the insertion of renewable energy in the mix, the lack of policies for the realization of this increase limits the efficiency of this government strategy. The cause pointed out for the lack of policies is institutional weakness. Therefore, for the implementation of initiatives in this sense, it is necessary to strengthen the institutions responsible for energy policies.

4.2.3 Incentive policies with little transparency and low social participation

Situations were detected that show that incentive policies are not at an adequate level of transparency or that existing mechanisms do not allow for popular participation in the formulation of initiatives. This entails the risk that the policies do not address the needs of the population.

In Colombia, Guatemala, Honduras and Venezuela, it was found that the dissemination of information is insufficient to allow citizens to participate adequately in policy formulation. On the other hand, Guatemala, Mexico and Paraguay present limited mechanisms to allow citizen engagement in the formulation of strategies in the electric power sector.

Among the causes of these problems, the low dissemination of citizen engagement mechanisms by public entities and the existence of incomplete databases stand out. In the case of Venezuela, the restriction of information in the electric power sector is caused by being considered a question of state security.

There are some opportunities for improvement to remedy these findings. In the case of Colombia, Guatemala, Honduras and Paraguay, the incentive to the participation of diverse actors could be given through a greater integration of dissemination spaces in channels with two-way interactions that guarantee the engagement of citizens in the formulation of policies. In Guatemala and Mexico, a clear definition of guidelines and mechanisms for the promotion of citizen engagement would be interesting, and it would be possible to adopt positive initiatives used in other countries, as in the case of public hearings and consultations. For Venezuela, the dissemination of information from the electric power sector could help in a greater influence of the different stakeholders in the formation of governmental strategies to insert renewable energy in the electricity generation mix, which could lead to an increase in the efficiency of the sector.

GOOD PRACTICES

Brazil and Costa Rica: holding public hearings (face-to-face) and public consultations (online) on government proposals related to the formulation, modification or regulation of the main policies, to the elaboration of planning instruments and other activities related to the public sector, including issues related to renewable sources.

Chile: participation of indigenous communities in the formulation of energy policies.

El Salvador: Creation of the “National Council for Environmental Sustainability and Vulnerability (Conasav),” a plural and autonomous consultative entity for dialogue and consultation on matters of environmental sustainability and vulnerability that seeks to respond to the country’s needs in terms of inclusion and citizen engagement.

4.2.4 Lack of evaluation of incentive results

Situations were found that demonstrate the lack of an evaluation of the results of the incentives granted to renewable sources, which generates a risk that the strategies adopted are not justified in terms of short-, medium- or long-term cost-benefit. The absence of an evaluation may result, for example, in greater expenditure of government resources due to the existence of excessive incentives or in unnecessary increases in consumer charges.

In Brazil, Colombia, Ecuador and Guatemala, it was found that most of the established policies do not have standardized processes for the evaluation of the results obtained. In the case of Mexico and Honduras, it was found that financial incentives do not have adequate evaluation processes. These failures are mainly due to deficiencies in the planning and measurement of incentives by government entities. In the specific case of Colombia, the lack of adequate measurement occurs because the monitoring and verification system of the energy sector is still under construction.

Another problem found in virtually all countries was the lack of mechanisms of progressive reduction in incentive values granted. This discovery reinforces the risk that incentives will become inefficient when they are perpetuated over time, while there is a difficulty in withdrawing them due to legal certainty or the possible influence of favored groups.

In Costa Rica, it has been detected that, although there is a monitoring of incentive results, there is no concern with the measurement of the optimization of the system. This leads us to the risk that there is an installation of renewable sources that exceeds the needs of the country, causing an increase in electrical energy rates for consumers due to the excess of plants built.

In all the aforementioned countries, the opportunity for improvement presented for the correction of problems is the adoption of an action plan for the systemic evaluation of the results of public policies aimed at increasing renewable sources in order to provide inputs for their improvement, including, if necessary, an evaluation of the need to maintain incentives or to provide for their manual reduction.

GOOD PRACTICES

Honduras: systematically presents mechanisms of progressive reduction in incentives granted to renewable sources, facilitating their withdrawal or non-perpetuation if they are inefficient.

4.3 Coordination among stakeholders involved with the expansion of renewable sources

Regarding the coordination of necessary actions for the increase of renewable sources in the electric power sector, it was verified that the coordinating body is well defined in Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, and Mexico. However, only in Chile and Cuba was it considered that the coordinating body fully exercises its function of articulating and aligning actions of the different key actors. El Salvador, Paraguay, and Venezuela present an unsatisfactory definition of the coordinating body, which also results in failures in the articulation of actions.

With regard to the functions, actions or competencies of the various responsible bodies and entities, no overlapping of their attributions was identified in most of the countries - Brazil, Chile, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala and Mexico. However, Honduras and Paraguay presented a wide overlap of functions, resulting in an undefined definition of responsibilities of each government entity involved. In Venezuela, on the other hand, there is no institutional coordination for policies to increase renewable sources, which potentially increases the risk of overlapping functions.

Regarding the participation of governmental entities that have attributions attached to the entities of the energy sector, such as the environmental bodies, it was noticed that their opinion is

considered at the moment of defining and implementing public policies in Brazil, Chile, Colombia, Cuba, Ecuador, Honduras and Mexico. Costa Rica, El Salvador, and Paraguay have their entities partially considered, while in Venezuela and Guatemala their opinion is not taken into consideration in any way.

Regarding the coordination among actors involved with the expansion of renewable sources, the following audit findings were registered: i) deficiencies in policy coordination; ii) deficiencies in the articulation among actors and; iii) deficiencies in the participation of bodies and entities.

4.3.1 Policy coordination deficiencies

Some situations were observed that show failures in the coordination of policies for the insertion of renewable sources in the electricity generation mix in the countries audited.

In El Salvador, the actions and coordination mechanisms are not adequately documented, while in Mexico, there is no agreement between the actions regulated and those adopted as substantive procedures of the coordinating entity. In both countries, these situations do not allow for the effective development of processes for the implementation, follow-up and review of public policies, and make it difficult to report on progress in implementing the objectives set. In this case, the opportunity for improvement is the formalization and systematization of actions and coordination mechanisms.

On the other hand, in Paraguay, the coordination body is not recognized by all its members, nor does it have the necessary resources for adequate articulation and alignment of actions with the various stakeholders, generating a high risk of overlapping functions and, therefore, harming the very optimization of the electric power system. The creation of a ministry responsible for energy policies is seen as a solution to the coordination deficit.

In Costa Rica, in turn, the problem is the delegation of electric power generation expansion planning to the institute responsible for operating the system. As a result, the granting power ends up omitting the necessary controls, which can result in the expansion of the grid happening far from the point considered optimal for a better use of existing resources.

Finally, as has already been mentioned, Venezuela does not have national coordination between the responsible ministry and the other government institutions to increase the participation of renewable sources in the mix, which can lead to a duplication of efforts. The opportunity for improvement in this case is the institution of a committee to serve as the entity responsible for the coordination of the initiatives.

4.3.2. Deficiencies in the articulation between the actors

Likewise, situations were observed that demonstrate failures in the articulation between actors responsible for the policies of insertion of renewable sources in the electricity generation mix.

In Cuba, the absence of a single regulatory instrument that ensures the systematization of articulation processes was detected. In Mexico, El Salvador, Ecuador and Paraguay, there is also no adequate articulation process between the different levels. On the other hand, in Honduras, the restructuring of the electric power sector, initiated in 2014, is still ongoing, as some of the institutions created are not yet operational, thus impairing the division of functions. This results in that, in these countries, the effectiveness of the processes of implementation, follow-up and evaluation of public policies is affected precisely by the lack of adequate articulation.

In the cases of El Salvador, Mexico and Paraguay, the solution suggested for correcting these failures was the formalization of a document that systematizes the articulation between the various actors. In the Cuban case, the opportunity for improvement lies in the expansion of government efforts to integrate the different documents for the unification of a single legislation. In Ecuador and Mexico, it is highlighted that an improvement could be made by better defining the attributes of the actors in the process (public sector, society and private sector). In the case of Honduras, the formulation and implementation of an action plan for the establishment of corresponding entities in accordance with the

law would be an appropriate means of promoting the modernization, development and efficiency of the sector.

