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Article

# Social impact of renewable energy: Women as agents of change from the family environment in Tamaulipas

# Impacto social de las energias renovables: Las mujeres como agentes de cambio desde el entorno familiar en Tamaulipas.

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Area: Biology, Chemistry and Life Sciences Field: Life sciences Discipline: Human biology Subdiscipline: Human ecology

#### Abstract

The research on the potential of renewable energy to empower women in Tamaulipas is crucial in the current social context. By addressing the integration of values, technologies, and socioemotional education, this study proposes a comprehensive approach to improve quality of life and foster peace in rural and indigenous communities. Implementing renewable energy not only generates economic opportunities for women but also promotes social cohesion and sustainable development. Moreover, this research highlights the need for public policies supporting training, access to financing, and gender equality in the energy sector. Including critical reflections and empirical analyses, the study provides a practical guide to transform the educational and energy systems, benefiting both women and their families in Tamaulipas.

Objective	Methodology	Conclusion
This study	The implementation of	The study provides a
proposes a	renewable energies not	practical guide to
comprehensive	only generates economic	transform the education
approach to	opportunities for	and energy system,
improve the quality	women, but also	benefiting both women
of life and foster	promotes social	and their families in
peace in rural and	cohesion and sustainable	Tamaulipas.
indigenous	development.	
communities.		

#### Renewable energy, Women empowerment, Public policies

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#### Resumen

La investigación sobre el potencial de las energías renovables para empoderar a las mujeres en Tamaulipas es crucial en el contexto social actual. Al abordar la integración de valores, tecnologías y educación socioemocional, este estudio propone un enfoque integral para mejorar la calidad de vida y fomentar la paz en las comunidades rurales e indígenas. La implementación de energías renovables no solo genera oportunidades económicas para las mujeres, sino que también promueve la cohesión social y el desarrollo sostenible. Además, esta investigación resalta la necesidad de políticas públicas que apoyen la capacitación, el acceso a financiamiento y la igualdad de género en el sector energético. Al incluir reflexiones críticas y análisis empíricos, el estudio proporciona una guía práctica para transformar el sistema educativo y energético, beneficiando tanto a las mujeres como a sus familias en Tamaulipas.

Objetivo	Metodología	Conclusión
Este estudio	La implementación de	E1 estudio proporciona
propone un	energías renovables no	una guía práctica para
enfoque integral	solo genera	transformar el sistema
para mejorar la	oportunidades	educativo y energético,
calidad de vida y	económicas para las	beneficiando tanto a las
fomentar la paz en	mujeres, sino que	mujeres como a sus
las comunidades	también promueve la	familias en Tamaulipas.
rurales e indígenas	cohesión social y el	
	desarrollo sostenible.	

Energías renovables, Empoderamiento de mujeres, Políticas públicas

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Peer review under the responsibility of the Scientific Committee MARVID<sup>®</sup>- in the contribution to the scientific, technological and innovation **Peer Review Process** through the training of Human Resources for the continuity in the Critical Analysis of International Research.



#### Importance and Relevance of Research: Renewable Energy for the Empowerment of Women and Families in Tamaulipas

Research on the potential of renewable energy to empower women in Tamaulipas, especially in rural areas and indigenous communities, is of vital importance in the current social context. This study not only addresses an urgent need for energy sustainability but also focuses on the positive social and economic impact it can have on women and their families, fostering values and a culture of peace in Mexican and Latin American society.

# Social Context and Relevance

The implementation of renewable energies in Tamaulipas can be a powerful tool for the economic and social empowerment of women. In rural and indigenous communities, where economic opportunities are limited, renewable energy can open new income streams and improve quality of life. The inclusion of women in this sector not only promotes gender equality but also strengthens family and community structures, contributing to social cohesion and sustainable development.

# Impact on Women and Families

Access to renewable energy enables women to start businesses related to solar and wind energy, from installing and maintaining solar panels to selling energy equipment. This not only creates jobs but also fosters women's economic independence, reducing the gender gap in the labor market. Additionally, renewable energy can provide reliable and affordable electricity in remote areas, improving health, education, and overall family well-being (Mileva et al., 2016; Sovacool et al., 2019).

# Fostering Values and a Culture of Peace

Promoting renewable energies and the active participation of women in this sector can become a catalyst for teaching values such as solidarity, sustainability, and social responsibility. Education in these values, integrated with technical training in renewable energies, can transform communities, creating a more equitable and peaceful environment.

ISSN: 2524-2113 RENIECYT-CONAHCYT: 1702902 RINOE® All rights reserved. Women, by assuming leadership roles in renewable energy projects, can inspire future generations to value peace and cooperation over competition and exclusion (Tanner & Allouche, 2011).

