

**ENERGY JUSTICE AND GENDER IMPLICATIONS ON  
PRODUCTIVE USES OF ENERGY**

A case study based in rural Bolivia

**Adriana Fernández Villalobos**

Supervisor

Frans Libertson

Thesis for the fulfilment of the  
Master of Science in Environmental Management and Policy  
Lund, Sweden, May 2023



© You may use the contents of the IIIIEE publications for informational purposes only. You may not copy, lend, hire, transmit, or redistribute these materials for commercial purposes or for compensation of any kind without written permission from IIIIEE. When using IIIIEE material you must include the following copyright notice: 'Copyright © Adriana Fernández Villalobos, IIIIEE, Lund University. All rights reserved' in any copy that you make in a clearly visible position. You may not modify the materials without the permission of the author.

Published in 2015 by IIIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,  
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: [iiiee@iiiee.lu.se](mailto:iiiee@iiiee.lu.se).

ISSN 1401-9191

## **Acknowledgments**

First and foremost, I would like to thank my supervisor, Prof. Frans Libertson who was enthusiastic to take on this project while allowing my ideas to unfold and supporting them through challenging and valuable feedback at any given moment. I am very thankful for all your suggestions, critical feedback, and support throughout this process.

I would like to express my gratitude to all interviewees, and the staff of the GIZ, Mariana, Alejandro, Diana, Lizeth, Veronica, Wara, Belén, Mauricio, Bladimir, and Daniel for giving me the opportunity to work together and welcoming me to your country as well as sharing with me your beautiful traditions. Thank you for supporting my project and sharing your valuable insights and perspectives. I am inspired and touched by the passion with which you deliver your work and the amazing contribution you make to Bolivian society.

I would like to give massive and infinite thanks to my family, especially my parents for always supporting me in this process and all my life decisions as crazy as they have been. Gracias papi y mami sin su apoyo nada de esto hubiera sido posible, este trabajo es dedicado a ustedes, los amo mucho. To my beloved husband, Philipp. You are my inspiration and my rock. Thank you for believing in me and always supporting me whenever I became frustrated. You are magic.

Finally, to all of Batch 28, you guys are one of the most amazing and capable people I have ever met. Thank you for making these two years a precious time in which I have learned and grown so much. I owe special thanks to Azusa, Bianca, Tim, Marta, Emi, and Markas. Thank you, guys, for letting me have the honor of having you as a friend, I really treasure all the moments we shared.

## **Abstract**

This research investigates the gender dimension of the impacts of access to clean and modern energy and technology in productive uses of energy. Rural organizations led by women supported by the EnDev project Bolivia were selected for a multi-site case study. This project aims to facilitate clean and modern energy access, create and strengthen rural markets, and alleviate poverty. The energy justice framework was employed to gain a comprehensive understanding of how gender intersects with access to energy and technology, distribution, decision-making and recognition. To address the critique of the energy justice framework for not considering intersectionality, a socio-ecological model (SEM) was used to examine effects on individual, interpersonal, organizational, and communal levels. Overall, the EnDev project contributes to promoting energy justice by reducing technology costs, supplying energy needs through grid connection or solar energy, and promoting energy-efficient technologies. The findings indicate that women perceive themselves as more empowered and self-confident because of the interventions. The performance of the rural organizations improved as a result of the interventions, leading to increased income for women. This economic empowerment, combined with a sense of self-confidence, has influenced their status within their households and communities. However, comprehensive support is required for women to fully realize their potential. This includes capacity building in technology, business skills, leadership, marketing, and access to finance. Moreover, societal, and cultural obstacles such as restricted access to finance, education, and caregiving responsibilities must be addressed. The research highlights the transformative potential of any energy intervention in rural areas in terms of power dynamics and gender norms. It also underscores the limitations of the energy justice framework regarding the lack of intersectionality. Consequently, the author proposes a framework combining both energy justice perspectives and the SEM employed in this research. This framework aims to inform strategies, interventions, and policies that not only ensure equitable distribution of energy resources but also address gender biases and promote inclusivity.

**Keywords:** energy, women, gender, justice, rural

## **Executive Summary**

This thesis explores the effects of access to clean and modern technologies on productive uses in rural areas. Many policy programs and energy interventions target the rural population as a measure to combat poverty and increase access to affordable, safe and sustainable energy. However, the sole access to clean energy does not necessarily translate into benefits, on the contrary literature suggests that women, especially in rural areas in the global south, can be negatively impacted in their livelihoods. Energy policies and interventions have often disregarded the gender dimension, assuming that access to energy alone is sufficient for positive outcomes (Winther et al., 2020; Fathallah & Pyakurel, 2020; Tsagakari, 2022). While most of the energy-gender research has focused on the household level, the implications of productive uses of energy (PUE) with a gender perspective are yet to be explored (Das et al., 2020; Pueyo & Maestre, 2019). This study took as a case study five women-led rural organizations that have been supported by the EnDev Bolivia project implemented by GIZ. This project works to facilitate access to clean and modern energy, create and strengthen rural markets, and alleviate poverty and stands out for incorporating a gender lens approach to empower women and promote gender-transformative actions in rural areas.

### ***Aim and Research Questions***

This research aimed to identify not only the impacts on women's livelihoods but also the energy justice implications of this access, using Bolivian rural productive organizations as a case study. Furthermore, the study not only aimed to generate knowledge for the improvement of energy access projects in the global south but also offers insights on how to accelerate the benefits in developing nations through a gendered lens approach to energy projects. By unmasking the gender and justice impacts of these energy projects, it is intended to contribute to pointing out nuances and contexts of these outcomes by focusing on the productive uses of energy.

### ***Research questions***

- **RQ1.** How have energy interventions on productive uses of energy in rural Bolivia addressed the distributional, procedural and recognition aspects of energy justice?
- **RQ2.** What are the socio-economic impacts of access to clean and modern energy technologies for productive uses in rural areas in Bolivia?
- **RQ3.** What are the implications of these impacts on women at the individual, interpersonal, community and organizational levels?

### ***Conceptual framework***

The energy justice framework employed is presented as a valuable tool in which social dynamics can be easily analyzed and incorporated to explore energy use in interventions and policy programs (Wither et al., 2020; Wiese, 2020; McCauley et al. 2019). Furthermore, the socio-ecological theory was simultaneously applied to understand if these interventions have managed to have an impact on women's lives at different scales of their surrounding environment: individual, interpersonal, communal, and organizational. Conducting a parallel analysis using SEM offered a more comprehensive understanding and additional dimensions of experiences of women and indigenous women of Bolivia, thereby addressing the criticism raised by researchers regarding the necessity to broaden the energy justice framework (Sovacool et al., 2023; Bell et al., 2020; Wood, 2023). Thus, this research applied a feminist and intersectional approach by combining energy justice and socio-ecological models to gain a deeper understanding of the effect of energy and technology access on PUE.

## Methods and research design

The research followed a qualitative approach, which presents the opportunity of gathering detailed insights and perspectives of individuals and groups. A multi-site case study (MCS) was chosen, allowing for consistent data collection and analysis across multiple settings. The MCS facilitated an analysis of the EnDev project's effects in various contexts, highlighting similarities among them. Data was gathered through interviews, focus groups, and direct observation. A pilot case study was conducted to validate the instrument and gain a firsthand understanding of the rural area. A total of 11 interviews with the rural association members and three with the GIZ staff were conducted along with five focus groups. Data analysis was performed using content analysis to identify key themes and patterns.

## Main results

The EnDev project in Bolivia promotes energy justice by providing access to energy and clean technologies to rural women's associations. By reducing technology costs, supplying energy needs through grid connection or solar energy, and promoting energy-efficient solar technologies, the project improves the performance, productivity, and profitability of economic activities. This approach contributes to distributional justice by ensuring equitable access to resources and promoting economic growth in impoverished areas. The project also incorporates the justice of recognition by understanding the specific needs of rural women's associations and recognizing their roles beyond profit generation. Procedural justice is emphasized through stakeholder involvement, providing access to information, meaningful participation in decision-making, and ensuring access to justice.

The impacts due to access to energy and clean, modern technology are summarized in Figure A. Women at the individual level reported feeling more empowered, with increased self-esteem and self-confidence. This empowerment was attributed to higher income, successful business ventures, and, to a lesser extent, the use of technology. Interpersonally, some women experienced greater respect from their partners, with recognition of their work. While household chores were still primarily handled by women, some women noted more equitable distribution. At the community level, opinions were divided, with some women indicating that local authorities now consider their input, while others felt their importance as women was never acknowledged. There were no observed gender dynamics at the organizational level, but it was noted that women may feel less confident in operating certain technologies. However, further exploration is needed as limited information was available beyond observations.