Although there is an articulation between the actors in Brazil, it was found that, in several relevant processes, it occurs in an informal and unstructured way, for example, in the development of planning instruments. Similarly, it was found that the state entity responsible for the area of transport does not participate in the definition of energy policies, which may hinder measures aimed at electric vehicles. These shortcomings can undermine the efficiency of policies related to the topic and, in the case of a scenario in which the vehicle fleet is electrified, there may be a deficit in preparing the electric power sector for the creation of the necessary structure for car recharging. In the Brazilian case, the opportunities for improvement are the formalization of the way in which the articulation in the relevant processes takes place and the inclusion of an entity responsible for the area of transport in the discussions that serve to support decisions in energy policies.

Finally, in Colombia, the existence of duplicate committees was observed, composed of the same institutional actors defined for the follow-up of each policy in a fragmented way, which imposes a risk of overlapping of functions regarding the monitoring of the goals of reduction of greenhouse gas emissions. Thus, it is convenient for the Colombian government to unify these committees so that monitoring is carried out by a single institution.

4.3.3 Deficiencies in the participation of bodies and entities

In addition, situations were detected that show failures in the participation of actors that are considered essential for the formulation of more effective policies.

In Paraguay and Guatemala, for example, the absence of participation of organizations essential for the establishment of more effective policies was verified. In El Salvador, although the participation of the environmental body has been verified, it was observed that its opinion was only considered after the definition of a national energy policy. Such situations generate a risk that policies consider costs and benefits only in the economic aspect, disregarding the importance of environmental and social aspects.

In the case of Paraguay and Guatemala, the solution indicated for the problem would be the development and formalization of a document that systematizes the articulation and participation of key actors in the elaboration of public policies, especially social and environmental entities. On the other hand, in El Salvador, the opportunity for improvement found is in the improvement of the articulation instruments so that the participation of the environmental body is foreseen in the phase of policy development and planning instruments of the energy sector. Another opportunity for El Salvador would be the updating of the energy policy so that the recommendations made to make them compatible with the national environmental policy be considered as soon as possible.

GOOD PRACTICES

Chile: the formulation and implementation of the national energy policy was carried out with broad and structured participation by government bodies and other stakeholders who were integrated into groups, committees and roundtables. Particularly noteworthy is the participation of public entities responsible for socio-environmental licensing processes and for climate change adaptation and mitigation measures, private-sector entities, universities, experts, industry associations, organized civil society and representatives of indigenous communities.

Costa Rica: the participation of universities in the formulation of energy policies with actions aimed at research and innovation on several important themes for the increase of renewables in the mix, such as energy storage and the development of new technologies from non-conventional sources.

Cuba: existence of a national university network for the study of renewable energy sources, with working groups related to the development of these sources or solutions that favor their highest increase in the electricity generation mix, such as the creation of laboratories for the technological development of the photovoltaic solar energy and the study of energy storage technologies.

4.4 Instruments for adapting the electric power sector to the characteristics of renewable sources

As mentioned, the insertion of renewable sources in the electric power system encompasses several challenges to face that require adaptation measures to enable an increase in the energy mix. These measures are largely related to the high daily variability in the generation of energy from wind and solar photovoltaic sources, which present a greater visibility for their expansion. The increase of these new intermittent sources causes a significant part of the installed capacity to become uncontrollable and often unavailable, compromising the possibility of injecting liquidity into the system in the traditional way.

This situation produces a new paradigm in the reliability of the system, since the capacity of response of the residual generation to this variability is as important to guarantee the supply as the installed capacity to meet demand peaks. Thus, the increase in solar and wind sources in electrical grids can lead to an increase in the use of dispatchable plants such as, for example, thermoelectric, predominantly driven by fossil fuels, or hydroelectric power plants with storage reservoirs.

In other words, the increase in intermittent clean energy in the system can generate a danger of increased greenhouse gas emissions due to the need for more frequent construction and distribution of plants that have a higher GHG emission level. Therefore, it is necessary to look for alternatives that do not necessarily presume an increase in environmental impacts, such as the development of energy storage systems, restructuring the distribution for use of hydroelectric power plants with battery reserves, as well as that of devices for chemical storage; expanded use of biomass as fuel in thermoelectric power plants; construction of hybrid plants that take advantage of the complementarity of the sources used; greater interconnection among electrical grids between regions or countries that allows compensation of surpluses generated with local generation reductions; and in the same way, alternatives for optimization of existing installed capacity, such as demand management, use of *smart grids* and the use of a price formation with higher time granularity in the market in the short term. These alternatives must be encouraged by public policies and by the adaptation of regulatory instruments.

Another challenge to be overcome in the field of renewable energy is the rational economic and environmental expansion of distributed generation. But, for the success of this new model, several adaptations are necessary, such as the adaptation of electrical grids for the injection of energy by

prosumers and self-producers, aiming at making possible the compensation of the energy produced, which demands investments. In addition, adaptations in the legal regulatory framework are necessary to promote distributed generation since, while incentives are needed in this modality, such as the regulation of Net Metering or the Compensation System, it is also necessary to create mechanisms that indicate the value of the use of the electrical grid by prosumers, under penalty of damages to the distributors and the most vulnerable consumers who do not have sufficient resources for the necessary initial investment. In addition to providing a boost to new renewable sources, this distribution modality brings several advantages, such as avoided costs of centralized generation distant from consumer centers (and electrical losses along the transmission and distribution grids), as well as the postponement of investments in new plants and in transmission and distribution lines, resulting in the reduction of environmental impacts caused by the construction of enterprises that would no longer be necessary. However, it has associated disadvantages, such as the absence of scale income from centralized generation, preparation of the distribution grid for energy flows - referring to the consumer unit - in all directions and the absence of information that may induce consumers to make non-domestic investments.

Faced with these challenges, it was found that, in the countries audited, there are already several strategies, some already in place and others still planned, for the adaptation of the electric power sector to a greater increase in renewable sources. Following, Boxes 1 and 2 are presented which show, respectively, existing and planned strategies, as well as the countries where they are already applied or where there is a forecast of implementation.

Box 1 - Existing strategies for adapting the electric power sector to the increase in renewable sources.

Strategy	Countries
The model underlying decisions for an expansion of the electric power sector considers the intrinsic characteristics of the sources.	Costa Rica
Consideration of the impact of climate change on planning for electric power system expansion.	Brazil
Introduction of the intraday system of energy price formation in the short-term market.	Chile
Use of studies or strategic plans that indicate the limit of introduction of renewable sources, notoriously intermittent, as well as regulatory and technical solutions to guarantee a safe, reliable and economic operation of the system by adding these sources.	Chile Colombia Costa Rica El Salvador Guatemala Mexico
Establishment of hourly blocks in the tender criteria, allowing a greater insertion of intermittent renewable energy and its adequate price scale.	Chile
Limitation of self-production and a maximum percentage of own demand in order to prevent the production of energy by these users from affecting the role of the entities responsible for energy generation and, consequently, guarantee the balance of the system.	Costa Rica El Salvador
Establishment of distributed generation systems that allow for the supply of small loads in the event of natural disasters.	Cuba
Establishment of strategies for the installation of solar panels on premises that minimize transmission costs and variability problems.	Cuba

Use of an indicative plan for the expansion of electric power generation with a forecast of the sources that will enter the system.	Brazil Costa Rica El Salvador
Prioritization of sending intermittent renewable energy sources (photovoltaic and wind) to generation plants.	Brazil El Salvador Guatemala Honduras
Long-term contracts for the supply of electrical energy supported by renewable distributed generation.	El Salvador
Annual contracts that oblige the distribution companies to guarantee the supply of energy necessary to satisfy user demand, with penalties being imposed if the programmed requirements are not met.	Guatemala

Box 2 - Planned strategies for adapting the electric power sector to the increase in renewable sources