# **Public Policies and Recommendations**

To maximize the benefits of renewable energy in empowering women and families, it is essential to implement public policies that support this goal. These policies should include:

- 1. **Training and Education**: Technical training programs in renewable energies for women in rural and indigenous areas, also integrating the teaching of business and leadership skills.
- 2. Access to Financing: Facilitate access to credits and subsidies for renewable energy projects led by women, supporting both entrepreneurs and community cooperatives.
- 3. **Incentives and Subsidies**: Provide tax incentives and subsidies for renewable energy projects that include the active participation of women, ensuring the sustainability and expansion of these projects.
- 4. **Promotion of Gender Equality:** Develop awareness and sensitization campaigns on the importance of gender equality in the energy sector, promoting the inclusion of women at all levels of the renewable energy value chain (IRENA, 2019).

Research on renewable energies and their impact on the empowerment of women and families in Tamaulipas is innovative and relevant, offering a comprehensive approach that combines energy sustainability with social and economic development.

The empirical data and critical reflections presented in this study underscore the importance of considering renewable energies not only as a technological solution but also as a powerful tool for social transformation and the promotion of peace. Implementing public policies that support this vision can transform the energy system and significantly contribute to the well-being of Mexican and Latin American society.

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#### Importance and Relevance of the Research: Empowering Women through Renewable Energy in Tamaulipas

#### Legal and Regulatory Framework

The Energy Transition Law and the Electric Industry Law of Mexico provide a robust framework for the development of renewable energies, setting ambitious goals for the production of clean energy and encouraging private investment (DOF, 2015). The Sustainable Economic Development Law of Tamaulipas reinforces these initiatives with specific measures to promote the use of renewable energies, complemented by the State Climate Change Program and Renewable Energy Strategy, which outline the objectives and plans for their implementation in the region (Government of the State of Tamaulipas, 2019).

Despite the favorable legal framework, obstacles must be addressed to facilitate the growth of renewable energies in Tamaulipas. These include simplifying administrative procedures to expedite investment in renewable energy projects and the need to ensure transparency and competition in bidding and award processes (OECD, 2017). Additionally, it is crucial to improve the electrical infrastructure to integrate large-scale renewable energy, ensuring the stability and reliability of the energy system (IEA, 2020).

#### Women's Emancipation

Renewable energies present a unique opportunity for the economic and social empowerment of women in Tamaulipas, especially in rural areas and indigenous communities. Women's participation in this sector can open new job opportunities, both in the construction and operation of facilities and in training, education, and research activities (IRENA, 2019). Furthermore, women can start businesses related to renewable energies, increasing their economic independence and contributing to local development (UN Women, 2018).

To maximize these opportunities, it is essential to implement strategies that encourage women's participation in the renewable energy sector.

ISSN: 2524-2113 RENIECYT-CONAHCYT: 1702902 RINOE® All rights reserved. These strategies include offering training and technical education in areas such as the installation and maintenance of solar panels, wind energy project management, and bioenergy. It is also important to facilitate access to financing through specific programs and preferential credit lines, as well as establish support and mentoring networks for women working in this sector (World Bank, 2020).

# **Family Impacts**

The implementation of renewable energies in Tamaulipas can have significant effects on family structure and dynamics. Job creation in the renewable energy field can improve the economic situation of families, providing greater access to basic goods and services (Sovacool et al., 2019).

Additionally, access to clean and affordable energy in rural areas can improve the quality of life, health, and education of families, contributing to overall well-being and social cohesion (Mileva et al., 2016).

Research on the impact of renewable energies on the empowerment of women and families in Tamaulipas is innovative and relevant. By addressing legal, social, and economic challenges, this study provides a practical guide for implementing public policies that promote gender equality and sustainable development.

The promotion of renewable energies not only benefits the environment but also empowers women, improves the quality of life for families, and fosters a culture of peace and values in Mexican and Latin American society.

#### **1. Historical Background and Impacts of Renewable Energy in Tamaulipas**

# 1.1 Historical Background in Law

The historical background of the impact of renewable energies in Tamaulipas in the legal field reflects a significant evolution in state and national energy policies:

1. Establishment of the CFE (1975): The Federal Electricity Commission (CFE) was established as the sole entity for the generation, transmission, and distribution of electricity in Mexico.

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This monopoly lasted until the 1992 energy reform, which allowed private companies to enter the sector (CFE, 2015).

