



Energy Planning in the Santa Ana Canton of the Manabí Province



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energy;*

Abstract

The accelerated increase in the demand for energy due to development and population growth involves increasing demands on resources. The diversity of typologies of the metropolis, reference to resources, requests, architectural conditions, infrastructure, or density, make a specific study important. The objective is to determine the most appropriate technology to be installed in the mode of distributed generation with renewable energy sources, the use of the geographic information system and qualitative and quantitative analysis was applied as a methodology. In the work, certain reference resources are identified for the organization process that would allow the selection of the most correct technology for the Santa Ana Canton in the province of Manabí, where the environmental resources that are sustained to make investments taking advantage of other types of clean energy were valued because the resource is the component with the most monumental preponderance, followed by economic conditions; On the other hand, it is detected that points of the environment such as climate change, eutrophication or acidification, are the least incidents, quick to choose technologies.

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1 Introduction

Humanity then requires an industrial composition implanted in primary energy sources to achieve the necessary services. It is exactly those energy choices on an industrial scale that have the possibility of profoundly influencing the ecological system of our world, with the danger of leading it to a state of disorder and death (Pascual, 2018).

Natural resources and therefore renewable energies form the basis of the 3 fundamental pillars of sustainable development: economic, social and environmental quality. The implementation of renewable energies needs a guarantee of sustainable development: the implementation of an energy model that satisfies recent needs, without compromising the role of future generations, by considering the economic magnitude (economic growth), social magnitude (social progress) and environmental magnitude (environmental protection and rational use of resources).

The energy theme became an element of priority to a universal degree due to the strategic value of guaranteeing the full and appropriate energy supply in an environmentally compatible manner. That is why a group of activities has been developed aimed at linking and engaging nations in the battle for environmental defence and confronting the global warming that everything mentioned has created. At the global level, efforts are made from the perspective of its legal regulation, as well as internally in most nations, some with more advances than others.

The research and application of tactics currently on the efficient implementation of classical or conventional sources of energy production, as well as novel ways, and the development of existing ways of energy production through the implementation of renewable sources is a necessity (Lopes et al., 2007; Ehsan & Yang, 2018).

The generation of electricity is sustained practically based on the implementation of fossil fuel reserves such as oil, coal, and uranium, that is, the so-called non-renewable energy sources, which by their nature are exhaustible and their subtraction, therefore, becomes more expensive while they become more inaccessible. In opposition, the implementation of so-called renewable energy sources that make use of fundamentally inexhaustible resources is becoming increasingly widespread: solar radiation, wind power, waterfalls, and vegetable fuels. Renewable energies have built a large part of the energy used by humans since ancient times, especially solar, wind and hydro (Mesalhy et al., 2005; Palizban & Kauhaniemi, 2016).

2 Materials and Methods

The Geographic Information System was applied to delimit the areas and application of the appropriate regulations for the introduction of renewable energy sources, in addition to the deductive and qualitative inductive method, which helped to make decisions regarding the new vision of the change of energy matrix.

3 Results and Discussions

The Ministry of Electricity and Renewable Energy (MEER) is responsible for designing and implementing renewable energy development programs; The National Electricity Council (CONELEC) is responsible for regulating the electricity sector, approving concessions for the use of renewable energy resources and establishing the price of these energies; and, in the case of biofuels, the Ministry of Coordination of Production, Employment and Competitiveness (MCPEC) is the coordinating entity for promotion at the productive level through the National Biofuels Council. As discussed below, the Republic of Ecuador has taken steps forward in the development of renewable energies from the institutional point of view.

In 2007 the Ministry of Electricity and Renewable Energy was created. In these 14 years of management, progress has been observed in the design and implementation of plans, programs and projects developed by

this Ministry and the achievement of the new institutionalism that responds to the task of advancing in the establishment of endogenous and sustainable development of Ecuadorian society.

The Ministry has created the planning and public policy instruments in correspondence with the objectives and policies of Plan A lifetime 2017-2021 and the Agenda of the Strategic Sectors, to guarantee Ecuadorian society, safety, quality, reliability, and full coverage of the electric power service.

In this way, the strategic plan of the Ministry of Electricity and Renewable Energy constitutes the main guiding input of institutional and sectoral management, to which the companies and institutions of the electricity sector are articulated in a coordinated process, for the realization of studies, feasibility analysis, evaluation of alternatives, detailed engineering, definition of financing and monitoring of the construction of large projects that allow reorienting the matrix energy of the country, towards the self-sufficiency of electricity, the export of electricity at the regional level and the change of the productive matrix (Republic of Ecuador. Ministry of Electricity and Renewable Energy, 2014).