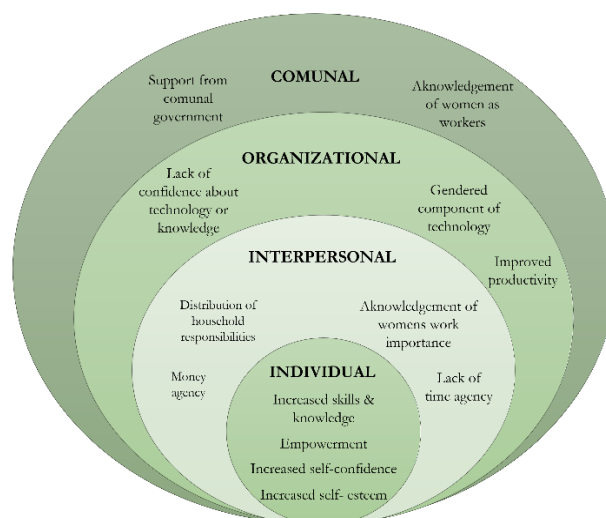


Figure A. Socio-ecological model of the impacts of clean and modern energy and technologies on rural women in Bolivia

## **Discussion**

The literature and fieldwork findings highlight the positive impacts of acquiring energy and technology for productive uses on women's empowerment. Increased income and the ability to manage productive associations collectively contribute to women's sense of empowerment, leading to improved self-confidence, self-esteem, and decision-making power. These impacts interact with the socio-ecological levels, influencing women's status within the family and community. However, it is important to consider contextual factors such as education, awareness campaigns, and access to technology, which can influence the outcomes of empowerment interventions. Women's empowerment is a complex concept, and energy and technology access are just one component that enhances agency. Understanding the local context and addressing gender dynamics are crucial for designing tailored interventions that align with existing social structures.

Despite the potential benefits of access to clean energy and technology for women, there are underlying challenges that hinder their full participation and empowerment. These challenges include limited education, lack of local recognition, barriers to credit and resources, unequal distribution of care responsibilities, and gendered divisions of labor. Gender norms, power dynamics, and socioeconomic factors further influence women's ability to benefit from energy access and reflect the complexity of achieving energy justice. To address these challenges and promote gender equality, interventions should go beyond the provision of energy technologies and include comprehensive approaches that empower women, enhance their knowledge and skills, and challenge gender roles and norms.

The energy justice framework has limitations in fully addressing the gendered and intersectional dimensions of energy inequalities. To overcome these limitations, this study suggests combining the energy justice framework with the socio-ecological model to incorporate an intersectionality perspective. This proposed framework acknowledges the varying gender dynamics based on social, economic, and political contexts, as well as diverse identities and experiences. It emphasizes the need for targeted strategies, interventions, and policies that address gender biases and promote inclusivity.

The proposed framework, which is illustrated in Figure B, is visualized as a circle divided into quadrants representing the principles of energy justice. Each quadrant encompasses concentric circles representing socio-ecological levels that interact with and impact one another. Analyzing all socio-ecological levels is crucial for a comprehensive understanding of energy justice and the forces that influence behavior and intervention effects.

By incorporating the intersectionality perspective and socio-ecological factors, this framework expands the conceptual framework of energy justice and highlights the importance of including the gender dimension in energy projects. It calls for inclusive and effective approaches to promoting equitable and sustainable energy systems.

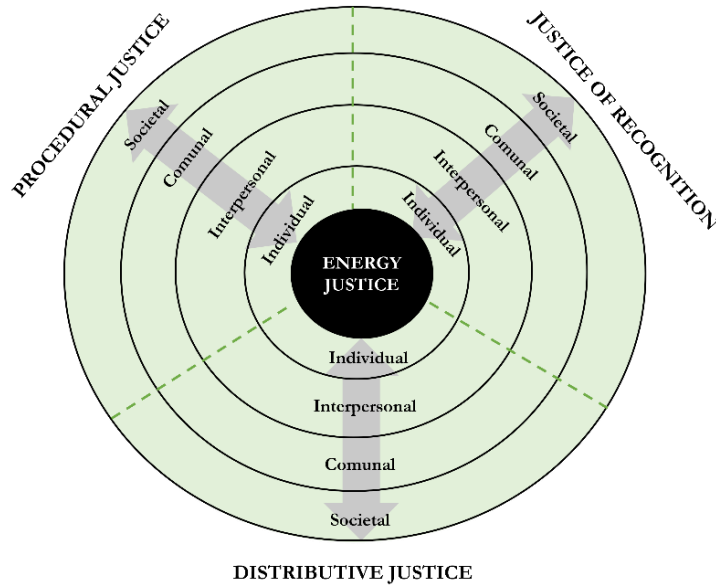


Figure B. Proposed combined framework: Integration of the Energy Justice Framework and Socio-ecological Model

### Conclusion future research

This research highlights the positive impacts of energy interventions and access to modern technologies on rural women's associations in Bolivia. These interventions have improved business performance, increased income, and empower women by enhancing their self-esteem and self-confidence. Access to energy and technology has the potential to challenge harmful gender norms, promote gender equality, and contribute to sustainable development at various socio-ecological levels.

However, to fully realize the potential benefits, comprehensive support is required. This includes capacity building, access to finance, overcoming societal and cultural obstacles, and addressing gender inequalities. The EnDev project actively promotes energy justice by addressing distributional, procedural, and recognition justice. Collaborations with institutions focusing on gender equality further enhance the project's effectiveness.

The energy justice framework used in the research proves useful but requires expansion to incorporate a gendered and intersectionality perspective. The framework alone is insufficient to capture the complexities and potential impacts of interventions. A comprehensive understanding of the context, including gender norms and contextual factors, is necessary. The combination of the energy justice framework and SEM has proven fruitful for improving the framework.

To conclude, policies and interventions that prioritize gender equality are crucial for ensuring fair access to modern energy and technology. The energy justice discussion should consider social, political, and economic dimensions and not solely focus on technological solutions. Future research should focus on analyzing the impacts of the productive uses of energy with a gender dimension, contextualizing gender dynamics, and incorporating an intersectionality approach. Additionally, research can explore the scaling up of successful initiatives, refine the framework, and further develop its theoretical underpinnings.



# Table of Contents

<b>ACKNOWLEDGMENTS</b> .....	<b>I</b>
<b>ABSTRACT</b> .....	<b>II</b>
<b>EXECUTIVE SUMMARY</b> .....	<b>III</b>
<b>LIST OF FIGURES</b> .....	<b>VIII</b>
<b>LIST OF TABLES</b> .....	<b>IX</b>
<b>ABBREVIATIONS</b> .....	<b>X</b>
<b>1 INTRODUCTION</b> .....	<b>1</b>
1.1 PROBLEM DEFINITION .....	2
1.2 AIM AND RESEARCH QUESTIONS .....	3
1.3 MOTIVATION.....	4
1.4 AUDIENCE.....	4
1.5 DISPOSITION .....	4
1.6 ETHICAL CONSIDERATIONS.....	5
<b>2 BACKGROUND</b> .....	<b>6</b>
2.1 POLITICS, ECONOMY AND GENDER IN BOLIVIA .....	6
2.2 ENERGY CONTEXT IN BOLIVIA.....	7
2.2.1 <i>Energy Access in Bolivia</i> .....	8
2.3 THE ENDEV PROJECT.....	9
<b>3 LITERATURE REVIEW</b> .....	<b>12</b>
3.1 GENDER IN THE ENERGY CONTEXT: A CONFLATED CONCEPT.....	12
3.2 THE GENDER-ENERGY NEXUS .....	13
3.3 PUE: AN UNDEREXPLORED AREA.....	14
<b>4 CONCEPTUAL FRAMEWORKS</b> .....	<b>16</b>
4.1 ENERGY JUSTICE.....	16
4.2 SOCIO-ECOLOGICAL MODEL (SEM) .....	18
<b>5 RESEARCH DESIGN MATERIALS AND METHODS</b> .....	<b>21</b>
5.1 RESEARCH DESIGN.....	21
5.2 DATA COLLECTION.....	22
5.2.1 <i>Pilot case study</i> .....	22
5.2.2 <i>Focus groups</i> .....	23
5.2.3 <i>Interviews</i> .....	23
5.2.4 <i>Observations in the field</i> .....	24
5.3 DATA ANALYSIS.....	24
5.4 REFLECTION ON METHODOLOGY.....	25
<b>6 FINDINGS</b> .....	<b>26</b>
6.1 OVERVIEW OF THE CASE STUDIES.....	26
6.2 ENERGY JUSTICE IN THE PRODUCTIVE USES OF ENERGY COMPONENT.....	29
6.2.1 <i>Distributional justice</i> .....	29
6.2.2 <i>Justice of Recognition</i> .....	30
6.2.3 <i>Procedural justice</i> .....	32
<b>BIBLIOGRAPHY</b> .....	<b>49</b>
<b>APPENDIX A. INTERVIEWS LIST</b> .....	<b>55</b>
<b>APPENDIX B. FOCUS GROUPS INTERVIEWS GUIDELINES</b> .....	<b>56</b>

## List of Figures

Figure 2-1. Percentage share of primary energy production in the year 2021 .....	7
Figure 2-2. Electricity coverage in Bolivia (2006-2020) .....	8
Figure 2-3. Solar water pump implemented by EnDev .....	9
Figure 2-4. Geographical coverage of PUE projects of EnDev – Bolivia .....	10
Figure 2-5. Number of users supported by the EnDev project (2006-2021) .....	11
Figure 3-1. Domains of sex-based studies and relevant definitions of social.....	13
Figure 4-1. The eight principles of energy justice .....	17
Figure 4-2. Example of a SEM representing changes to transform masculinities.....	19
Figure 4-3. Socio-ecological Model elaborated to analyze the impacts on women of access to clean and modern energy and technology in PUE.....	20
Figure 6-1. Facilities of llama meat producers. Left: solar dehydrator. Right: llama meat product and electric meat tenderizer.....	27
Figure 6-2. Electric dehydrator.....	27
Figure 6-3. Facilities of the cusu producers. Left: solar panels installed for electricity. Right: cusu grinder.....	28
Figure 6-4. Women working with the cassava peeler.....	28
Figure 6-5. Left: organization facilities. Right: Electric mixer and blender for shampoo production.....	28
Figure 6-6. Women cutting cusu manually.....	30
Figure 6-7. Training for women in business management, FEM 2022, Organization Palacio Tambo de Chuquisaca.....	31
Figure 6-8. Consultation process for the design of the cusu grinder.....	33
Figure 6-9. Socio-ecological model of the impacts of clean and modern energy and technologies on rural women in Bolivia.....	35
Figure 7-1. Proposed combined framework: Integration of the Energy Justice Framework and Socio-ecological Model .....	45