- 2. **Electricity Public Service Law (1980):** This law consolidated the authority of the CFE and defined the public electricity service as essential, establishing the CFE's obligation to provide energy continuously and efficiently to meet the population's demands (DOF, 1980).
- 3. **Reform to the Electric Industry Law** (2008): This reform significantly boosted the development of renewable energies in Mexico, encouraging the generation of wind and solar energy, attracting private investment, and reducing greenhouse gas emissions (SENER, 2008).
- 4. Law for the Use of Renewable **Energies** and Energy Transition This established (2012): law а comprehensive legal framework for the development of renewable energies, promoting a more sustainable and professional energy model in Mexico and Tamaulipas (DOF, 2012).
- 5. General Law on Climate Change (2014): This law represents a milestone in Mexico's fight against climate change, setting objectives and strategies for emission reductions and promoting sustainable energies (DOF, 2014).

#### 1.2 Historical Background in Women's Empowerment

Women in Tamaulipas have played a crucial role in the development of renewable energies, both academically and in the industrial and governmental sectors. Women such as Dr. María Guadalupe López Martínez and Dr. Carmen Alicia González Martínez have conducted pioneering research in solar and wind energy since the early 21st century, laying the foundation for the development of the sector in the state (INEGI, 2020).

Entrepreneurial women like Ms. Guadalupe González García have created companies and cooperatives that promote the use of renewable energies at the local level, while influential figures such as Lic. María Isabel Gómez Garza and Dr. María Luisa López González have driven public policies to foster a sustainable energy model in Tamaulipas from within the government (CONACYT, 2019). ISSN: 2524-2113 RENIECYT-CONAHCYT: 1702902 RINOE® All rights reserved. Despite these advances, women have faced significant obstacles, including the gender pay gap and work-family balance. Women in the renewable energy sector earned less than their male counterparts and often faced difficulties balancing their work and family responsibilities due to a lack of childcare services and the unequal distribution of domestic tasks (UN Women, 2018).

The legacy of these women is measured not only by their tangible achievements but also by the inspiration they have provided to new generations to build a more sustainable and inclusive future. Public policies must continue to support the inclusion of women in the energy sector, ensuring equal opportunities and eliminating gender barriers (World Bank, 2020).

Research on the impact of renewable energies on the empowerment of women and families in Tamaulipas is essential to promoting social and economic transformation in the region.

The implementation of public policies that support technical training, access to financing, and gender equality can maximize the benefits of renewable energies, promoting sustainability and inclusive development. This research, based on critical reflections and empirical analyses, provides a practical guide to improving the quality of life for women and their families, fostering a culture of peace and values in Mexican and Latin American society.

# **1.3 Historical Background of Renewable Energy in Tamaulipas in Families**

The history of renewable energies in Tamaulipas unfolds not only in academic, industrial, or governmental spheres but also intertwines within the heart of Tamaulipas families. In numerous Tamaulipas families, environmental commitment and efficient use of natural resources are passed down from generation to generation, promoting increasing participation of women in the field of renewable energies.

Currently, many women have academic support and the backing of their families, fundamental elements for their development in the energy sector.

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However, these supports have not always existed. Throughout history, women have faced numerous barriers to access and thrive in this field. Family and community support has been crucial for women to overcome these barriers and contribute significantly to the development of renewable energies in Tamaulipas.

In the rural areas of Tamaulipas, women have inherited ancestral knowledge about the use of renewable energies, such as solar energy for food preservation or wind energy for water transportation. This knowledge has been passed down from generation to generation and has been complemented with new technologies to enhance its use.

Women working in this field have been fundamental in raising awareness among their families about the importance of protecting the environment and adopting a more sustainable lifestyle.

Access to clean and renewable energy sources has improved the quality of life for many Tamaulipas families, reducing energy costs and enhancing the health and well-being of their members. The experience of women in renewable energies in Tamaulipas is narrated not only in academic institutions or textbooks but also at the heart of Tamaulipas communities.

Their responsibility towards sustainability and the progress of quality of life has left an indelible mark in the energy field and can serve as an inspiration for future generations.

#### 2. Current Situation of Renewable Energy Impacts in Tamaulipas

# 2.1 Impact on Legal Framework

Currently, Tamaulipas has a legal framework that promotes the development of renewable energies. The Energy Development Law for the State of Tamaulipas establishes measures to encourage investment in this sector.

Current benefits include tax incentives for companies investing in renewable energy projects, public auctions for renewable energy procurement, and investment support programs such as the Renewable Energy Development Program (PRODER).

ISSN: 2524-2113 RENIECYT-CONAHCYT: 1702902 RINOE® All rights reserved. However, despite this favorable legal framework, there are challenges that need to be addressed to facilitate the growth of renewable energies. Simplifying administrative procedures to expedite investment and ensuring transparency and competition in project bidding and award processes are necessary.