The creation of this Ministry makes possible the restructuring of Ecuador's energy sector. The State takes the lead and progress of strategic sectors, promoting the implementation of new projects and new technologies, to differentiate the energy matrix, and considers the possible export of energy from renewable sources by Ecuador.

It is necessary to insist that the Ministry of Electricity and Renewable Energy of Ecuador is attacked by a series of competencies, faculties, and attributions such as:

Areas of Competence: Power Generation and Transmission, Energy Distribution and Marketing, Renewable Energy, Energy Efficiency and Peaceful Use of Atomic Energy.

It has the faculties of stewardship, planning, management, evaluation, coordination and participation and within the framework of its competencies develops the following attributions:

Formulation of policies and strategies of the electricity sector, preparation of draft regulations and higher regulations to be sent to the Presidency of the Republic; Issuance of securities for the operation of companies (generation, transmission, distribution and commercialization of energy); Approval of electricity sector tariffs; Issuance of plans for the development of the electricity sector; Management and execution of cooperation agreements and agreements at the national level and implement the mechanisms required for this; Evaluation of compliance with policies, strategies, plans and projects in the electricity sector; Design of management evaluation systems for the electricity sector; Evaluation of compliance with conventions and agreements; Monitoring and evaluation of the supervision of electrical infrastructure projects; Evaluation of the impact they have on the environment; Coordination with other sectors in the formulation of policies and implementation of plans and programmes; Coordination of the design, development, operation, maintenance and processing of the information system of the electricity sector; Execution of citizen participation events (Republic of Ecuador. Ministry of Electricity and Renewable Energy, 2014).

However, the value that the regime attaches to the development of renewable energies is borne in mind. In 2011 begins the performance of the National Institute of Energy Efficiency and Renewable Energies (INER) delegated the generation of technical understanding applied to issues of definition of public policies, strategic idealization, control, monitoring and evaluation of the sector, the promotion of technology transfer and novelty and the promotion of human ingenuity specialized in electricity and renewable energies (Republic of Ecuador. Ministry of Electricity and Renewable Energy, 2008).

Marco legal normative

The legal and institutional framework of renewable energies in Ecuador originates from the Constitution of the Republic (Republic of Ecuador, 2008), among its articles are considered the promotion and use of renewable energies, which are transcribed below:

Article 3.- Distributed Generation is defined as small generation plants installed close to consumption and connected to the distributor's network.

Article 5.- establishes that the right to live in a healthy and ecologically balanced environment includes: "(...) 8) The development and use of environmentally clean and healthy practices and technologies, as well as non-polluting, renewable, diversified alternative energies with low environmental impact";

Article 15.- The State promotes, in the public and private sectors, the use of environmentally clean technologies and non-polluting and low-impact alternative energies. Energy sovereignty is not achieved to the detriment of food sovereignty, nor does it affect the water right.

Article 313.- The State reserves the right to administer, regulate, control and manage strategic sectors, following the principles of environmental sustainability, precaution, prevention and efficiency.

The State promotes energy efficiency and the use of clean technologies and renewable energies and does not affect food sovereignty or the balance of ecosystems or the water right.

In addition, the state exercises a policy of decentralization and participation towards autonomous governments to develop programs for the rational use of water and the reduction, recycling and proper treatment of solid and liquid waste (Republic of Ecuador, 2008).

In addition, in 2008, the Ministry of Electricity and Renewable Energy prepared the document entitled Energy Policies of Ecuador 2008 - 2010, which highlights the following State policies for the sustainable development of the energy sector, related to renewable energies:

- Promote an energy development model with environmentally friendly technologies.
- Formulate and carry out a National Energy Plan, which defines the optimized expansion of the sector within the framework of sustainable development.
- Promoting the sustainable development of energy resources and promoting projects with renewable generation sources (hydroelectric, geothermal, solar and wind) and new efficient electricity generation, including nuclear, excludes generation based on the use of diesel.
- Reduce fuel consumption in transport by replacing compressed natural gas – CNG, electricity and introducing hybrid technologies.

Additionally, the policies for the development of biofuels, the promotion of biogas, and the promotion and development of geothermal energy are detailed (Republic of Ecuador. Ministry of Electricity and Renewable Energy, 2008).