## **List of Tables**

Table 5-1. Location of each organization visited.....	22
Table 6- 1. Summarized information of rural associations interviewed.....	26
Table 7- 1. Guideline on factors or impacts to look for when using the proposed framework.....	46

## **Abbreviations**

EnDev	Energising Development
FEM	Fondo Energía Mujer
GIZ	Gesellschaft für Internationale Zusammenarbeit
IPCC	Intergovernmental Panel on Climate Change
MCS	Multi-site case study
PUE	Productive uses of energy
SDG	Sustainable Development Goals
SEM	Socio-ecological Model
SSI	Semi-structured interviews

# 1 Introduction

Climate change is one of the most complex global environmental challenges. Intermediate and deep reductions in emissions in all sectors are thus essential to limit global warming beyond 1.5°C. Electricity and heat production from the energy supply sector account for 12% of global net anthropogenic greenhouse gas emissions. Although global emissions were reduced by 5.2% during the 2020 pandemic, there was a rebound effect in 2021 due to accelerated economic growth. This meant that energy-related emissions grew by 36.3 billion tons (6% increase) in that year, reaching a record high (International Energy Agency, 2022). The Intergovernmental Panel on Climate Change (IPCC) highlights in its latest report major action will be required for a sustainable transition in the energy sector (IPCC, 2022).

Fortunately, the warnings issued by the IPCC, along with a greater proportion of research focused on this issue, have led to much more attention being paid to the subject in recent years. In fact, decarbonization efforts in the developed world range from the development of renewable energy communities to climate targets set by the European Union demanding the reduction of fossil fuels, and widespread and increasing use of renewable energy technologies (Backe et al., 2022). On the other hand, the United Nations has defined three emission reduction mechanisms that support countries committed under the Kyoto Protocol: Emission Trading, Joint Implementation and Clean Development Mechanisms (Papadis & Tsatsaronis, 2020).

The examples of decarbonization mentioned above consider power generation mostly in developed nations, which are the main carbon emitters. However, supporting the developing world by providing and giving access to modern energy and clean technologies is a pivotal task to enhance human development as well as climate change adaptation while reducing emissions. Electrification and energy access in these areas must avoid following the path of rich nations based on “centrally planned and carbon-intensive power systems with high levels of demand and low energy use efficiency” (Alstone et al., 2015, p. 305).

Rural communities can benefit from energy transitions, especially those that have their foundations in the conceptions of energy justice. Energy justice aims to apply “social fairness and equity principles to energy policy, production, systems, consumption, accessibility, affordability, and distribution” (Buechler & Martínez-Molina, 2021, p. 1). Energy justice issues are intertwined with both technological and social elements of the energy system. This is why decarbonizing energy systems and providing access to clean energy will help reduce emissions necessary to combat climate emergencies, but it will not necessarily deliver equitable and just outcomes. Sustainable development and transition encompass many dimensions, in the energy context, for example, clean technologies can themselves be the source of injustice. For instance, a study on energy justice in the Malawi solar market reported that despite the sale of original solar products in this market, there is a deficiency in skilled labor for the installation of the equipment. As a result, less-privileged people do not have access to it because they cannot afford to pay for the installation (Samarakoon & Zalengera, 2022).

Globally, over 800 million people lack access to electricity and more than 2.6 billion people lack access to clean cooking facilities. Women are the most impacted by this inefficient cooking as they spend approximately 40% of their family income on kerosene, a dangerous and inefficient fossil fuel (IEA, IRENA, UNSD, World Bank, WHO, 2022). As a matter of fact, women in rural areas tend to be in a more disadvantageous position than men, as they generally have less influence over decisions and exercise less control over their own lives and resources. This means that energy interventions will most likely disproportionately benefit men and women (Tsagkari, 2022). Consequently, access to clean energy is insufficient without progress in conjunction with gender equality.

## 1.1 Problem definition

In 1987, The United Nations published the Brundtland Report also known as Our common future, which had a heavy influence on incorporating sustainable development in the international agenda. In this report, the concept of sustainable development is defined and specified as a fundamental piece to face the greatest challenges of humanity. Sustainable development establishes a clear connection between socioeconomic and environmental problems: “Sustainable development is the result of the growing awareness of the global links between mounting environmental problems, socio-economic issues to do with poverty and inequality, and concerns about a healthy future for humanity” (Hopwood et al., 2005, p. 39). Drawing on this definition, the United Nations in its 17 Sustainable Development Goals (SDGs) has set targets for SDG 5 (Gender Equality) and SDG 7 (Affordable and Clean Energy) which have an undeniable connection and multiple benefits can be obtained by addressing them together (Sustainable Development Goals, n.d.). Thus, energy as an environmental concern and gender equality are intertwined concepts, and it is necessary to integrate both concepts within energy transition plans that seek to create a more sustainable and egalitarian society, as “social justice today and in the future is a crucial component of the concept of sustainable development” (Hopwood et al., 2005, p. 39).

For the most part, energy policies, energy projects and interventions, especially in the global south, have been characterized as gender-blind, that is, they tend to ignore the needs of women (Winther et al., 2020). Literature on the subject demonstrates that energy is a highly gendered phenomenon in practice, yet it was not until recent years that more attention has been paid to this issue (Fathallah & Pyakurel, 2020; Tsagkari, 2022; Winther et al., 2017). Unfortunately, it has generally been assumed that the transition to a low-carbon system provides access to clean energy and that energy interventions are beneficial for rural communities and vulnerable groups such as women. However, mere access to energy does not necessarily translate to benefits or fair outcomes. For example, a study in Ethiopia showed that although the overall benefits of a community micro-hydropower project achieved positive results, these varied between men and women: women's energy needs were not sufficiently addressed: women's overall working time was not reduced, whereas men used the extra time for recreational activities (Wiese, 2020). Therefore, sustainability and social justice do not necessarily align.

Following this line, Bolivia is an interesting case to look at. Since 2005, significant investments have been made in the country to electrify rural areas, going from 33% electricity coverage in that year to 86% by 2019. According to official information from the Bolivian national government, national coverage for 2019 reached 93.5%, and the government has set a goal of achieving universal energy access by 2025 (Ministry of Hydrocarbons and Energies, 2021), however according to the German organization Gesellschaft für Internationale Zusammenarbeit (GIZ) staff it is very likely that this will be delayed especially because electricity services have a strong natural gas base and that has been declining recently. Moreover, a research conducted in 2020 on energy justice in rural areas of this country revealed several shortcomings that may prevent this goal from being successfully achieved. The study found constraints in meaningful participation, power imbalance and “lack of recognition of energy requirements across different cultural and socio-economic identities within rural populations” (Nogales, 2020, p. 2). According to the study, government officials maintain that the current policy framework considers the sociocultural characteristics of rural communities and ensures that training and capacity development are focused on women. Nonetheless, the author pointed out that, at the same time, there are no official guidelines or a national strategy to address gender issues of off-grid energy access. Additionally, some rural communities use sources such as wood and kerosene as energy sources, which have impacts on both human health and the environment and have a detrimental impact on family income as well as on gender equality (Nogales, 2020).

The GIZ has been part of this big leap in rural electrification in recent decades. The GIZ oversees and implements the Energising Development Project (EnDev), which aims to facilitate access to clean, modern energy by creating and strengthening rural markets and alleviating poverty. Since 2016, EnDev has begun incorporating a gender lens approach into its projects with a clear gender strategy that has been implemented since 2020. This strategy has sought to empower women through activities such as capacity building, skills and practices, and experience exchanges for rural women in management positions in rural cooperatives, working towards a gender transformative focus. In this context, the program provides preferential support (technical and financial) in access to clean energy technologies for female producer organizations (Componentes Proyecto EnDev, n. d.).

Most of the research that has been done on energy justice and the impact of modern and clean energy access on gender has largely focused on the household realm. Conversely, research on the impact of productive uses of energy (PUE) and how access to clean modern technologies has impacted women's livelihoods is limited (Das et al., 2020; Pueyo & Maestre, 2019). Hence, the study of productive uses of energy, which refers to any formal or informal economic activity that generates income (ENERGIA, 2020), with a gender approach remains a gap in the literature and requires further research (see more in section 3). Through collaboration with the GIZ, this work sought to explore and critically assess energy projects of access to clean, efficient and modern technologies for productive uses and their contribution to energy justice, directing particular attention to the gender dimension.