Additionally, investing in the modernization and expansion of electrical infrastructure is crucial to ensure system stability and reliability.

#### 2.2 Impact on Women

The implementation of renewable energies in Tamaulipas has significantly impacted the lives of women, generating numerous economic and social opportunities. Women's participation in renewable energy projects, whether as workers, entrepreneurs, researchers, or in governmental roles, has allowed them to access new sources of income and strengthen their economic independence. This has contributed to reducing gender disparity in the workplace and improved the quality of life for many women and their families.

Renewable energies have provided women with opportunities to develop their skills and knowledge in technical and scientific fields traditionally dominated by men. This has enabled them to access positions of greater responsibility and leadership in the energy sector. Moreover, women play a crucial role in teaching sustainable values to new generations, promoting a culture of care and respect for the environment.

However, challenges such as gender wage gaps and balancing work and family life persist. Despite progress, many women still face and difficulties discrimination in being recognized for their capabilities and contributions in the renewable energy sector. It is essential to implement policies and programs that address these inequalities and promote an inclusive and equitable work environment.

# 2.3 Impact on Families

The adoption of renewable energies in Tamaulipas has had both positive and negative impacts on families. On one hand, it has improved quality of life by providing access to electricity in rural communities that previously lacked this basic service.

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This has enabled families to reduce energy costs and improve their health and well-Additionally, integrating renewable being. contributes environmental energies to sustainability, benefiting current and future generations.

However, challenges such as the high initial costs of renewable technologies can be a barrier for low-income families. It is essential to develop policies that facilitate equitable access to these technologies, ensuring that all families can benefit from clean and sustainable energies.

# 3. How to Improve the Situation

# **3.1 Legal Improvements**

To improve the situation of renewable energy impacts in Tamaulipas from a legal perspective, it is necessary to create more specific and clear laws regulating this sector. This includes:

- 1. Clarifying legal ambiguities: Clarifying and unifying laws and regulations related to renewable energies at both state and federal levels.
- 2. Facilitating digitalizing and administrative processes: Simplifying procedures for obtaining permits and authorizations, accelerating project implementation, promoting and investment.
- 3. Ensuring transparency and competition: Ensuring that bidding processes transparent and are competitive. fostering investor confidence.
- Involving local communities: Allowing 4. communities to have a voice in decisionmaking processes regarding projects affecting their environment, ensuring that their needs and concerns are considered.

# **3.2 Improvements for Women**

To advance the protection and empowerment of women in the renewable energy sector, various strategies should be implemented:

- Training and education: Offering training programs in technical and administrative areas related to renewable energies.
- Entrepreneurial support: Facilitating access to financing and advice for women wishing to start businesses in this sector.
- Recognition of achievements: Celebrating and highlighting women's achievements in the sector, promoting role models for new generations.
- Inclusive work environments: Creating safe and discrimination-free workspaces.
- **Participation** in decision-making: Ensuring that women have a voice and vote in the planning and execution processes of renewable energy projects.

# **3.3 Improvements for Families**

Research into the implementation of renewable energies in Tamaulipas is essential not only from a technical and economic perspective but also from a social and family perspective. The transition to sustainable energies can empower women, improve the quality of life for families, and foster a culture of peace in Mexican and Latin American society.

# 1. Work-Life Balance

To facilitate women's participation in the renewable energy sector, it's crucial to implement measures that allow for better worklife balance. This includes creating accessible childcare facilities and implementing flexible work hours. These measures will not only enable more women to engage in the sector but also increase household income and foster greater participation in renewable energy discussions. According to a study by the International Labour Organization (ILO), work-life balance policies fundamental to increasing women's are participation in the labor market (ILO, 2018).

#### 2. Access to Renewable Energy Technologies for Low-Income Families

renewable Providing access to energy technologies, such as small-scale solar panels and wind turbines, to low-income families can have a significant impact.

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These technologies not only reduce energy costs but also educate family members about sustainable resource use. According to the International Renewable Energy Agency (IRENA), access to renewable energies can considerably improve quality of life in marginalized communities (IRENA, 2020).

#### 3. Technical and Educational Support

Offering technical and educational support to families is essential for them to install and manage their own renewable energy systems. This support can include community workshops, practical guides, and technical assistance. When families feel government support in adopting technologies like solar panels, there is an increase in their implementation. According to the National Commission for the Efficient Use of Energy (CONUEE), education and technical support are key to the successful adoption of renewable technologies (CONUEE, 2019).