Strategy	Countries
Possibility of resuming the system's expansion strategy through the construction of new hydroelectric power plants with regularization reservoirs, considering that environmental impacts may be lower than other dispatchable generation alternatives to compensate for intermittency.	Brazil Cuba
Introduction of the intraday market of energy price formation in the short term.	Brazil Colombia
Construction of a model that allows consideration of the increase in the complexity of the system with a greater introduction of renewable sources in the future planning of the expansion of the national electric power sector	Brazil Costa Rica Mexico
Improvement and expansion of the transmission and distribution system	Chile Colombia Venezuela
Improvement in auxiliary (complementary) services necessary for an adaptation of the operation of the electric power system to the increase of renewable energy and distributed generation.	Chile Colombia Costa Rica Honduras
Integration of battery systems into the electric power system	Colombia
Control by demand-side management of power system	Colombia Costa Rica
Application in planning evaluation tools with higher time granularity	Costa Rica
Greater diversification of the energy mix with a predominance of renewable energy through the implementation of geothermal plants, optimization and potentiating hydroelectric power plants, and greater communication of solar and wind sources.	Guatemala
Review of the law on independent production and transport of electrical energy	Paraguay
Carrying out studies to determine the potential of biomass as energy that can be dispatched to the interconnected system, including economic, technical and environmental variable	Venezuela

Given the existence of strategies, planned or already implemented, in Chile and Cuba it was considered that the initiatives contemplate adequate solutions to reduce the environmental impacts of adaptation measures to intermittency. In other countries - Brazil, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Mexico and Venezuela - it was concluded that the strategies only partially contemplate solutions for this adaptation. In Paraguay, in turn, it was understood that the strategies do not contemplate the concern regarding the environmental aspect.

Another point highlighted concerning the expansion of renewable sources in the electric power system refers to the economic impact of the measure on electrical energy rates. The insertion of clean sources should not generate an increase in the price of energy, either in a shorter or longer time horizon, since this would make the expansion of the electric power system itself, and access to electrical energy, impracticable. It should be noted that the same SDG 7 indicates that, in addition to an expansion of renewable sources in the energy mix, it is necessary to expand electricity access to populations, especially those who do not have access to energy or whose access is restricted. Therefore, it is necessary to adequately assess the attributes of each source, in addition to their environmental impacts, including the weighting of services needed for an adaptation of the grid (auxiliary services), and the back-up cost for the expansion of intermittent sources.

Due to this concern, this audit also had the objective of investigating if the countries consider the real price of energy, present and future, in their forecasts for the expansion of the electric power system. In particular, it was questioned whether the strategies adopted take into account the following criteria that can influence the price of energy, either in the present or in the future: evolution of costs and technologies in the national or world scene; costs of flexibility solutions to supply the high variation of intermittent renewable energy; local peculiarities and other factors that can influence the price formation. It was verified that only Chile and El Salvador consider all these factors in their system expansion strategies. In contrast, Colombia and Venezuela do not consider any of the factors mentioned. However, a large part of those countries - Brazil, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico and Paraguay - consider only some of these criteria.

Finally, regarding the instruments for adaptation of the electric power sector to the characteristics of renewable sources, the following audit findings were identified: i) deficiencies in the consideration of environmental impacts of renewable sources in the expansion of the supply; ii) insufficient instruments for the reliability and economy of the electric power system; iii) regulatory and technical deficiencies for the increase of renewable energy.

4.4.1 Deficiencies in the consideration of environmental impacts of renewable sources in the expansion of supply

Situations were found that demonstrate that the expansion of renewable sources in the electricity supply is not correctly considering the possible direct or indirect environmental impacts of the options chosen.

In Brazil, for example, it was found that, in the planning and socio-environmental licensing processes of hydroelectric power plants with reservoirs, there is not a correct evaluation of the costs and benefits of their construction compared to other alternatives of dispatchable plants to compensate for the intermittency of wind and solar sources, which increase their percentage in the electricity generation mix. This problem, caused by the lack of better coordination between environmental and electric power sector bodies, as well as by the absence of systemic evaluation of the attributes of generation sources, has been faced by the expansion of thermoelectric power plants based on fossil fuels, with the consequent increase of GHG emissions and a negative impact on rates, as they are generally more expensive and polluting. Therefore, a better evaluation of the advantages and

disadvantages of the different energy sources, considering all their attributes, is presented as an opportunity for improvement so that planning and socio-environmental licensing consider all aspects involved, including existing alternatives that can substitute the option analyzed.

In Colombia, Honduras, Mexico and Venezuela, the different attributes of the sources, notably their environmental impacts, have not been considered in the choice of options for the expansion of the electricity supply, causing a risk of an incidence of more severe impacts. In Colombia, this situation is caused by the lack of local studies on the damage to the environment of measures of adaptation to intermittency. In Honduras, it was observed that the choice of the renewable source for system expansion was not consistent with its environmental impacts. In Mexico, the damage to the environment caused by the construction of hydroelectric power plants and the risks related to nuclear fuel are not properly measured since there is no greater deepening in relation to their impacts. In Venezuela, on the other hand, there is a lack of specific studies on the potential of biomass as dispatchable energy for the interconnected system, which could be an adequate solution for the intermittency of solar and wind sources. In all these countries, the solution denoted for the correction of this problem is the elaboration of local studies on the advantages and disadvantages of each energy option, mainly of its direct and indirect environmental impacts considering the whole life cycle for the expansion of the electricity supply.

Another verified issue has been the lack of a better evaluation of the possibility of exploiting geothermal energy in Guatemala, Honduras and Mexico, compared to the potential of these countries for this source. It is highlighted that this is a dispatchable energy that could help in an even greater insertion of intermittent renewable sources. The lack of its use could mean the need for a greater thermal generation from fossil fuels.

GOOD PRACTICES

Brazil: Government procurement for the development of tools to assist in the construction of a model that considers the different attributes of sources to support the planning of wind and solar sources, as well as distributed generation.

El Salvador: Monitoring by the ministerial body responsible for the environment of the process of expanding the electricity supply to mitigate, prevent or compensate for the environmental impacts of activities, works or projects aimed at introducing renewable sources.

4.4.2 Scarce instruments for the reliability and economy of the electric power system

Several situations were found that show that the adopted governmental instruments are not sufficient to allow the expansion of renewable sources to happen in a way that guarantees the reliability and economy of the electric power system.

In Ecuador, for example, there is a lack of studies for a better evaluation of the impacts of the expansion of distributed generation on the security of the system. In Colombia, Honduras and Venezuela, since the development of non-conventional renewables is still very recent, it was found that there are no instruments of any kind for the adaptation of the system's operation to the increase of non-deliverable sources.

In the case of Colombia and Ecuador, as a solution to their problems, the preparation of studies for specific analysis of technologies applied to the country to promote adaptation to intermittency and for distributed generation was pointed out. In Honduras, in turn, the opportunity that has been found is the establishment and formal implementation of norms and strategies that bring about operational adaptations and control measures to guarantee the quality, supply and stability of the electric power system with the insertion of intermittent renewable energy. In Venezuela, it is understood that the limit of subsidies to fossil fuels and the incentive to investments in renewable sources through a greater

participation of the private market can help in the increase of clean sources accompanied by the necessary adaptations for the reliability of the system. Another measure aimed at Venezuela is the development of an optimization model that considers environmental and operational characteristics of renewable sources according to methodologies that include environmental externalities and operating costs associated with intermittency.

In Cuba, it was considered that the scarcity of instruments that better measure attributes of renewable sources can negatively affect the price of energy, since there is no more detailed analysis of direct and indirect costs of these sources in the mix. In the case of that country, this also causes the risk of increased government expenditures, since the State subsidizes the difference between the cost of generation and the price of energy sales.

Mexico, in turn, shows a lack of compliance with instruments and strategies for energy security and for adapting the system to the effect of greater insertion of intermittent sources, despite the fact that these exist. As an example, there is a low adoption of measures for the fulfillment of goals related to the increase of energy storage systems. One of the possibilities to correct this problem is the development of an optimization model in the same molds proposed by Venezuela. Another opportunity noted has been the improvement of strategies and planning instruments to accelerate water pumping programs in hydroelectric power plants and energy storage.