Therefore, adding to the academic discussion, the subject of energy justice in productive uses of energy in rural areas and incorporating gender dimensions is innovative and addresses the issue both on a global level and in Bolivian and Latin American contexts. However, this work is relevant not only to academia but also to practitioners. For instance, in a pre-study conducted by the author, it was found that the GIZ personnel, despite including certain gender indicators in their projects, consider themselves implementers and do not formally or systematically know to what extent has their intervention impacted women's livelihoods and whether it is a positive or negative way. Until now, no research has been carried out to generate in-depth knowledge on the gendered impact of energy on productive uses. In their view, information and data that unveil the factors and implications of gender interventions are essential for the improvement of EnDev. Identifying these aspects can help make the necessary adjustments in these interventions, with a view to a more just and egalitarian energy transition. Therefore, generating data for analyzing the gender implications of clean energy projects and understanding the energy needs and impacts on women remains a crucial task.

## **1.2 Aim and research questions**

Given the unavailability of literature and knowledge on the implications of clean energy projects for productive uses on rural women, this research aims to identify not only the gender impacts but also the energy justice implications of this access, using Bolivian rural productive associations as a case study. Furthermore, the study not only aims to generate knowledge for the improvement of energy access projects in the global south but also offers insights on how to accelerate the benefits in developing nations through a gendered lens approach to energy projects. By unmasking the gender and justice impacts of these energy projects, it is intended to contribute to closing the existing literature gap by focusing on the productive uses of energy. At the same time, the results will serve as a guide for improving energy interventions in the global south toward egalitarian implementation.

## **Research questions**

**RQ1.** *How have energy interventions on productive uses of energy in rural Bolivia addressed the distributional, procedural and recognition aspects of energy justice?*

**RQ2.** *What are the socio-economic impacts of access to clean and modern energy technologies for productive uses in rural areas in Bolivia?*

**RQ3.** *What are the implications of these impacts on women at the individual, interpersonal, community and organizational levels?*

## **1.3 Motivation**

On a personal level, this topic is not only interesting for the author, but she also considers it of extreme relevance. The work done in the EnDev project resonates with the researcher's values as she is convinced that gender equality is key to the transition to sustainable energy and ensuring universal energy access. Sustainable energy transition can create benefits and opportunities for both men and women. Having been raised as a woman in one of the most unequal regions in the world and now living in a rich country such as Sweden has made the author more aware of the major environmental and gender issues in my region as well as the high level of inequality that exists worldwide. Therefore, contribute to closing this inequality gap both globally and regionally has become a big motivation and it is clear that the right path is to apply sustainability in all its dimensions.

## **1.4 Audience**

There are three main audiences for this work. First, the personnel of the GIZ working on the EnDev project, as the results of this study will serve them first to understand and evaluate the impact on women that their interventions have had. Additionally, the work offers a starting point to restructure their projects and make adjustments so that the projects can have a greater impact on gender and energy justice issues in the future.

Second, this study will be of interest to policymakers and energy project implementers in Bolivia. This work provides a contextual analysis of women's needs regarding the productive uses of the energy realm. The results of this study are valuable when planning a gender strategy or financial incentives with a gender perspective and energy and development policymaking. This is at the same time, of relevance for researchers in energy, energy justice, and gender both in Latin America and globally. The conclusions and information generated in this research contribute to the literature and fill a gap that can help to enhance academic work in this direction.

## **1.5 Disposition**

This thesis is structured as follows: Chapter 2 provides background information about Bolivia's context and the EnDev project, whereas Chapter 3 contains the literature review section that shows the current knowledge about the gender-energy nexus and the status of clean energy access. Chapter 4 gives an overview of the theoretical framework selected to analyze this work. Chapter 5 describes the rationale behind the research design and the methods chosen for data collection and analysis. Chapter 6 presents the results of the study, while Chapter 7 provides an



in-depth analysis and discussion of these results based on the chosen theoretical frameworks. Finally, Chapter 8 provides the conclusions and a reflection on future research that could be derived from the present study.

## **1.6 Ethical considerations**

As already mentioned, this research was supported by an organization. The author contracted an internship with the GIZ in order to have easier access to the documentation of the organization and to be able to travel in their official car without any problem. It is worth mentioning that this was an unpaid internship although the organization provided travel expenses for the field trips. To ensure transparency, it is important to define the interest of the organization clearly: they are highly interested in the results and data that the project will generate, as they intend to understand the impact of their projects as they intend to identify opportunities for improvement in the future. Thus, the author was not involved in any conflicts of interest and was free to observe and report her findings without any interference from the GIZ. The organization provided support only in correcting inaccurate data or observations.

Regarding ethical responsibilities to the subjects of research, participation in the study was completely voluntary and prior informed consent was handed to each participant. There is no cause to believe that participants may suffer any disadvantage or damage from their participation. Special attention will be paid to anonymizing any data that may otherwise identify study participants.

Finally, regarding data handling and storage, files containing personal information and all the data had restricted access, a password was needed to access them. Data was stored in a hard drive and a local folder in the author's personal computer.

## **2 Background**

This section outlines the background context of this study. Having a finer idea of the Bolivian political and economic situation as well as the views on gender equality, and the progress that has been made is relevant to make sense of the context and bring into view a picture of the circumstances that surround the topic. Additionally, a thorough description of the history, objectives, achievements and structure of the EnDev project is provided.

### **2.1 Politics, Economy and Gender in Bolivia**

Bolivia's official name is Plurinational State of Bolivia, so called since 2009 when the new political constitution was ratified. It is a landlocked South American country in which Sucre is the official and judicial capital, while La Paz is the headquarters of the executive and legislative branches of the government. One third of its land lies in the Andes Mountain chain. Bolivia is a country rich in cultural diversity and natural resources, which recognizes 36 indigenous groups (being Quechua and Aymara the largest) with a population of more than 10 million inhabitants (Instituto Nacional de Estadística, 2020a). Bolivia's political division is organized into nine autonomous departments (Beni, Cochabamba, Chuquisaca, La Paz, Oruro, Pando, Potosí, Tarija and Santa Cruz), provinces, municipalities and indigenous native peasants' territories. All organized in the framework of the law of autonomy and decentralization, resulting in departmental autonomy, regional autonomy, municipal autonomy and peasant indigenous autonomy (Instituto Nacional de Estadística, 2020b).

In recent years, Bolivia experienced an important period of economic growth based on the significant expansion in the value of natural gas exports, in addition to the boost to domestic demand and macroeconomic stability, which positively impacted household income levels and their poverty situation (Yañez & Echenique, 2019). Current indicators show that the Gini Coefficient (a measure of inequality) fell from 0.45 in 2020 to 0.42 in 2021 (Banco Mundial, 2020). The Bolivian government has included in their economic and social development plan (2021- 2025) ten strategies aligned to the SDGs as they have committed to the 2030 Agenda for Sustainable Development. However, as significant as these advances could appear, structural inequalities and the social, economic and climate vulnerability still have monumental tasks to address (OXFAM, 2020). In 2021, the national total poverty rate was 36.4% whereas 11% of the population lives in extreme poverty (World Bank Group, 2022).

In a report on climate change, OXFAM lists Bolivia as particularly vulnerable to climate change due to high rates of deforestation, melting glaciers and widespread poverty. Women in rural areas (which account for 30% of the total women in Bolivia) are the most affected, as they were the ones in charge of the family and small crops, resulting in fewer livelihood alternatives when they suffered the loss of their crops (OXFAM, 2020).

The economic inequality experienced by women in Bolivia is evident in the increase in the precariousness of labor in relation to the male population. For instance, the unemployment rate of women between 2015 and 2019 was on average 6.2% higher than that of men (Peláez, 2017). Nonetheless, Bolivia has made significant progress concerning gender equity. In 2019, the Plurinational Service for Women and Depatriarchalizing "Ana María Romero" (SEPMUD) was created. This institution aims to monitor and evaluate the fulfillment of public policies towards depatriarchalization and promotes the eradication of all forms of violence and discrimination against women. In addition, a reform has been created that recognizes parity democracy in the political and electoral system (Peláez, 2017). These advancements are fairly recent and have not necessarily translated into concrete advancements to date, therefore gender inequality remains a massive challenge to overcome.

Overall, Bolivian women encounter many barriers that prevent them from accessing financial services because they are not adapted to women's needs, such as gender stereotypes that reduce incentives for women; lack of time, restrictions on mobility and low levels of financial education, among others (Johnson et al., 2019; Tsagakari, 2022). The Covid-19 pandemic increased this gender gap, especially in the labor sector, which is why it is essential to advance women's economic autonomy and make progress in terms of equal opportunities for men and women (ONU Mujeres, 2020).

## 2.2 Energy Context in Bolivia

In general, the energy sector is entirely operated by the Bolivian State, with the participation of the private sector as suppliers of services and goods for state operations. Bolivia has a great abundance of natural resources, including natural gas, which has become one of the country's main export products. It is not surprising, therefore, that primary energy production is dominated by natural gas (ENERGETICA, 2020). In 2021, this gas accounted for 80.68% of total energy generation. Unfortunately, Bolivian national policy is betting on achieving greater investments and generating a greater number of hydrocarbon activities and continuing to promote its industrialization, developing the petrochemical industry for the generation of economic surpluses that contribute to the growth of the country (Ministerio de Hidrocarburos y Energías, 2022).