That is why the Ministry of Electricity and Renewable Energy as the governing body of the electricity sector, has the task of diversifying the sources of energy production of the territory, which becomes less dependent on oil as a primary raw material to achieve the change of the energy matrix of the territory, promotes the execution of projects that cooperate to the development of a sustainable energy matrix based on a larger proportion of renewable energies.

Among the non-conventional energies with more potential in Ecuador is: solar energy, biomass, geothermal and wind, there are studies and projects on the use of these types of energy. In 1996, the Law on the Electricity Sector Regime was approved. It establishes that the State promotes the development and use of non-conventional energy resources through public agencies, development banks, universities and private institutions (Beccali et al., 2003; Mourmouris & Potolias, 2013).

Chapter XI, Article 67 of the same law includes certain tariff advantages, as well as exemptions from income tax to encourage energy production based on renewable energy such as solar, wind, geothermal, biomass, etc.

This law determines a disintegrated scheme, both horizontally and vertically, in which most state-owned companies with private participation remain, especially in a generation. There is a legal framework for biofuels in Ecuador based on various executive decrees of 2008 and 2009 in which the costs of anhydrous ethanol, biodiesel and vegetable oil are fixed.

The Eco Territorio Biofuel, which is applied in Guayaquil, results from the mixture of 5% anhydrous ethanol, with 95% base gasoline. It should be noted that Eco país, since last year has represented 17% of the fuels shipped in Guayaquil and equals the levels of delivery in Super gasoline. The acceptance is positive on the part of the final consumer, and it is possible to displace the extra gasoline in Guayas. The product is sold in 5 of the 10 gas stations with the highest volume of liquid fuels in the country (Kumar et al., 2010; Choudhary et al., 2019).

As there was not enough demand for bioethanol, Eco territory gasoline could not be massified throughout the national territory. In the first month of 2015, the National Assembly approved the Organic Law of the Public Service of Electric Energy, ratifying the concepts of Constituent Mandate No. 15 whose primary objective is: the provision of electricity service and public lighting, with quality.

Article 1 lists the specific objectives of the same, which includes the development of promotion mechanisms by the State that encourage the technical and economic use of energy resources, with emphasis on renewable sources. Title IV of the Law refers to the Management of energy sources and non-conventional renewable energies. The article establishes that "the Ministry of Electricity and Renewable Energy promotes the use of clean technologies and alternative energies, following the provisions of the Constitution that proposes to develop a sustainable electricity system, based on the use of renewable energy resources. It is also established that electricity produced with this type of energy must acquire preferential conditions established by regulation issued by ARCONEL (Electricity Regulation and Control Agency).

Energy Planning

Within the criteria for the selection of renewable technologies in the Santa Ana canton of the province of Manabí, the following aspects shown in figure 1 are considered.