In Costa Rica, although the system already presents a high percentage of renewable sources, there are barriers that restrict further optimization. For example, the existence is mentioned of multiple companies of different legal personalities that have the right to develop generation projects in their concession area, which may be convenient for such companies, but not for the system as a whole. In addition, a better legal adaptation in the sense of coherently incorporating changes that occur in the system, such as the integration of new actors and technological advances, would be missing. The possible consequence of these problems comes on the values in energy, which could be lower if there was a better use of resources already available. In the case of this country, the measure aimed at overcoming these barriers is the development of planning, operational and tariff instruments that respond to the strategy of optimization of the national electric power system.

GOOD PRACTICES

Brazil: the specific wind power generation auctions, previously contracted by availability, now by quantity; this helps in the more precise identification of real costs of this source.

Chile: the improvement in the legislation dealing with auxiliary services (complementary for the adaptation of the operation of the electric power system to the increase of renewable sources, such as the capacity of generation or injection of active power and the capacity of injection or absorption of reactive power and the connected power of the users.

Costa Rica: the construction of an electric power system through the diversification of energy sources for generation by means of the use of the varied resources existing in the country, which has allowed the use of its complementary attributes. Another exemplary practice is the periodic creation of a generation expansion plan based on studies that simulate the effects of different renewable sources and verify compliance with reliability criteria using computer models.

4.4.3. Regulatory and technical deficiencies for renewable energy expansion

Different situations were observed that demonstrate that the regulatory instruments of the audited countries still need improvements to promote solutions for an increase in renewable sources in the electric power system. In Box 3, a list of situations encountered by country is shown, as well as

their respective improvement opportunities for the solution of verified problems.

Box 3 - Regulatory deficiencies for the expansion of renewable sources and opportunities for improvement.

Regulatory deficiencies	Opportunities for improvement
Absence of adequate regulatory treatment for the implementation of hybrid plants that best use the complementarity of sources (Brazil)	Improve regulatory instruments so that hybrid plant projects participate in energy auctions competitively.
Inadequate standards to provide greater system flexibility in the insertion of intermittent renewable sources (Colombia, Costa Rica, El Salvador, Honduras)	Establish or refine the standards that bring solutions for greater system flexibility, such as intraday merchant deployments and auxiliary services.
Excessive guarantee requirements by credit granting bodies hinder investments by the private sector (Ecuador, Mexico, Paraguay)	Review rules that establish conditions for granting credit in renewable energy projects
Slow and complex process when granting projects and undefined municipal taxes limit the expansion of renewable sources (El Salvador).	Establish a new concession process without a parliamentary grant and improve transparency in municipal taxes used in renewable source projects.
Insufficient incentives or high level of technical requirement for prosumers make it difficult to expand distributed generation (El Salvador, Guatemala).	Institution of new regulations reducing the level of demand for prosumers, among other adjustments that allow expanding distributed generation, such as improving regulations for energy self-production and grid injection requirements.
Insufficient rules on social conflict in land use delay socio-environmental licensing processes to authorize the construction of hydroelectric power plants (Guatemala).	Review the regulations to deal with issues related to social conflict over land use to facilitate the expansion of hydroelectric power plants.
Lack of more openness to private market participation in the electric power sector limits investments in renewable sources (Honduras, Venezuela).	Implement rules for more openness to the private sector, enabling even price updates practiced to make investments in the electrical energy market more attractive.
Excess fossil fuel subsidies limit investments in renewable sources (Venezuela).	Adjust standard to limit fossil fuel subsidies together with the creation of incentives to renewables.
Tariff regulations of the electric power sector did not accompany technological innovations introduced, negatively affecting the optimization of the electric power system and rates (Costa Rica).	Develop a tariff structure that allows adequate remuneration of different services and products that are part of the operation of the electric power sector, mainly new technologies that adapt the system to the increase of intermittent renewable sources and the expansion of distributed generation.

GOOD PRACTICES
Chile: a bill in progress by parliament that aims to allow a safe, efficient and sustainable integration of variable renewable energy. The main measures foreseen in the project are related to the recognition of what each agent contributes to the flexibility required by the system and to the development of new technological solutions and business models so that the electric power system can integrate a large volume of clean energy.
Costa Rica: the preparation of a four-year plan to develop regulatory instruments with the aim of designing, updating and implementing regulatory instruments based on regulatory principles and public policies that incorporate criteria of quality, innovation costs, equity, social well-being, social sustainability and incentives for efficiency.
Mexico: the existence of indicators for increasing energy storage with batteries to minimize the effects of intermittency in the national strategy for expanding the electricity supply.

In addition, some technical deficiencies of the electric power system were identified that restrict a greater insertion of renewable sources. Box 4 shows a list of these situations and opportunities for improvement for technical refinement.

Technical deficiencies	Opportunities for improvement
Limitations in the system infrastructure that reduce the possibility of installation and operation of Mini and Micro distributed generation (Brazil, Ecuador)	Investments for the adaptation of electrical grids to the bi-directional flow necessary for the operation of Mini and Micro distributed generation.
Lack of adequate infrastructure for the development of renewable energy projects (Guatemala)	Investments for the improvement of the infrastructure necessary for the development of energy projects, such as the expansion of roads and equipment storage sites at the port and airports to make it possible to increase the supply of wind energy.
Lack of infrastructure in the grid to guarantee reliability of electricity supply with the entry of more intermittent sources (Honduras, Venezuela)	Introduce necessary adaptations in the grid for a greater integration of non-dispatchable renewable sources, such as solutions to smooth power differences and guarantee the stability of the system.
Insufficient transmission and distribution grid to facilitate a greater insertion of intermittent renewable sources (Chile, Honduras, Mexico, Paraguay, Venezuela)	Increase interconnection between different systems to allow a greater input of intermittent sources, taking advantage of the complementarity between them.

GOOD PRACTICES
Costa Rica: the adoption of various projects for the technological updating of electric power system operation in strategic planning, such as short-term forecasting studies of variable renewable generation; digital transformation process of the entity operating the system and integrated management of resources distributed in the electric power system demand.

5. FINAL CONSIDERATIONS

This coordinated audit made the exchange of data and information between the participating SAIs possible, allowing for a diagnosis of the evolutionary picture of the expansion of renewable sources in the electric power sector. This evaluation led to the compilation of various lessons, opportunities for improvement and good practices which, when disseminated, can help the governments of each country to make decisions that are more appropriate to their respective realities, with the intention of making public policies for the increase in clean energy more effective. The success of the energy transition can contribute not only to the reduction of GHG emissions, but also to the expansion of the electrical energy supply for the populations of the countries involved, considering the decreasing cost of clean energy and the possibility of decentralized generation make access to electrical energy feasible, even in locations distant from the transmission and distribution grid.

It is noted that the results of this audit can also be used for other countries that did not participate in the audit, including other regions of the world, since the challenges for the expansion of renewable sources are often similar. The action of OLACEFS countries may also serve as an example for other coordinated audits for other SAIs, since the mitigation of the effects of climate change is a transnational issue that needs the joint effort of the international community.

Finally, it is highlighted that the action of SAIs for the increase of renewable sources in the electric power sector, related to the realization of the already mentioned SDG 7 - "Ensure access to affordable, reliable, sustainable and modern energy for all;" 11 - "Make cities and human settlements inclusive, secure, resilient and sustainable; and 13 - "Take urgent action to combat climate change and its impacts," also connects to the implementation of SDG 16 - "Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels," and 17 - "Strengthen the means of implementation and revitalize the global partnership for sustainable development."