Regarding renewable energies, the government has set objectives in the electricity sector, first to expand electricity coverage in the country (both in urban and rural areas), there has been an increase in the use of hydroelectric plants and the incorporation of more alternative energy projects (solar, wind, among others) (Ministerio de Hidrocarburos y Energías, 2022). Likewise, in 2011 the “Política de Energías Alternativas para el Sector Eléctrico del Estado Plurinacional de Bolivia” (Alternative Energy Policy for the Electricity Sector in the Plurinational State of Bolivia) was approved, a policy for the development of renewable energies in the country. With this, photovoltaic parks and wind farms connected to the national electricity grid have been installed. These advances have made it possible to boost a change in the energy matrix, intending to incorporate renewable energies into the system. However, if we look at the total energy produced by renewable sources its contribution is still marginal. Figure 2-1 shows the distribution of energy production in 2021, where the participation of renewable energy sources is reduced to less than 7% of the total, biomass with 4.5% and hydropower with a share of 0.84% (Ministerio de Hidrocarburos y Energías, 2022).

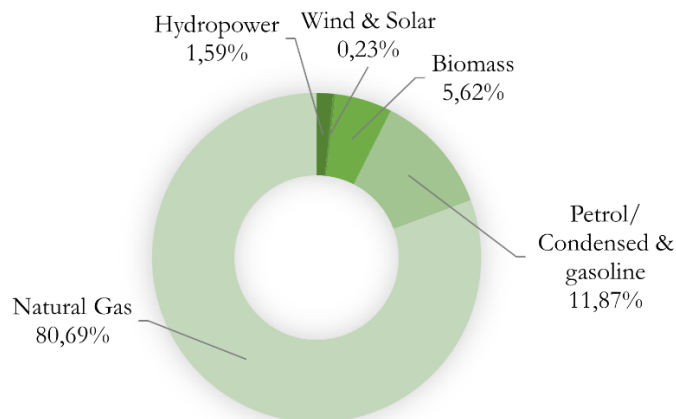


Figure 2-1. Percentage share of primary energy production in the year 2021

Source: Balance Energético Nacional 2006 - 2021 (Ministerio de Hidrocarburos y Energías, 2022)

## 2.2.1 Energy Access in Bolivia

Until 2009, the electric energy service in Bolivia had been characterized as being minimally inclusive where especially people living in rural and low-income areas did not have the possibility of accessing the service. Since the change of constitution in 2009, considerable investments have been made in electricity service coverage. This is due to the conceptualization of electricity as a fundamental right for citizens. (Galopo Pinto & Carlo Santos, 2017). As can be seen in Figure 2-2 in 2005 only 33% of the Bolivian rural population had electricity and by the year 2019 it reached 86% (Ministerio de Hidrocarburos y Energías, 2021). It is important to note that for this study the focus is on electricity as the energy carrier.

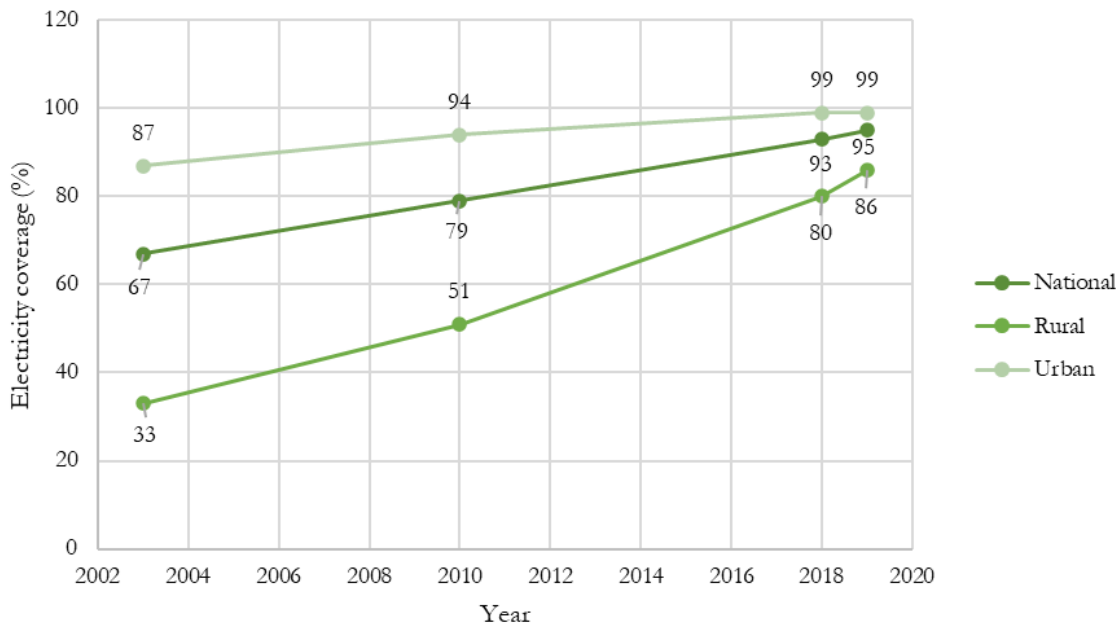


Figure 2-2. Electricity coverage in Bolivia (2006-2020)

Source: Balance Energético Nacional 2006 - 2021 (Ministerio de Hidrocarburos y Energía, 2022)

Thus, in 2008, the “Programa Electricidad para Vivir con Dignidad” was implemented, which uses credits and donations from various financing sources for the execution of projects aimed at increasing electricity coverage. Similarly, the Central Bank of Bolivia grants loans to the Bolivian public company that supplies electricity to increase the installed capacity of generation plants, as well as to extend electricity transmission lines in the national territory. These initiatives help low-income households to benefit from access to electricity services (Galopo Pinto & Carlo Santos, 2017).

Despite this, access to energy is one of the greatest concerns of the population, as they claim that there are energy limitations and injustices. According to Ricaldi (2020), 70% of people in rural areas consider that one of the problems is inaccessibility to energy services. In fact, a study on energy justice in rural Bolivia showed that the regulatory framework for the universalization of basic services in Bolivia lacks a regulated strategy to address the (re)allocation of the benefits of off-grid energy access in rural areas (Nogales, 2020). Another study conducted by the Inter-American Development Bank showed that these energy injustices are also more pronounced among rural women. Rural Bolivian women have less access to energy and therefore less access to opportunities, most of them work on land that belongs to their families, without receiving remuneration; this increases their economic dependence, and they also have less access to training, technical assistance, and credit (Banco Interamericano de Desarrollo, 2021).

## 2.3 The EnDev Project

EnDev Bolivia - Access to Energy Project is a project implemented by the German Cooperation GIZ. This project started in 2005 and its implementation is scheduled to end in 2023, starting an exit phase that will culminate in 2024. Energising Development (EnDev) is part of a global multi-donor program funded by the governments of Germany, the Netherlands, Norway, and Switzerland. In addition, the project implements actions together with strategic allies, which include the Bolivian State, Empresa Nacional de Electricidad (National Electricity Company), Inter-american Institute for Cooperation on Agriculture (IICA for its acronym in Spanish), electricity cooperatives, communities, productive associations, a variety of civil society institutions such as universities and other international cooperation agencies (EnDev Bolivia, 2022a).

EnDev's objective is to increase the number of people with access to clean and modern energy in rural and peri-urban areas through the creation and strengthening of rural markets and poverty alleviation. Its approach is based on capacity building, knowledge transfer, and support for technology design and implementation. The activities are developed under a gender focus, seeking greater participation and empowerment of rural women (Marqu ez, 2023). Through technological solutions and innovations in renewable energy. The project offers support to three different target groups: rural households, social infrastructure (schools, health centers and community centers) and micro, small and medium-sized enterprises (MSMEs). It is also structured based on three main components: on-grid electrification, PUE, and photovoltaic systems (EnDev Bolivia, 2022a). Figure 2-3 shows a project implemented by EnDev where a solar water pump was installed for agricultural purposes.



*Figure 2-3. Solar water pump implemented by EnDev  
Source: EnDev Project Bolivia, GIZ*

The data used for this research were taken from the supported users of the PUE component. The main objective of this action line is to increase the number of families that have access to modern energy to meet their productive needs. The project offers solutions to the latent problem of limited access to technologies and services for productive uses, which constitutes a significant constraint to social and economic development and contributes to greenhouse gas

emissions in Bolivia. Therefore, it remains relevant to provide the definition that the GIZ uses for PUE: those that increase income and/or productivity (Componentes Proyecto EnDev, n. d.). However, other institutions provide different concepts; the World Bank (as cited in Arévalo, 2021) defines it as activities that involve the use of electrical and non-electrical energy in the form of heat or mechanical energy for activities that improve income and welfare in rural contexts. These activities are typically found in the agriculture, rural enterprise and education sectors. Additionally, the PUE's strategy and objective align with the SDG 7: affordable and clean energy. PUE's geographical area of coverage is the whole country of Bolivia (Marquéz, 2023), Figure 2-4 shows the distribution and geographic coverage of the PUE component, from 2009 to 2019.