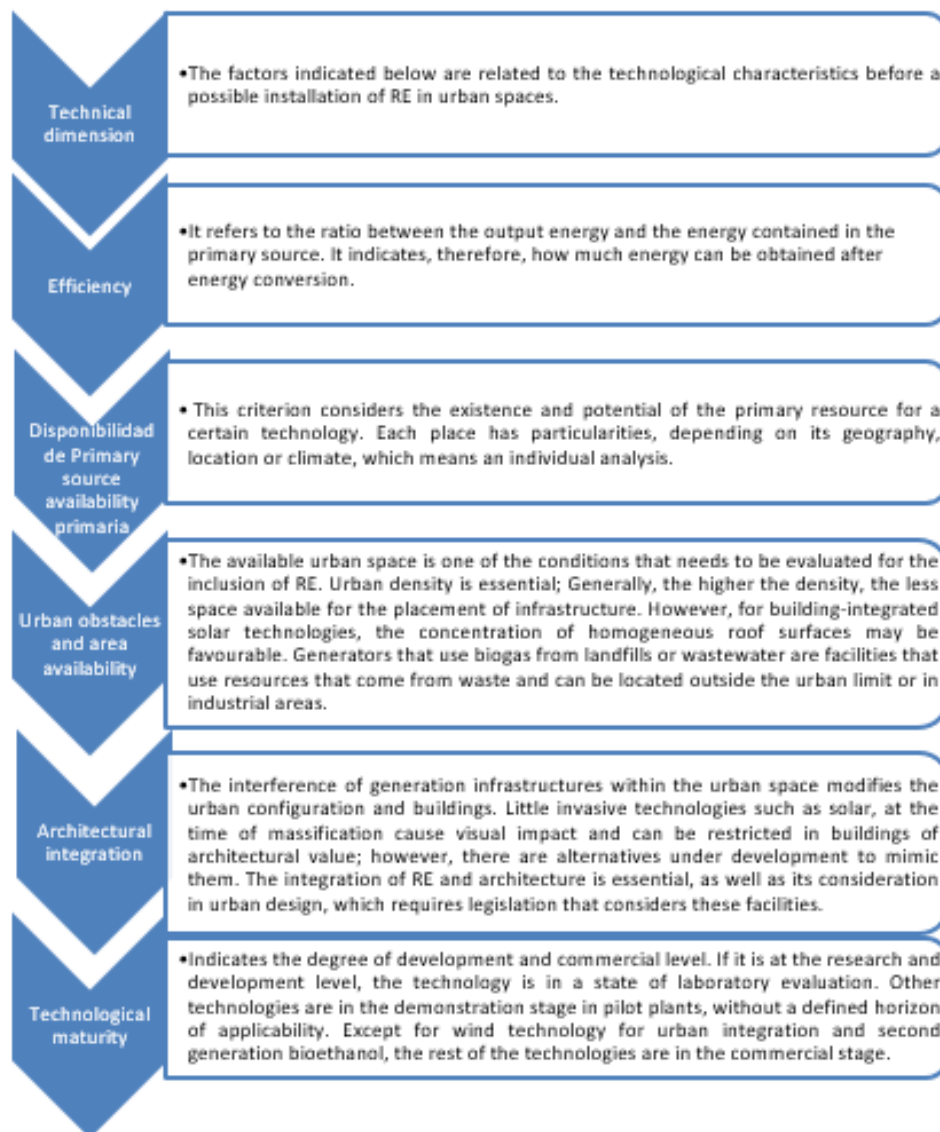


Figure 1. Technological features for the installation of renewable technologies in urban spaces

Economic dimension

It corresponds to the price of provision, operation and maintenance of equipment and production. These prices are subject to taxes, the promotion of the system or the import of accessories, and generally the city in which they are installed (Linares et al., 2021). The criterion of appreciating only technologies could be insufficient for making elections, since there are alternatives such as photovoltaic, solar thermal and even wind that have the possibility of becoming widespread and claiming greater investment, in which mini-hydro electric, tidal, biomass or biogas technologies remain conditioned to few plants, commonly requiring less investment.

- Investment cost: It is the most generalized criterion to compare technological alternatives. It represents the cost of equipment, installation, network construction, and engineering services.
- Cost of operation and maintenance: Considers the operating prices (personnel, products or services) during its useful life.
- Cost of production: Considers the monetary value of an energy unit obtained.

Environmental dimension

- Renewable energies generate low or zero emissions of gases into the atmosphere throughout the operation, but the construction and installation need inputs and energy that have the possibility of causing an environmental effect related to climate change, acid rain or eutrophication. Therefore, exploration should integrate the entire life span of the technology.
- Global warming: As CO₂ is the gas that has increased its emissions the most since the industrial revolution, mainly due to the burning of fossil fuels caused by human activity, global warming occurs: an increase in the temperature of the atmosphere and oceans. It should be noted that the largest increase was recorded during the last 30 years. Global warming is one of the most visible impacts of climate change
- Acidification: Once the seas absorb CO₂, unwanted effects are generated, because it also harms the decrease in the pH of ocean water, which makes its waters more acidic, especially in the preeminent layer of 100 meters. This phenomenon is called ocean acidification and is changing at an unprecedented rate.
- Eutrophication: It is a phenomenon that creates irreversible effects on the ecosystems where it takes place. The process relies on the enrichment of nutrients, mostly nitrogen and phosphorus, in an aquatic ecosystem. In this article, we will address in detail how water eutrophication works and the threat it poses to our ecosystems.

Social dimension

Renewable technologies distributed in cities must be considered under regulations and social conditions, they request to be admissible and advantageous, related to demands, spaces and times. They promote the creation of employment with the development, production, installation, construction, maintenance and operation of energy infrastructure and demand personnel to a greater or lesser extent. Employment improves the quality of life and enables the establishment of new businesses, also generates wealth. Studies publish that the insertion of energy sources increases the need for personnel with different degrees of qualification, variable in each technology, but usually higher than a traditional generation (Løken,2007).