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PARTICIPANTS

COORDINATION:
BRAZIL (FEDERAL COURT OF ACCOUNTS (TCU))
Aroldo Cedraz (Minister responsible for general supervision)
Manoel Moreira de Souza Neto
Arlene Costa Nascimento
Rodrigo Almeida Motta
Fernando Simões dos Reis

SAI PARTICIPANTS

BRAZIL (FEDERAL COURT OF ACCOUNTS (TCU))
Aroldo Cedraz (Rapporteur)
Manoel Moreira de Souza Neto
Arlene Costa Nascimento
Rodrigo Almeida Motta
Fernando Simões dos Reis
Jonatas Carvalho Silva
Klauss Henry de Oliveira
Leandro Cunha da Silveira

CHILE (OFFICE OF THE COMPTROLLER GENERAL OF THE REPUBLIC)
Jorge Bermúdez Soto (Comptroller General)
Jaime Guarello Mundt
Benjamín Reyes Riesco
Sebastián Soza Inostroza
Francisco Moraga Illanes
COLOMBIA (OFFICE OF THE COMPTROLLER GENERAL OF THE REPUBLIC)
Carlos Felipe Córdoba Larrarte (Comptroller General)
Ricardo Rodriguez Yee (Delegated Comptroller for the Mines and Energy Sector)
Hadar Yesid Suarez Gómez
Edgar Vicente Gutiérrez Romero

COSTA RICA (OFFICE OF THE COMPTROLLER GENERAL OF THE REPUBLIC)
Marta Acosta Zúñiga (Comptroller General)
Lilliam Marín Guillén

Lía Barrantes León
Adriana Badilla Fuentes
Mario Andrés Reyes Mejías
María Alejandra Rojas Guillén
Vanessa Pacheco Acuña

CUBA (OFFICE OF THE COMPTROLLER GENERAL OF THE REPUBLIC)
Gladys Maria Bejarano Portela (Comptroller General)
Aymée Fernández Robaina
Wina Baró Guerrero
Yanet Aguila Rodríguez

EL SALVADOR (COURT OF ACCOUNTS OF THE REPUBLIC)
Carmen Elena Rivas Landaverde (Prime Magistrate)
Reynaldo Otoniel Zepeda Aguilar
Beatriz Funes Ávalos
Yuri Armando Williams Saca
Diana Vilma Beatriz López
Susana Odeth Zacarías de Grande
Sandra Lizzett Landaverde de Cota
Roy Donaldo Silva Flores

EQUADOR (OFFICE OF THE COMPTROLLER GENERAL OF THE STATE OF THE REPUBLIC)
Pablo Celi de la Torre (Comptroller General)
Guillermo Maldonado Ramírez
Jesús Alejandro Herrera Gallardo
Verónica Lucila Albuja Valdivieso
Tatiana Paola Muñoz Guerrero
Ángel Rodrigo Lema Jaya
Michelle Estefanía Barros Herdoiza

GUATEMALA (OFFICE OF THE COMPTROLLER GENERAL OF ACCOUNTS OF THE REPUBLIC)
Edwin Humberto Salazar Jerez (Comptroller General)
Carlos Alberto Hernández Ramos
Rodrigo Sánchez Viesca

HONDURAS (SUPREME COURT OF AUDITORS OF THE REPUBLIC)
Roy Pineda Castro (Prime Magistrate)
Edwin Arturo Guillén Fonseca
Hernán Roberto Bueso Aguilar
María Elena Aguilar Murillo
Francisco Edgardo Tercero
Iris Ondina Reyes Vargas
María Teresa Cerna Guillén
Dennis Antonio García Cerrato
José Vicente López Oliva

Oscar Armando Fajardo Murillo

MEXICO (SUPERIOR AUDIT OFFICE OF THE FEDERATION)
Agustín Caso Raphael (Minister responsible for general supervision)
Ronald Pieter Poucel Van Der Mersch
Edgar López Trejo
Eloisa Basaldúa Ortega
Fernanda Dicé Ruelas Flores

PARAGUAY (OFFICE OF THE COMPTROLLER GENERAL OF THE REPUBLIC)
Camilo D. Benítez Aldana (Comptroller General)
Edgar Meliton Paiva Unsain
Humberto Franco
Derlis Cabrera Báez
Andrea María González
Valeria Galeano Portillo
Hugo Martínez
Sirley Yegros
Lourdes Armoa

VENEZUELA (OFFICE OF THE COMPTROLLER GENERAL OF THE BOLIVARIAN REPUBLIC)
Elvis Amoroso (Comptroller General)
Neldys Alayon
Yessica Morán
Andreina Moreno

Responsibility for content development:

Federal Court of Accounts (TCU)
General Secretariat of External Control
Office of the Coordinator-General for the Infrastructure Sector Department of External Control – Electric Power Infrastructure

APPENDIX A - Main policies for increasing renewable energy in the world[1]

In order to boost the growth of renewable sources, various governments have been adopting public policies to stimulate this process. The main objectives of these policies are to attract investors; to stimulate the technological development of related sources and technologies, such as energy storage and smart grids; to promote the nationalization of the production of instruments for the generation of clean energy; to diversify the energy mix in order to increase energy security; to reduce dependence on the price of commodities; and to reduce GHG emissions, in accordance with international agreements.

The establishment of carbon trading markets to limit GHG emissions and carbon taxation can be considered indirect public policies in the sense of providing incentives for clean sources, since it makes the use of fossil fuels more expensive. Examples of functioning carbon markets include those in the European Union, China and California. On the other hand, carbon taxation has already been implemented in countries such as Canada, Chile, Mexico, South Africa and Denmark.

Another type of strategy that has been adopted in several countries is the establishment of Renewable Energy Goals. In Germany, for example, a commitment was established to generate 18% of its gross electrical energy consumption from renewable sources by 2020, meaning a commitment to generate 35% of its electrical energy from renewable sources. On the other hand, in Denmark, the parliament entered into an agreement that 35% of the total energy consumption must be renewable until 2929, and about 50% of the electricity consumption must be supplied by wind energy until that year.

Some countries formalized a quantitative goal of decarbonization of the energy sector in their NDCs such as Chile, China, South Africa, India and Brazil, although in some cases the goal is only indicative. It should be noted that, in the case of the European Union, the NDC covers the participation of all Member States, not linking specific GHG emission reduction goals or renewable source share in the mix for each member of the block. In order to achieve the goal set out in the NDC, the European Union has a range of internal laws and regulations that bring a kind of partitioning of efforts between the members.

In order to present individual contributions with regard to the share of clean sources in the European energy mix, all the countries of the bloc adopted national action plans for renewable energy, which include several measures such as sectoral goals, planned policy measures, combination of different renewable energy technologies they expect to use and the planned use of cooperation mechanisms. It is noted that the GHG reduction goals are mandatory for each Member State, although as far as the share of renewable sources is concerned, the goals established in the individual plans are merely indicative.

In addition to establishing goals and markets for carbon trading and taxation, a series of fiscal incentives and public financing, as well as specific regulatory policies, were identified as mechanisms to support renewable energy. The main fiscal incentives and financing identified were: investments and tax credits for production, reduction of taxes on energy sales and other rates, payment for energy production and public investments, subsidized loans, grants, subsidized capital or discounts.