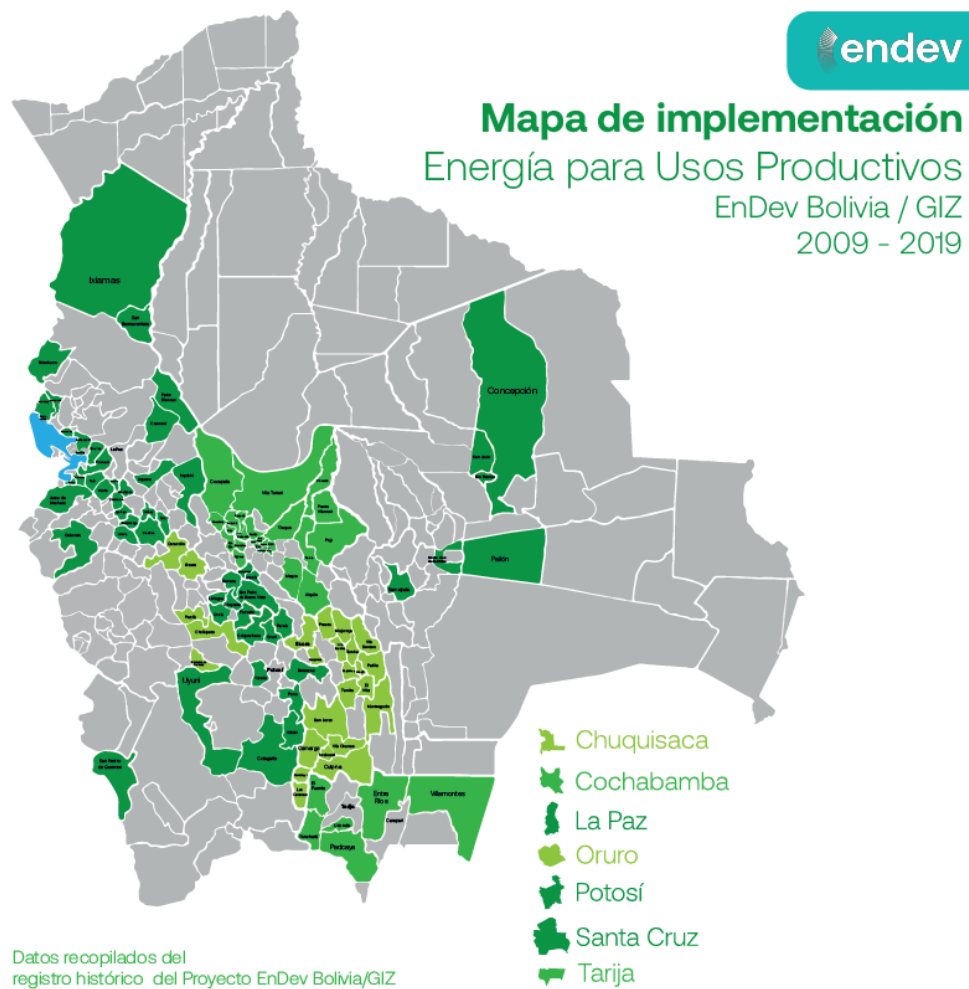


Figure 2-4. Geographical coverage of PUE projects of EnDev – Bolivia  
Source: Usos Productivos de la Energía en Bolivia. Lecciones aprendidas en 16 años de implementación del Proyecto EnDev/ GIZ (EnDev Bolivia, 2022b)

Over its years of implementation, EnDev has intervened in a wide variety of production chains: horticultural crops, dairy cattle, grains and cereals, coffee, peppers, corn and legumes, milk and its derivatives, among others (Marquez, 2023). As of July 2022, there were 36,919 micro and small enterprises that have received an economic incentive or technical assistance through this component (EnDev Bolivia, 2022). A breakdown of the number of projects implemented by department is summarized in Figure 2-5.



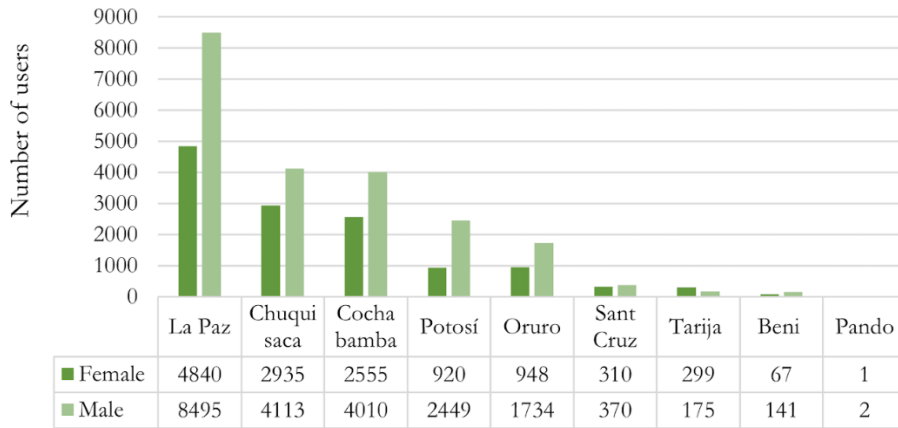


Figure 2-5. Number of users supported by the EnDev project (2006-2021)

Source: *Usos Productivos de la Energía en Bolivia. Lecciones aprendidas en 16 años de implementación del Proyecto EnDev/ GIZ (EnDev Bolivia, 2022b)*

EnDev's support for PUE has several areas of intervention from technical advice on technologies for productive uses, facilitating access to technologies, adaptive technological innovation and co-design. Likewise, it is the productive associations who make the request through a letter to the EnDev project coordinator. EnDev supports the associations with a monetary incentive of 160 Bolivianos (60 EUR) per member. The rest of the investment must be paid by the association (Marqu ez, 2023).

In addition to its main components, EnDev started in the year 2021 the Fondo Energ a Mujer (FEM) (Woman Energy Fund). This initiative was created to strengthen women producers or women leaders in their productive activities and improve their confidence aiming to shorten the inequality gap between men and women. The FEM is an opportunity for financial and technical support to rural enterprises led by women who demand access to modern energy technologies, among others. Therefore, FEM supports access to modern technologies such as machinery or electrical equipment, solar energy, or other forms of renewable energy for productive use (EnDev, n.d.).

### **3 Literature review**

This chapter delimits the concept of gender adopted in this research and examines the different definitions given in the energy context. It also draws attention to the relationship between gender and energy and examines the main outcomes that studies using this approach have generated such as the distribution of benefits of energy interventions and impacts on women's livelihoods. On the other hand, this section also discusses how the PUE analysis has been incorporated into energy-gender research.

#### **3.1 Gender in the energy context: a conflated concept**

Gender as a concept has been utilized in different ways in the energy context, leading to confusion and misinterpretation. As a matter of fact, Fathallah & Pyakurel (2020) claim that in the literature, the terms gender and sex are often used interchangeably, as researchers are imprecise about what they mean when using them. The concept of gender is fluid and can vary from one society to another; therefore, researchers recommend clearly stating and clarifying it when performing gender studies (Fathallah & Pyakurel, 2020). Indeed, the literature review revealed that a definition of gender is not usually provided and, on the contrary, is assumed (Ding, 2019; Tsagkari, 2022; Wiese, 2020).

Nonetheless, gender research in the energy sector has almost exclusively been directed at women. In particular, the differences between men and women according to access to and use of energy services have become the focus of energy-gender nexus research (Feenstra & Özerol, 2021). This understanding of gender is almost limited to its conceptualization as a dual concept that associates the distribution of resources with either male or female characteristics. The present research is based on a binary concept of gender female/male as it has its foundation in studying the indigenous women in Bolivia who belong to families that traditionally follow a conventional structure. These women bear the burden of childcare and household responsibilities. In this context, traditional gender roles are still prevalent and extremely rooted (World Bank, 2015). However, the author acknowledges that it is important to take into account an intersectional approach when researching just transitions in different contexts. This refers to the various factors an individual identity, such as race, gender, socioeconomic status, and others, can be combined to create marginalization and oppression (Cannon & Chu, 2021, p. 1).

To establish the meaning and delimitate gender in this study, the domain of sex and gender studies proposed by Fathallah & Pyakurel (2020) was deemed appropriate (see Figure 3-1). Although, it is important to understand that the concepts provided by the authors are not “universal definitions that seek to essentialize sex or gender” (Fathallah & Pyakurel 2020, p. 3). For the purpose of this study, gender is defined as the “socially prescribed roles, behaviors and appearance, culturally inferred from sex” (Fathallah & Pyakurel, 2020, p. 3) whereas sex is understood as “a person's biological features, notably their chromosomes and the secondary sex characteristics expressed by the physical body as a result” (Fathallah & Pyakurel, 2020, p. 2).



**Definitions:**

**Sex:** Chromosome combinations and resulting biological features

**Gender:** Socially prescribed roles, behaviours and appearance, culturally inferred from sex

**Orientation:** Attraction to others based on gender and sex

**Gender identity :** the gender one perceives and feels oneself to be. In transgenderism, a person's gender identity is different to their sex.

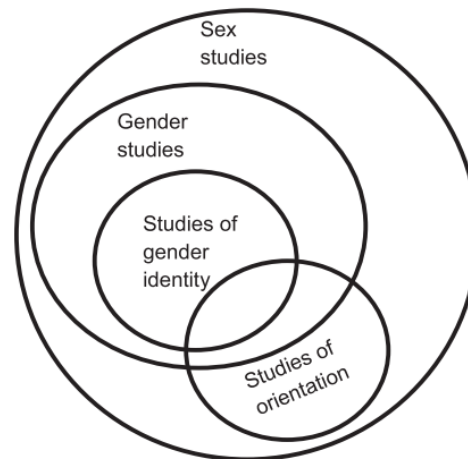


Figure 3-1. Domains of sex-based studies and relevant definitions of social  
Source: *Addressing gender in energy studies* (Fathallah & Pyakurel, 2020)

### 3.2 The gender-energy nexus

Research on the gender-energy nexus began in the 1970s and has been based on “the recognition of the differentiated needs and priorities of women and men with regard to energy stemming from gendered societal and cultural roles” (United Nations Industrial Development Organization, 2015, p. 7). This nexus has undergone a process that began with a gender-neutrality approach (avoiding distinguishing between genders) and has gradually transformed into a more inclusive concept. This initial belief that energy technologies are gender-neutral and benefit the whole community equally has meant that energy studies have not paid sufficient attention to gender issues (Feenstra & Özerol, 2021).

