

ABSTRACT

To mitigate economic and environmental issues, Ecuador must reduce its dependence on fossil fuels for electricity generation. Therefore, new alternatives are sought to ensure energy security. One promising option is the use of solar thermal technologies for power production. This research aims to identify suitable locations for power generation using parabolic trough collectors (PTC) in the province of Azuay. Suitable sites will be determined based on various criteria using a multicriteria technique. Three potential sites in Azuay will be evaluated, considering climate, geographical area, proximity to a power substation, and water resource availability. The best location will be identified, demonstrating the effectiveness of multicriteria techniques in addressing energy planning challenges in Azuay. These techniques promote sustainability by leveraging the area's existing resources.

INTRODUCTION



- Parabolic trough collectors (PTCs) are a clean and mature technology with a long history, currently ready for large-scale implementation.
- Since 1980, PTC technology has been commercially installed with an approximate yield of 62%.
- In Ecuador, solar radiation at noon reaches the earth at an almost perpendicular angle, resulting in low seasonality and a stable solar resource throughout the year.
- The city of Cuenca, the capital of Azuay province, is geographically located in southern Ecuador.
- Using the Bristow & Campbell methodology, it is estimated that the daily solar radiation available in Cuenca is 4.26 kWh/m², or approximately 1560 kWh/m² per year.

- Since the 1960s and 1970s, environmental pollution and atmospheric degradation have intensified due to the growing use of fossil fuels, particularly in power generation plants. This has led to an increase in CO₂ and other greenhouse gas emissions. Consequently, there is a search for alternative power production methods that do not involve combustion and rely on renewable sources. Since the 1970s, solar thermal energy has been considered one of the main alternative energy options. Although electricity can be produced through various solar technologies, there has been increasing interest in photovoltaic systems in recent years.

RESULTS

- Multicriteria decision methods (MCDA) have been applied to problems in energy planning.
- In this study, after carrying out the AHP analysis, it was concluded that the best option for the implementation of PTC for electricity production is Santa Isabel (Table III).
- The AHP method allowed for the characterization of situations in a group manner of multicriteria decisions.
- Relevant factors influencing the process were identified through this method.
- This characterization served as the basis for analyzing and classifying the information obtained from the literature review related to the selection of multicriteria techniques.
- Finally, a list of criteria proposed in the investigative work was obtained.

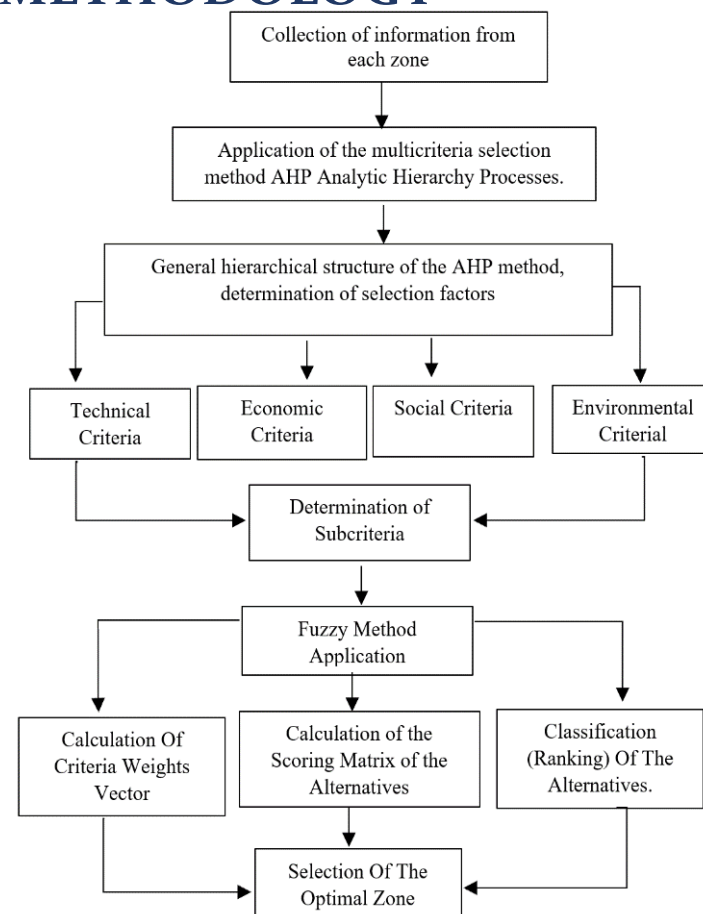
The parameters of each place

Place*	P1	P2	P3
Area (m ²)	25871	16201	27684
Altitude (m.a.s.l.)	930	2314	2226
Average temperature (°C)	20.9	14.1	14.2
Direct radiation per year (kWh/m ²)	1049.8	857.4	876.8
Highest period Cloudiness	Dec. to Apr.	Nov. to Apr.	Nov. to Apr.
Distance to substation (km)	12.53	1.01	1.24
Place*	P1	P2	P3
Distance populated area (km)	7.3	0.5	0.2
Water source distance (m)	15	30	50
Coordinates	-3.340, -79.342	-2.841, -78.883	-2.858, -78.802

Results of the participants (%)

ID*	P1	P2	P3
PA	52.7	27.6	19.7
CF	52	32	16
JC	68	24	8
JR	61	26	13
HA	32	35	33
MC	68	24	8
NG	40	22	38
XS	56.4	21.8	21.8
EB	52.2	30.3	17.5
CF	28.2	25.7	46.1
Total	51.05	26.84	22.11

METHODOLOGY



Subcriteria Applied to Three Locations in the Province of Azuay

Objective	Criteria	Subriterion	Alternatives	
CCP for the production of electricity	Technical	Road Network Availability	Santa Isabel (Sulupali)	
		Availability Of Electrical Network For Evacuation		
	Economic	Economic Benefit		Cuenca (Guanguarucucho)
		Land Cost		
	Social	Social Acceptance Of Technology		Gualaceo (Ganalcaey)
		Employment of Workers		
	Environmental	Availability Of A Water Source		
		Visual Impact		

CONCLUSION

- Utilized multi-criteria techniques to identify optimal locations for Photovoltaic Thermal Collectors (PTC) in the Azuay province of Ecuador, considering the complexity of evaluating alternatives against multiple criteria.
- Applied Analytic Hierarchy Process (AHP) methodology to assess energy projection in Azuay, a region characterized by its equatorial proximity and mid-altitude Andean setting.
- Evaluated 8 sub-criteria and 3 placement alternatives for PTC, determining Santa Isabel as the most favorable location with 51.05% suitability, followed by El Descanso (26.84%) and Gualaceo (22.11%).
- Highlighted Santa Isabel's direct radiation at 1049.8 kWh/m² annually, below the minimum requirement of 1700 kWh/m² for PTC implementation, necessitating public subsidies for viability.
- Emphasized the role of multi-criteria techniques in mitigating subjectivity in decision-making, acknowledging the necessity for careful selection of sub-criteria through extensive literature review to enhance the decision-making process.