The regulatory policies identified were the following: Net metering (Compensation System); Feed in tariff (FIT); Feed in premium (FIP); mandatory renewable energy quotas; Renewable Energy Certificate (REC); renewable energy auctions; passenger and cargo transport obligations and heating obligations. The first six regulatory policies mentioned are described below and are considered the

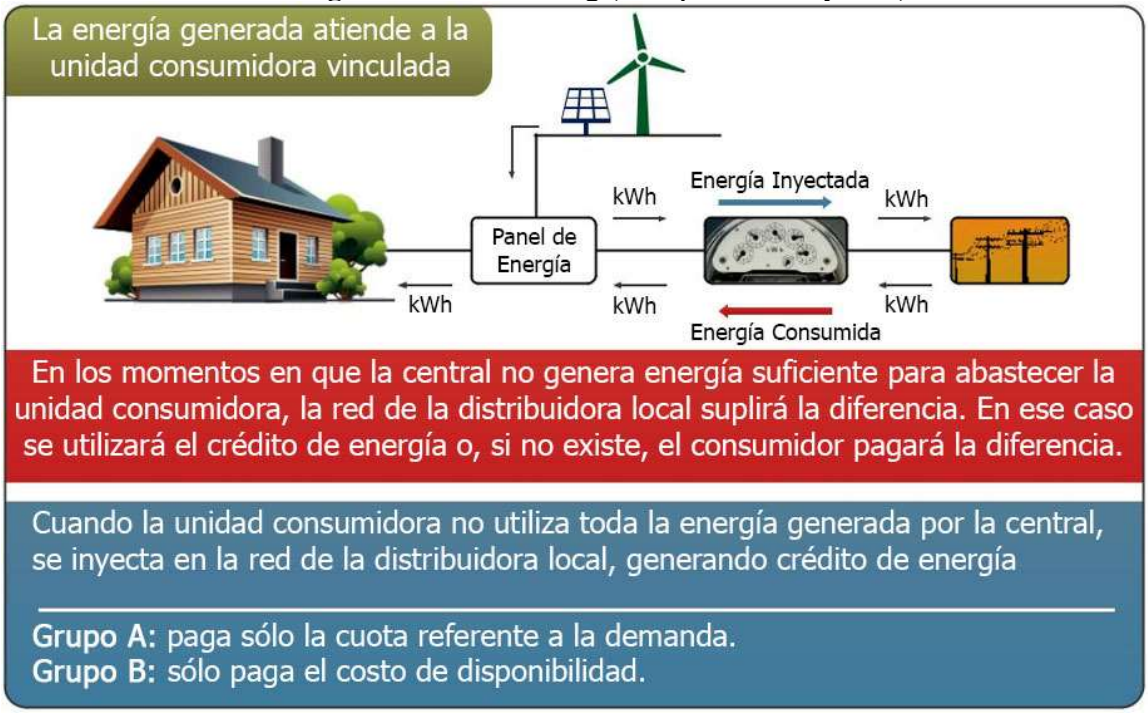
[1] The information recorded in this appendix was removed from the *Benchmarking* International – "Expansion of electrical energy generation from renewable sources," available at the link:

most important in a context of stimulating the entry of renewable sources into the electricity generation mix.

Net metering (Compensation System)

A system that allows electricity generators to export surplus electricity to the electrical grid. In this case, the electrical grid functions as a battery for the prosumers, who are both energy producers and consumers. This strategy, therefore, encourages the expansion of distributed generation which, in turn, favors the increase of renewable sources, mainly solar, since the installation of photovoltaic panels is the main means used by prosumers for energy production. The figure below explains how Net Metering works:

Figure 1 - Net metering (Compensation System)



Source: AGENCIA NACIONAL DE ENERGIA ELÉTRICA. *Micro e Minigeração Distribuida> Sistema de Compensação de Energia Elétrica*. Cadernos Temáticos ANEEL. 2 ed. Brasilia, 2016. Available in its Portuguese version at: <http://www.aneel.gov.br/documents/656877/14913578/Caderno+tematico+Micro+e+Minigera%C3%A7%C3%A3o+Distribuida+-+2+edicao/716e8bb2-83b8-48e9-b4c8-a66d7f655161> Accessed Oct. 10, 2019

Some advantages of this strategy that can be mentioned are the following: minimization of losses with transmission, since the generation is in a place close to consumption; postponement of investments in expansion in distribution and transmission systems; improvement in the grid voltage level in a period of heavy load; low environmental impact. Disadvantages include: increased complexity of grid operation; increased rates for consumers without generators; negative consequences for the profitability of distributors when charging by monomial rate, which does not consider the cost of grid availability.

Feed in tariff (FIT)

It is a special pre-established cost for buying energy from a certain type of energy source, generally used for the incentive of renewable sources. In addition to the type of sources, the size of the project and the location are also considered in order to guarantee the feasibility of the projects. The main objective of this regulatory strategy is to create a safe environment for the growth of the competitiveness of certain types of energy, since it supports the necessary investments in research and development. Over time, technological advances will ensure that costs are reduced, and it will be possible for authorities to gradually withdraw incentives.

The main advantages of the FITs are: a relatively simple nature, risk reduction for investors and financial institutions; it enables a more continuous and stable development of the renewable sources market; it encourages the maximization of generation and potentiates the development of less mature technologies. Disadvantages concerning this strategy are concentrated in the difficulty to define the adequate level of remuneration since there are political influences involved, as well as the asymmetry of information between the public and private sectors. If a high level of remuneration is established, this can lead to overcompensation for generators to the detriment of consumers; if a lower level of remuneration is established, this can alienate investors.

Feed in premium (FIP)

It is a mechanism that consists of long-term contracts that are designed for the reduction of short-term market exposure to high levels of intermittent renewable sources connected to the grid. Payment for available electricity depends on current prices in the spot market (wholesale) and therefore encourages exports to the grid when necessary and during periods of lack of supply, for self-consumption.

On the spot market, where electricity from renewable energy sources is generally sold, generators receive a premium/bonus on the market price of their production. The FIP can be fixed/constant, establishing a premium unaffected by market prices, or fluctuating, establishing variable premiums according to the evolution of market prices.

Among the main advantages of this mechanism is the incentive for operators to respond to price signals in the electricity market, i.e., to produce electricity when demand is high or when production from other energy sources is low. In addition, such a strategy contributes to the further integration of renewable energy sources into the electricity market, resulting in a more efficient combination of electricity supply on demand.

Among other disadvantages, there is the limitation of technologies that could benefit since variable generation sources, such as wind and solar, faced with the difficulties of controlling their power generation, have limited possibilities to adapt to market price signals. In addition, as is the case with FIT, there is a risk of over- or under-compensation when setting FIP values.

Mandatory renewable energy quotas

The idea is to define minimum quotas of renewable energy sources in the energy mix of generating and distributing companies and large consumers of electricity: These are defined by the government and generally increase over time to support the development of renewable sources. Sometimes, they are not defined by national governments, but there is a definition of quotas by region or location. In some countries, sub-quotas are defined for individual renewable sources with the intention of stimulating technological diversification.

The advantage that stands out the most in this mechanism is the strong incentive to fulfill the goals of the renewable energy policy in case there are sufficiently high penalties. In addition, it creates predictability for the growth of new sources, making it possible to adequately adapt the operation of the

system. As a main disadvantage, we can mention the fact that there is no incentive for clean sources beyond the quota limit.

Similarly, the lack of provision for diversification of energy to be introduced can lead to the development of one source deteriorating from others, resulting in the non-diversification of the renewable energy mix.

Renewable Energy Certificates (RECs)

This is the creation of a specific market for certificates issued for each unit of electricity (kW) introduced from renewable sources. The marketing of these certificates creates a flow of income to plant operators, who are dependent on fluctuating certificate prices. For generating plants, the formulae for certificate sales must cover the difference between the costs of electricity generation using clean sources and the profits from the sale of energy in the market.

Generally, this mechanism is used in conjunction with mandatory quotas. In this way, companies must acquire the number of certificates necessary to complete their quota of renewable sources and are penalized if they do not comply. The penalty for non-compliance with quotas is one of the main determinants of certificate prices.

The allocation of certificates can be uniform or by ranges. In the case of uniform allocation, there is no differentiation between sources, which may only result in the implementation of lower cost sources. For the allocation by ranges, technologies with higher generation costs receive more than one certificate per unit of energy produced, which can drive the development of a minimum limit for the price of CERs, in order to reduce the price risk of renewable plant operators.