The social perception of technology is an element that estimates population acceptance and urban interaction with renewable technologies. It must be compatible with public policies where there must be a growing collaboration of renewable energies at the nation-region scale that arises from policies that motivate their insertion both on a large and small scale. The change of energy model is where the client is a participant in the process and where political mediation is needed via regulations, incentives and financing (Ghosh et al., 2010).

As a consequence, it is established that the regulatory framework to the incentive of the use of technologies that promote their implementation and the application of renewable energy sources in the Santa

Ana canton, leads to the Energy Distribution Company moving towards the projection of the networks in the towns, as can be seen in Figure 2, limiting their implementation because these projects are subject to assent by the electricity company and the allocation of resources by the Ministry of Electricity and Renewable Energy.

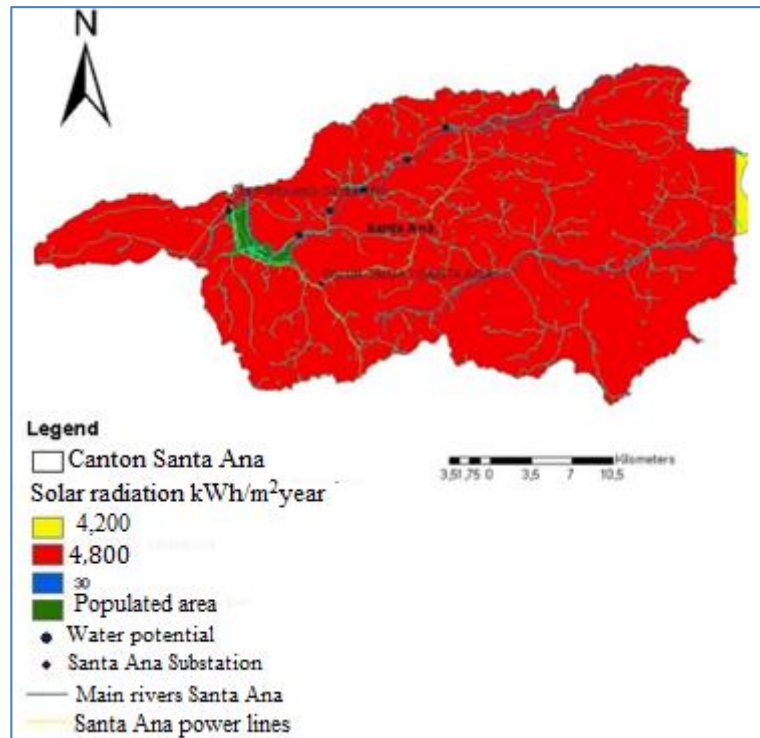


Figure 2. Santa Ana's solar potential and planning goals

In the area of analysis the proposed route crosses through urban and rural areas, as shown in Figure 2, here in the urban part the calculations of the net aggregate price NPV and the internal rate of return IRR probably result in the investment that the distribution companies make, is more profitable to make it with traditional networks than with other technologies, In rural areas, the application of renewable energy sources is probably more profitable considering accessibility and the course of maintenance. Currently, the scarce implementation of FRE projects means that there is no competitive and accessible local market for supply and requests for sets and technologies of electricity generation, limiting their investment, since most of the rural population is dedicated to agricultural work, to this is added that while the distribution companies prepare for the operation and maintenance of these, the buyer must incur additional maintenance prices. Likewise, financing mechanisms must be identified, primordial regulations created, and the commitment and acceptability of citizens must be promoted, in addition to establishing a solid municipal structure that includes energy as one of its development axes.

Ecuador currently has a legal platform capable of carrying out reasonable energy development, varying the energy matrix through the work of 8 large hydroelectric projects and will have to preserve a set of strategies and projects integrated into the National Plan of Good Living that affect the increase of renewable energy generation, the decrease in the import of petroleum products and efficient energy consumption. At the moment, 97% of the population has access to electricity, which makes Ecuador an energy leader in Latin America. Electricity projects that use renewable energies will prevent millions of tons of CO₂ per year from being expelled into the environment and save from the purchase of fuels.

4 Conclusion

The regulations on renewable energies in Ecuador institute the basic requirements and preferential situations for the production of this variety of non-conventional energies in the Ecuadorian electric space. The Ecuadorian state originates in the public and private zone the use of environmentally clean technologies and non-polluting alternative energies of small effect and energy efficiency to all degrees through its legal regulations, which must be applied for planning anywhere in the country, as has been proposed in the Santa Ana canton.





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