Consensus exists that the opportunities and benefits derived from energy provision differ between men and women since the latter in the rural developing world have different responsibilities and contributions to the household and community. Especially in rural areas, women are often given the responsibility of household work. In this context, the acquisition and consumption of energy is a women's duty (Opoku et al., 2021). In some areas of Africa, for example, women use wood and charcoal for cooking (Winther et al., 2018). They are often the ones who have the task of obtaining this raw material, which requires physical effort and time on their part (Winther et al., 2018).

Over the last decade, several studies have documented the implications of access to modern and conventional energy from a gender-based perspective (Tsagkari, 2022; Wiese, 2020; Winther et al., 2017). These studies have revealed that providing women with access to energy is constantly marked by trade-offs. A study on the gender impacts of access to renewable energy in Tibetan pastoral areas of China showed how this benefit empowered women by improving their energy management at home and made chores such as cooking and milking more efficient. However, women's daily work time increased because the time saved on some tasks was used for others, such as making meat or producing milk to sell for money (Ding, 2019). Therefore, women tend to be left with fewer benefits or even in a less beneficial situation compared to how they were before. Assuming that modern and clean energy access will translate into gender equality fails to value women's perspectives or recognize gender dynamics within society at all scales (Moniruzzaman & Day, 2020).

Scholars attribute this disproportionate distribution of benefits to various reasons. On the one hand, the structural problem has shaped the gender norms and socio-cultural practices associated with energy production and consumption (Johnson et al., 2019). On the other hand,

the implementation and design of interventions to improve access to modern energy by public-private institutions is criticized for being gender-blind (Winther et al., 2020). It is argued that clean technology deployment and the frameworks used for implementation pay little or no attention to women's needs and specific interests while neglecting women's participation and role in interventions of this nature (Tsagkari, 2022).

Despite this clear and well-documented inequality issue, transformative changes in gender roles have been linked to access to modern energy services. Overall, evidence suggests that this leads to a change in women's standard of living. The results indicate that women have improved their well-being due to increased leisure time and less physical effort to perform daily tasks (ENERGIA, 2020; Sahrakorpi & Bandi, 2021; Terrapon-Paff et al., 2018). The International Network on Gender and Sustainable Energy (ENERGIA) implemented a project in Burkina Faso that sought to stimulate the use of energy-efficient cooking stoves. Approximately 600 women entrepreneurs were trained to use these technologies in the brewing sector. As a result, the women have saved approximately 50 hours of work, improved their health and increased their business profits (United Nations Industrial Development Organization, 2015). Targeting women using adequate tools and approaches helps overcome barriers and constraints to their personal development and opens the way for them to take advantage of the opportunities offered by modern energy, such as business opportunities (ENERGIA, 2020).

### **3.3 PUE: an underexplored area**

The vast majority of research on gender and energy has largely focused on the household level. Research on the impact of PUE and how access to clean modern technologies has impacted women's livelihoods is very recent and scarce. Some scholars have criticized the lack of research on PUE by arguing that the role of women goes beyond household energy use and that women can benefit from clean technologies in their productive roles (Das et al., 2020; Pueyo & Maestre, 2019). Just as energy needs and benefits at the household level differ between men and women, the same occurs at the productive level. In a study conducted in Ghana, Myanmar and Tanzania, the authors conclude that men and women "operate in different types of productive activities at different locations" and have different challenges to facilitate business, such as infrastructure, skills, finance, and markets (Pueyo & Maestre, 2019, p. 171).

In relation to the above-mentioned, studies have found that women-led enterprises usually involve activities that are heat-intensive, labor-intensive or light intensive. Such activities demand physical effort and are time-consuming and even may pose health risks to women who perform them (Clancy & Dutta, 2005; Winther et al., 2017). Moreover, women face challenges that constrain them to operate their businesses effectively or safely. One of the main challenges that women face in running their entrepreneurship is a lack of energy and technology supplies. For instance, in a study conducted in Ghana, it was found that lack of equipment and technologies was a major problem since it prevented women from growing their productive activities as they did not have the necessary tools and all the work took them a great amount of time and physical effort (ENERGIA, 2018).

In addition, researchers discuss a series of structural barriers that hinder women's economic opportunities and lead to unequal access to productive resources, such as finance, land technology, markets and information. First, the gender gap in access to information and technical and technical skills is conditioned by the low level of education received by women in rural areas, especially in comparison to men. Second, women's disproportionate responsibility for domestic work and unpaid care (ENERGIA, 2018; Glemarec et al., 2016; Serra et al., 2023). Third, lack of agency, in both realms, economic and time agency. Household responsibilities

limit women's time and the first two barriers mentioned above disrupt their opportunities to actively participate in economic activities (ENERGIA, 2018).

Despite all these challenges in PUE, studies highlight the potential of rural women's entrepreneurship when provided with access to energy and technology. Specifically, studies indicate a positive correlation between the provision of clean and modern energy for productive uses and women's empowerment (Clancy & Dutta 2005; ENERGIA, 2020; Glemarec et al., 2016). An example of this is a project in the village of Bulelavata in the Western Solomon Islands, where a community-owned micro hydro system was designed with a women's participatory approach, it is reported that women increased their welfare and confidence and participation in the community, which, as a consequence, has to some extent challenged gender norms (Clancy & Dutta 2005). Moreover, another report indicates that the use of electrical appliances in women's entrepreneurship allowed for diversification in products for sale which allowed women to increase their financial independence (ENERGIA 2019).

Conversely, there is a debate about how the role of energy technology in promoting the process of empowerment is still uncertain (Das et al., 2020) and encourages academia to promote more research. Thus, there is a growing body of literature that suggests that access to clean energy and technology is insufficient to bring about change and benefits in PUE without addressing underlying inequalities (Clancy & Dutta, 2005; ENERGIA, 2018; Terrapon-Paff et al., 2018).

To increase the benefits for women in PUE, the literature strongly emphasizes that projects, policies and initiatives must be accompanied by a more holistic approach than simply providing accessibility. In this sense, including training, leadership workshops, stakeholder consultations and participation in all phases of a PUE project (design, implementation, generation, distribution, consumption, evaluation) are recommended measures to ensure success (Clancy & Dutta 2005; United Nations Development Programme, 2001). One illustration of this concept is the GRESDA initiative carried out in Ghana. The project aimed to enhance women's economic empowerment and ensure food security by introducing energy technologies and equipment that enhance agricultural processing businesses while minimizing post-harvest losses. The project findings emphasize the necessity for thorough training and confidence-building measures at the project's outset, as women expressed being afraid of operating the equipment (United Nations Development Programme, 2001, p. 42).

## **4 Conceptual Frameworks**

This research aimed to study the impact of access to modern and clean technology on PUE in rural areas. The energy justice framework was selected to analyze how its principles are employed in the EnDev project. Additionally, a socio-ecological model was applied to understand if these interventions have managed to have an impact on women's lives at different scales of their surrounding environment: individual, interpersonal, communal and organizational. This section provides a description and justification of the selected conceptual frameworks (energy justice framework and socio-ecological model) used for the data analysis and interpretation to answer the research questions.

### **4.1 Energy justice**

The notion of energy justice is a term derived from other concepts of justice discussed in the environmental debate, such as climate and environmental justice. Over time “energy was separated from the wider range of topics concerning the environment and climate change, creating the concept of energy justice” However, there is no consensus on when the concept emerged (Feenstra & Özerol, 2021, p. 2). Several definitions of it can be found in the literature, although many authors agree that energy justice is an analytical, conceptual and decision making-framework that can facilitate policymakers, energy planners and consumers to make more informed energy choices (Jenkins et al., 2016; Feenstra & Özerol, 2021).

Fundamentally, the concept of energy justice has emerged from research that incorporates philosophical foundations and justice theory applied to energy policy. Thus, the energy justice framework uses a tripartite approach, whose core themes are distributional justice, justice of recognition, and procedural justice (McCauley et al., 2013). Distributional justice oversees the fair allocation of the impact of access to modern energy services, that is, the even distribution of risks and opportunities (Baker et al., 2019; Sovacool & Dworkin, 2015). In a study conducted by Wiese (2020), the concept of distributional justice was explored by examining the gender impacts of access to electricity in community-based micro-hydropower cooperatives in Ethiopia. The author concludes that access to electricity reduced cooking time for both men and women. However, the overall time of women did not decrease significantly. Instead, women used the additional time for household chores such as cooking, taking care of children, or feeding animals. Conversely, men from high-income groups mentioned that they spent extra time on leisure activities.

Procedural justice encompasses various aspects, in the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) of 1998 the three pillars of access to procedural justice are established: access to information, meaningful participation and decision making and access to justice (United Nations Economic Commission for Europe, n.d.). This structure seeks to create a space of fairness in terms of decision-making issues and is considered a useful tool to examine the procedural component of energy justice (McCauley et al., 2013; Moniruzzaman & Day, 2020). Procedural justice is particularly important for this study as women's energy requirements and needs are usually overlooked in developing countries, “poor women have no or little access to the courts to get energy justice, so they remain in energy poverty” (Moniruzzman, 2016, p. 54).