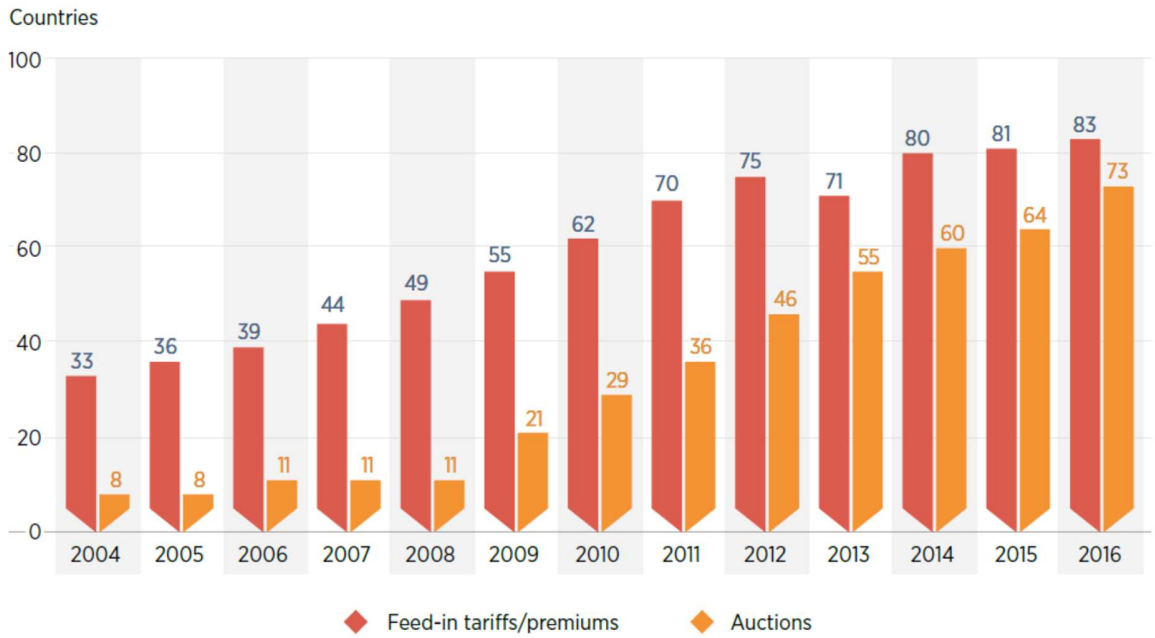
The main advantages of these mechanisms are the determination of prices of certificates by market forces, minimizing the total cost of such strategy, and the viability of private investments in generation from renewable sources. As disadvantages, we can mention the fact that they carry more risk in investments, they may produce more of a factor to be considered besides the price of electricity, and the tendency to favor large generating companies over costs with commercialization of electricity and of the certificates themselves. Another possible disadvantage in the case of a uniform allocation of certificates and the failure to promote a diversified energy technology mix.

Renewable Energy Auctions

These are processes in which the government opens a tender to acquire certain electricity capacity or generation from renewable sources. To participate in the auctions, project developers submit proposals with a price per unit of electricity. The auctioneer, in turn, evaluates bids by price and other criteria, signing a power purchase agreement with the winning bidders.

Although the FIT/FIP mechanism is still the most widely used incentive policy in the world, the number of renewable energy auctions held has increased considerably. To put this in perspective, the number of countries adopting auctions increased from 8 in 2004 to 73 in 2016. Figure 2 shows the evolution of the number of countries that conducted auctions and FIT/FIP strategies.

Figure 2 - FIT / FIP adoption trend in auctions (2004-2016)

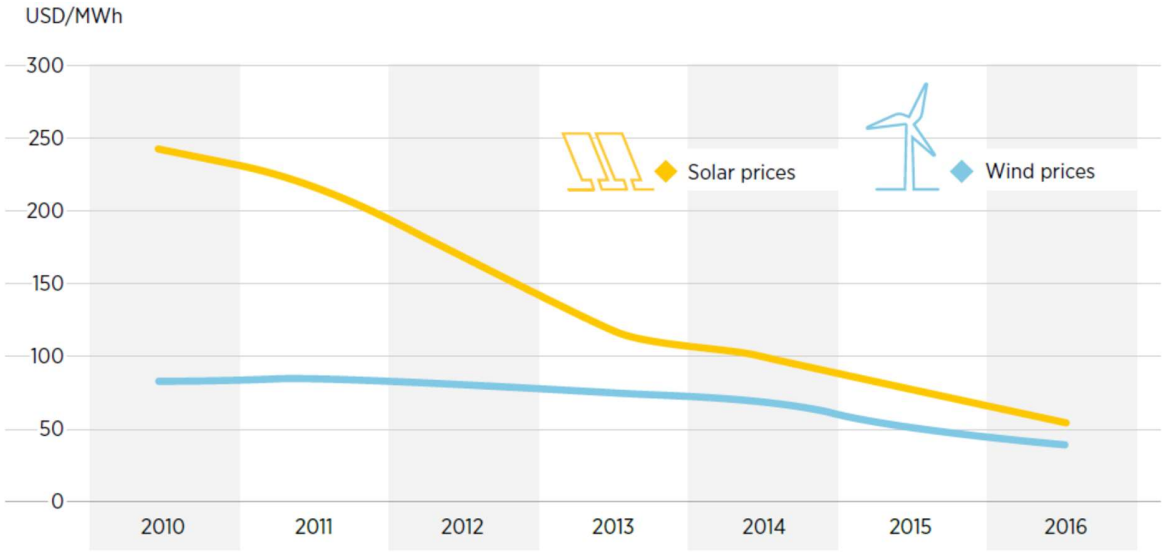


Source: INTERNATIONAL RENEWABLE ENERGY AGENCY. *Renewable Energy Policies in a Time of Transition*. Abu Dhabi, 2018. Available at: <http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_IEA_REN21_Policies_2018.pdf>. Accessed: Aug 5, 2018

The growth in the establishment of auctions is a consequence of innumerable comparative advantages that this strategy for the introduction of renewable sources has shown, such as its capacity to facilitate the implementation of projects in a planned and transparent environment, making it possible to meet other objectives such as the creation of jobs, an increase in local content and adaptation to national goals for the reduction of emissions. In addition, auctions are not linked to a market arrangement to a specific regulatory platform, being possible to use it in open markets or by monopolies with verticalized structures.

However, the most important advantage is its great potential to achieve low prices, which is a decisive element for the increased use by various countries. The use of competitions for contracting solar and wind energy projects was successful in reducing the costs of these technologies in the world, as shown in Figure 3.

Figure 3 - Global average of prices resulting from auctions for solar photovoltaic and *onshore* wind energy (2004-2016)



Source: INTERNATIONAL RENEWABLE ENERGY AGENCY. *Renewable Energy Policies in a Time of Transition*. Abu Dhabi, 2018. Available at: <http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Apr/IRENA_IEA_REN21_Policies_2018.pdf>. Accessed: Aug 5, 2018

Although this strategy has achieved great success in the expansion of renewable sources in the electric power sector, there are disadvantages that are worth mentioning, such as the lack of incorporation of indirect costs for the electric power system and the high transnational cost for both the entity responsible for the auction and the participants in it, since there are expenses related to the costs of project development and the execution of various administrative procedures.

APPENDIX B - Main policies for increasing renewable energy in participating countries

Incentive policies or strategies	Country and regulations where policies are established
Specific auctions or that allow the competitiveness of the RE	Brazil - Law 10,848/2004 Chile - Law 20,018/2005 Colombia - Law 1,715/2014, Resolution MME 90,352/2014 and Decree 570/2018 El Salvador - General Law of Electricity and its Regulations Guatemala - General Law of Electricity and its Regulations Honduras - State Contracting Law (Decree 74/2001) Mexico – Electrical Industry Law (2014)
Feed in Tariffs (FIT)	Brazil - Law 10,438/2002 Cuba - Higher legal standard in the process of approval Honduras - Law for the Promotion of Electric Power Generation from Renewable Resources (Decree 70/2007)
Compensation system (Net metering or Net billing)	Brazil - Resolution ANEEL 482/2012 Chile - Law 20,571/2012 Cuba - Higher legal standard in the process of approval Ecuador - Regulation ARCONEL 003/2018 El Salvador - Agreement 367-E-2017 Guatemala - Resolution CNEE-227/2014 Honduras - standard in process of elaboration Mexico - Electrical Industry Law (2014); Energy Transition Law (2015)