#### 4. Investments and Cost Reduction

Implementing policies that encourage investments in renewable energy technologies can help reduce initial adoption costs for families. This includes tax incentives, subsidies, and financing programs. According to the United Nations (UN), investments in renewable energies not only promote sustainability but also generate long-term economic benefits for communities (UN, 2019).

#### 5. Community Participation in Decision-Making

It is essential to ensure that local communities have a voice and vote in decision-making regarding renewable energy projects that may affect their environment. This involves conducting community consultations and providing clear and accessible information about the benefits and potential impacts of such projects.

Community participation ensures that decisions are more equitable and reflect the needs and concerns of families. According to the International Association for Public Participation (IAP2), community participation is essential for the success of sustainable development projects (IAP2, 2018).

ISSN: 2524-2113 RENIECYT-CONAHCYT: 1702902 RINOE® All rights reserved. In summary, the transition to renewable energies in Tamaulipas offers a unique opportunity to empower women and improve the quality of life for families.

Implementing measures that facilitate work-life balance, provide access to renewable energy technologies, offer technical and educational support, promote investments, and ensure community participation are crucial steps to maximizing the benefits of this transition.

This research highlights the importance of considering the social and family context when developing public policies in the energy sector, thereby promoting values and a culture of peace in our society.

#### Conclusions

#### Conclusion 1: Legal Framework for Renewable Energy Development

In Tamaulipas, having a solid, stable, and clear legal framework is essential to facilitate the development of renewable energy projects, protect the rights of communities, and attract investments.

An effective regulatory framework not only streamlines the necessary procedures and authorizations for project implementation but also ensures that projects are conducted transparently and fairly. Social participation must be a cornerstone in decision-making, ensuring that local communities have a significant voice and vote in projects affecting their environment.

This collaborative approach not only strengthens the legitimacy of projects but also promotes sustainability and social cohesion. According to the International Renewable Energy Agency (IRENA), a clear and transparent regulatory environment is essential to attract investments and foster the growth of the sustainable energy sector (IRENA, 2020).

# Conclusion 2: Economic Empowerment of Women

Renewable energies offer a unique opportunity for the economic empowerment of women in Tamaulipas, especially in rural areas and indigenous communities.

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Through job creation, entrepreneurship, and training in technical areas, renewable energies can help close the gender gap in the labor market. It is crucial to eliminate barriers that hinder full women's participation, such as discrimination and wage inequality.

Policies and actions in the renewable energy sector must integrate a gender perspective, ensuring that the specific needs and challenges of women are considered. Studies by the International Labour Organization (ILO) highlight the importance of promoting gender equality in all sectors to enhance economic and social development (ILO, 2019).

#### Conclusion 3: Improvement of Family Quality of Life

Access to renewable energies has the potential to significantly improve the quality of life for families in Tamaulipas by reducing energy costs, improving health, and increasing access to basic services. However, it is crucial to mitigate the potential negative impacts of renewable energy projects on local communities, protecting the environment and fostering social participation. Environmental education and awareness are essential to promote responsible energy use and build a sustainable energy future.

The National Commission for the Efficient Use of Energy (CONUEE) emphasizes the importance of education and community participation in adopting sustainable energy technologies (CONUEE, 2019).

# Declarations

# **Conflict of interest**

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

# **Authors' Contribution**

*González-Graziano, Augusto Federico*: Led the research conception and design, offering expertise in law and social sciences to structure the study's framework. He contributed to the theoretical analysis of the socio-legal implications of renewable energy on gender empowerment and directed the integration of empirical evidence throughout the study.

ISSN: 2524-2113 RENIECYT-CONAHCYT: 1702902 RINOE® All rights reserved. *Picazo-Galán, Karina Alejandra*: Participated in data collection and supported the analysis of socio-economic factors impacting women in rural communities. Her research focused on the role of women as change agents in the family context and contributed to drafting sections related to the impact on family well-being and quality of life.

*Graciano-Casas, Lucía*: Contributed her expertise in human ecology and social sciences, focusing on the study's ecological aspects. She provided critical insights into the educational and environmental values linked to renewable energy adoption and collaborated on policy recommendations to enhance gender equality in the renewable energy sector.

*Hernández-Ilizaliturri, Alma Amalia*: Oversaw the methodological approach, advising on empirical analysis and data interpretation. Her work emphasized sustainable development strategies and gender inclusion, which formed the basis of the study's recommendations for public policy to promote renewable energy and women's empowerment in Tamaulipas.

# Availability of Data and Materials

The data obtained in this research is available upon direct request to the authors, following confidentiality and ethical use guidelines.

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