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Impacts of climate trends on energy production by renewable sources

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INTRODUCTION

Climatic changes significantly affect the outputs of renewable energy technologies. It is still often the case that energy systems based on renewable sources consider the influential climatic parameters in their production to be constant, such as the incidence of solar radiation. However, climate trends analyzed and evaluated in various regions of the world have shown that it is no longer possible to consider these parameters as constant and stable values over the years.

OBJECTIVE

The objective of this study is to present how climate change affects the use and generation of renewable energy, based on a literature review of scholarly articles published on the subject.

MATERIALS AND METHODS

A search was conducted within the Google Scholar, CAPES Journals, and Science Direct databases.

- Inclusion criteria: the papers included in the analysis were those specifically addressing the generation, production, or use of renewable energy affected by climate change and published between 2001 and 2019.
- Exclusion criteria: The papers that addressed climate change without focusing on the consequences of renewable energy were excluded from the analysis.

The references of the included studies were also analyzed, in case relevant studies could be found.

RESULTS AND DISCUSSION

After the initial bibliographical research, the search returned 20 papers that were considered relevant according to the inclusion criteria. Table 1 shows details and information compiled from analyzed papers and allows a comparison between the studies. Please refer to the complete manuscript for more information.

CONCLUSIONS

The studies identified herein mainly address two types of renewable energy sources: wind and solar photovoltaic. Future climate projections are very site-dependent and could be both advantageous and disadvantageous for the same region studied, differing only by the seasons of the year.

However, the amount of studies on this topic is still scarce. The studies included in the review presented herein were carried out in different parts of the world for specific, limited renewable electric power generation, showing the growing interest in this area of study and demonstrating growing demand for more research in the area.

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Table 1 - Details and information compiled from analyzed papers.

Author	Source	Expected energy production	Region	Scenario (s)	Spatial scope
Sailor et al.	Wind	Decrease(summer), Increase (winter)	Northwest United States	A1B and A2	Regional
Jerez et al.	PV	Decrease	Europe	RCP4.5, RCP8.5	Regional
Sengal et al.	Wind	Decrease	United States	**	Country
Pryor et al.	Wind	Increase	Northern Europe	A2 and B2	Regional
Lucena et al.	Hydro, Biofuel	Decrease	Brazil	A2 and B2	Country
Crook et al.	PV and CSP	Increase	*	A1B	Country
Nolan et al.	Wind	Increase (winter), Decrease (summer)	Ireland	A1B, A2, B1 and B2	Country
Cradden et al.	Wind	*no significant change*	United Kingdom	A1B, A2 and B1	Country
Wachsmuth et al.	Wind and PV	Increase	Northwest Germany	A1B	Regional
Burnet et al.	PV	Increase (South), Decrease (Northwest)	United Kingdom	n/a	Country
Panagea et al.	PV	Increase	Greece	A1B	Country
Tobin et al.	Wind	Decrease	Europe	A1B	Regional
Fant et al.	Wind and PV	*Unchanged*	Southern Africa	IGSM	Country
Bazyomo et al.	PV	Decrease	West Africa	RCP8.5	Country
Abrahão et al.	Wind and PV	Decrease	Northwest Brazil	n/a	Regional
Silva et al.	Wind	Increase	Mozambique	RCP8.5	Country
Silva et al.	PV	*no significant change*	Brazil	n/a	Region

* regions: California, Nevada, Spain, Algeria, Germany, Saudi Arabia, China, and Australia.
** the climatic models are: NOAA, NCC, MPI, MIROC, IPSL, ICHEC, CNRM, CCCMA.

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