Incentive policies or strategies	Country and regulations where policies are established
System of mandatory quotas or renewable energy certificates	Chile - Law n. 20,698/2013 El Salvador - General Law of Electricity and its Regulations; Regulations for the Operation of the Transmission System and the Market Based on Production Costs Honduras - Nation Plan 2010-2022 Mexico - Electrical Industry Law, Energy Transition Law
Tax exemption or tax incentives	Brazil - Laws 11,848/2007 and 11,488/2007 and Confaz Agreements between the states Colombia - Law 1,715/2014 Costa Rica - Decree 41121/2019 Cuba - Higher legal standard in the process of approval Ecuador - Organic Code of Production, Trade and Investment; Organic Law of the Internal Tax Regime; Ministerial Agreement 140/2015 of the Ministry of the Environment (accelerated depreciation) El Salvador - Law on Fiscal Incentives for the Promotion of Renewable Energy in Electricity Generation Guatemala - Decree 52-2003 Honduras - Law for the Promotion of Electric energy generation with Renewable Resources (Decree 70-2017) Mexico - Income Tax Law (2013) Ecuador - Ministerial Agreement 140/2015 of the Ministry of the Environment

Incentive policies or strategies	Country and regulations where policies are established
Incentives for financing and public investment	Brazil - Law 12.114/2008 and Decree 7,343/2010 Chile - Decree 331/2010 of the Ministry of Energy, approves Regulation of Law . 20,365, which Establishes Tax Relief Regarding Thermal Solar Systems Cuba - Higher legal standard in the process of approval Ecuador - Regulation CONELEC 008/2008, 002/2013, and 056/2016; Organic Law of the Public Service of Electrical Energy El Salvador - CNE-BANDESAL 2015 Agreement; Private Banking and FONDEPRO Credit Lines; Law of Legal Stability for Investments Honduras - Law for the Promotion of Electric energy generation with Renewable Resources (Decree 70-2017) Mexico - Energy Transition Law (2015) and Electrical Industry Law (2014)
Incentives for the distribution, transmission or marketing of electric energy generated from renewable sources	Brazil - Law 9,427 / 1996 Chile - Decree 244/2015
Alternative for contracting distributed generation by energy distributors	Brazil - Goal MME 65/2018 Cuba - Higher level legal standard in the process of approval
Taxes on fossil fuel power generation	Chile - Law 20,780 / 2014
Renewable energy goals in the energy mix	Chile - “Energy 2050: Energy Policy of Chile”
Opening of generation by renewable sources for the private sector	Costa Rica - Law 7200

GLOSSARY

Auxiliary (complimentary) services: technical services whose purpose is to maintain a permanent balance between generation and load. These services are mainly used for tasks such as maintaining the frequency of the system within certain limits; controlling the voltage profile of the system; maintaining the stability of the system; preventing overloads in the transmission line and restoring the system or part of it after a electricity supply failure. Performing these tasks increases the reliability and stability of grid operation. However, it entails an additional cost for the system, which must be properly measured when introducing new energy sources.

Cogeneration: simultaneous production of two or more forms of energy, from a single fuel or by-products of generation, maximizing the use of energy potential.

Conventional renewable energy: renewable sources used for decades and, therefore, have already reached a high level of technological maturity as the case of hydroelectric power plants. So the trend is that there will be no significant reduction in their cost over time.

Dispatchable energy sources: energy sources that allow more precise control of the moment of energy production due to the possibility of storing the source of generation. Examples: hydroelectric with storage reservoir; thermoelectric power plants in general; geothermal plants.

Distributed generation: electric power generation carried out in the vicinity of consumers, regardless of energy, technology and source. Compared to centralized generation, distributed generation has the advantage of reducing investments in transmission lines and losses in the transmission of energy over long distances.

Greenhouse effect: a natural phenomenon of global warming that makes it possible to maintain the temperature of the planet in ideal conditions for the survival of beings. Greenhouse gases (GHGs) - such as carbon dioxide (CO2), methane (CH4) and water vapor (H2O) - act as a barrier that prevents the solar energy absorbed by the Earth during the day from being emitted back into space. In doing so, some of the heat is retained close to the planet, whose average temperature is about 15° C. Without the greenhouse effect, the earth would be cold enough to make the development of most animal and plant species unfeasible. However, the excess of greenhouse gases is also harmful. Increased emissions of these gases as a result of activities such as burning, logging and polluting industrial activities have raised the temperature of the earth threatening the survival of several species of fauna and flora, including human health.

Hybrid power plants (hybrid power systems): power plants that use more than one type of source for electricity production to take advantage of their complementary attributes.

Intermittent energy power plant: energy power plant that does not allow control of the moment in which the generation of energy will take place, which can vary considerably

depending on the climatic conditions and the period of the day since the storage of the source is not possible. Examples: solar photovoltaic and wind power plants.

Intraday electricity markets: electricity markets that measure the price of electricity at various times during the same day. A more efficient measurement is sought through higher time granularity. The development of intraday electricity markets makes the resulting prices more closely related to generation characteristics.

Net metering / net billing: this is a system that allows prosumers (agents who, depending on the availability of the source, are either producers or consumers of electricity) to export surplus energy to the grid, and there may be compensation at the due values. In this case, the electrical grid acts as a battery for the prosumers. This strategy is intrinsically related to the expansion of distributed generation, which favors greater use of renewable energy, especially solar photovoltaic and wind energy.

Non-conventional renewable energy: energy sources that have had their technological development recently and still have a great potential for expansion, especially biomass, wind and solar photovoltaic sources, which have been presenting increasingly lower costs. Other non-conventional sources that can be mentioned are geothermal and tidal.

Non-renewable energy: sources of energy that cannot be replaced within a period compatible with its use by humans (such as fossil sources, mineral coal, oil and natural gas derivatives and nuclear fuel).

Public consultation: opportunity given to the general public to contribute to a technical discussion so that the government and society can formulate public policy together. Citizens, businesses, movements and civil society organizations can access the consultations available on government portals and make contributions.

Public hearing: opportunity given to the general public to contribute in an open, transparent and widely discussed meeting, allowing communication between the various sectors of society and public authorities. Its objective is to debate or present, orally, a topic of relevant interest.

Public procurement by availability: in this public procurement modality, energy generating agents are paid according to their guaranteed (or potential) energy quantity and not based on the energy generated. Buying agents assume the risks and consumers assume possible positive or negative exposures in the short-term market.

Public procurement by quantity: in this public procurement modality, the energy-generating agents are paid according to the energy generated. The generators assume the risks integrally, which presupposes a more precise knowledge of the amount of electricity that will be produced according to the technical and climatic conditions.

Prosumers: agents who, depending on the availability of the energy source, are either producers or consumers of electricity. In general, prosumers, even when producing their

own electricity, have an interest in remaining connected to the grid because of the guarantee of supply.

Renewable energy: energy in which the source (or fuel) for its production is replaced by nature in periods consistent with its energy demand (such as water, tidal, solar, wind and geothermal sources) or whose management by man can be carried out in a compatible manner with the needs of their energy use (as in the case of biomass: sugarcane, energy forests, and animal, human and industrial waste).

Reversible hydroelectric power plants: hydroelectric power plants whose generation potential comes from the prior pumping of water to a high-level storage reservoir. Pumping can be carried out, for example, at the moment of excess production of non-disposable sources to optimize the available resources. Technological developments in this type of enterprise and appropriate regulatory incentives can encourage the use of these plants.

Self-producers: natural persons or legal entities or companies gathered in a consortium that receive a concession or authorization to produce electrical energy for their own and exclusive use.

Smart grids: systems that allow optimizing the management of the network and its energy supply. These smart grids can be used for various purposes, such as reducing technical and commercial losses; improving the quality of service provided; reducing operational costs; improving network expansion planning; and promoting energy efficiency.

Time granularity: this is the time interval for the evaluation of electricity supply or demand. The higher the granularity, the shorter the time interval for this measurement. Because storage technologies remain very expensive, scheduling based on the higher granularity of energy supply and consumption ensures greater adherence to actual generation costs (or the respective price).