The acknowledgment of the different groups affected or influenced refers to the justice of recognition. Although this pillar can be confused with procedural justice by considering it as participation in the process, each tenet encompasses different aspects. Justice of recognition requires that individuals are represented fairly and calls for the offering of complete and equal

political rights to all individuals (Feenstra & Özerol, 2021). This includes the recognition of contextual and cultural, gender, ethnic, and racial differences.

In this study, the analysis will be grounded in the three principles of energy justice. Nevertheless, for a comprehensive understanding of a complex concept like energy justice, it is essential to delve into an alternative type of analysis that conceives energy justice differently. Sovacool & Dworkin (2015) proposed the eight principles of energy justice, which in fact arise from the three pillars of energy justice mentioned above. These eight principles are availability, affordability, due process, transparency and accountability, sustainability, intragenerational equity, intergenerational equity, and accountability. The framework emerged from the concern that social justice issues are not incorporated into the planning of energy systems. This framework aims to "highlight the futurity, fairness, and equity dimensions of energy production and use" (Sovacool & Dworkin, 2015, p. 1). Figure 4-1 provides a description of each principle.

Energy justice decision-making tool.

Principle	Explanation
Availability	People deserve sufficient energy resources of high quality
Affordability	All people, including the poor, should pay no more than 10 percent of their income for energy services
Due process	Countries should respect due process and human rights in their production and use of energy
Good governance	All people should have access to high quality information about energy and the environment and fair, transparent, and accountable forms of energy decision-making
Sustainability	Energy resources should not be depleted too quickly
Intragenerational equity	All people have a right to fairly access energy services
Intergenerational equity	Future generations have a right to enjoy a good life undisturbed by the damage our energy systems inflict on the world today
Responsibility	All nations have a responsibility to protect the natural environment and minimize energy-related environmental threats

Figure 4-1. The eight principles of energy justice

Source: *Energy justice: Conceptual insights and practical applications* (Sovacool & Dworkin, 2015)

Most of the reviewed empirical studies attempting to establish the relationship between energy and gender have based their analyses on the energy justice framework. This framework is presented as a valuable tool in which social dynamics can be easily analyzed and incorporated to explore energy use in energy systems (McCauley et al. 2019; Wiese, 2020; Wither et al., 2020). In addition, energy justice provides a framework for addressing the central theme of this research: access to energy and incorporating the gender dimension. Energy injustice has a strong gender face, especially for women who struggle to have access to clean, sustainable, and affordable energy services (Feenstra & Özerol, 2021).

This research primarily concentrates on analyzing energy justice through the lens of the three core tenets: distributive justice, procedural justice, and justice of recognition. However, it is crucial to acknowledge that the eight principles proposed by Sovacool & Dworkin (2015), which serve as key features of energy justice, should not be disregarded during the analysis. This is because it is plausible that the three tenets alone may not encompass all the diverse aspects of justice. In fact, a developing field has criticized the tripartite approach and highlighted the need to expand the scope of energy justice to incorporate multiple perspectives and forms of oppression. It is argued that the energy justice discussion often prioritizes Western context and perspectives, therefore overlooking the experiences and concerns of marginalized communities especially in the Global South (McCauley et al., 2019; Tornel, 2023). Integration of other frameworks such as postcolonial theory, and the capabilities approach could lead to a more nuanced analysis and the development of tools to guide decision-making and policy processes (Sovacool et al., 2023; Bell et al., 2020; Wood, 2023).

To date, no existing studies have employed the energy justice framework to assess the outcomes and consequences of PUE interventions. Although some studies indicate how PUE contributes to energy justice (Domegni & Azouma, 2022; Clancy & Dutta, 2005) there is a lack of research

that specifically examines each component of energy justice while incorporating a gender dimension. Furthermore, conducting a parallel analysis using the socio ecological model (SEM) offers a more comprehensive understanding and additional dimensions of the experiences of women and indigenous women of Bolivia, thereby addressing the criticism raised by researchers regarding the necessity to broaden the energy justice framework. Thus, this research applied a feminist and intersectional approach that combines energy justice and the socioecological model for a broad understanding of the effects on the productive uses of energy.

## **4.2 Socio-ecological Model (SEM)**

The SEM developed by Bronfenbrenner explores how the behavior of individuals or human development is constantly shaped by the surrounding environment. In other words, the context in which humans develop needs to be considered, as it provides factors that influence attitudes, knowledge, and behaviors, among others (Kilanowski, 2017). Applying a socio-ecological model allows the researcher to deeply analyze the interactions and impacts between individuals and the environment within a social system (Kapungu et al., 2018). Interactions occur through a dynamic process where individual characteristics, social factors, and physical environment factors interact and influence each other. SEM is closely related to systems thinking as it emphasizes the importance of comprehending all the influences and interdependencies to understand a given phenomenon (Watts et al., 2013). Although, it must be contemplated at all times that the environment changes over time and it can be shaped as well by the individual (Rosa & Tudge, 2013).

Bronfenbrenner's original theory illustrates these interactions as a multilevel system consisting of concentric circles. The innermost circle refers to the individual level or the microsystem. This is the most proximate level of influence and it concerns the individual knowledge, skills and concerns. The next level is known as the mesosystem and has to do with relationships with other people, the individual and those at the interpersonal level, such as family and friends. These are the interactions between multiple microsystems (Kilanowski, 2017). The exosystem encompasses interactions that influence systems but not the individual directly. In this particular study, we examine the exosystem at the organizational level. The macrosystem distinguishes itself from other contextual levels as it encompasses the established norms and structures within a culture or subculture. These systems include economic, social, educational, legal and political systems (Rosa & Tudge, 2013).

To provide a clearer depiction of the SEM, Figure 4-2 presents the model generated in a study that sought to unravel the causes and enablers of violence against girls and women. The study identified a range of factors at all levels, according to the researchers, should be the focal point of interventions. By targeting all levels, practitioners can comprehend not only individual factors but also shopping the social environment. For instance: within a classroom delivering educational programs, institutional and national policy on sexual harassment or enrolling parents in support of schools' teaching (wider environment) (Jewkes et al., 2014, p. 7).

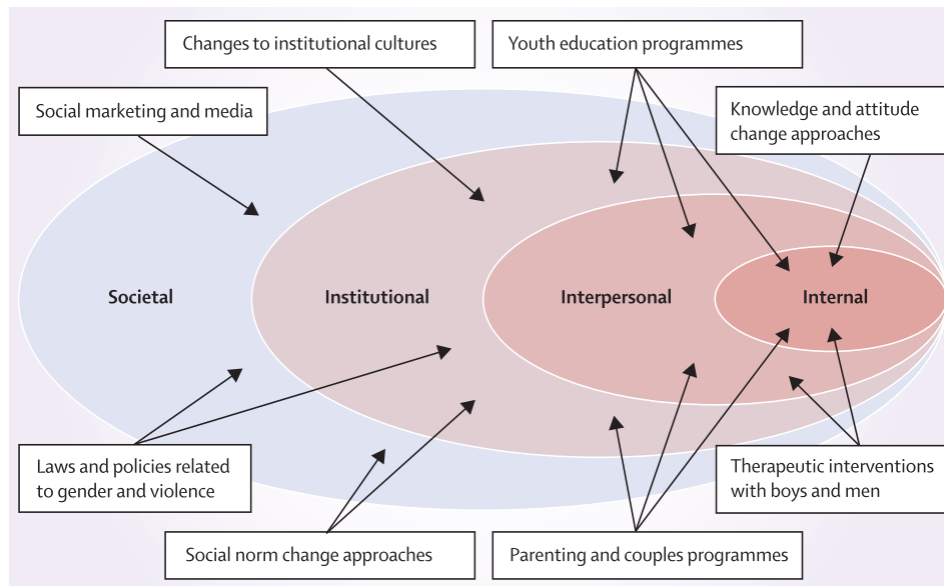


Figure 4-2. Example of a SEM representing changes to transform masculinities

Source: From *work with men and boys to changes of social norms and reduction of inequities in gender relations: a conceptual shift in prevention of violence against women and girls* (Jewkes et al., 2014).

This approach aims to guide interventions in promoting opportunities and changes across various socio-ecological levels, while also challenging prevailing gender norms (Rutgers, 2019). Hence, in the context of this study, the utilization of SEM as a framework is appropriate as it facilitates an understanding of the extent to which interventions have affected women's lives and brought about a transformation in gender role patterns. Additionally, SEM proves valuable, as demonstrated by the Jewkes et al. (2014) example, in comprehending the interactions occurring at different scales and identifying the driving forces behind change. It will help determine whether the EnDev has impacted established social norms within rural communities, while also providing opportunities for women.

The research in question adopts the specific socio-ecological model depicted in Figure 4-3. In this study, all socio-ecological levels, except for the societal level, were taken into account. Since this study does not include in its scope an analysis at the institutional or political level, the macrosystem is limited to exploring dynamic interactions up to broader community levels. Moreover, a separate analysis was conducted on the communal and organizational levels. The communal level focuses on interactions with individuals residing in the same villa or neighborhood, as well as their involvement in local groups and activities. Conversely, the organizational level pertains to the productive association itself. The overlapping rings of Figure 4-3 illustrate how factors at one level influence factors at other levels.

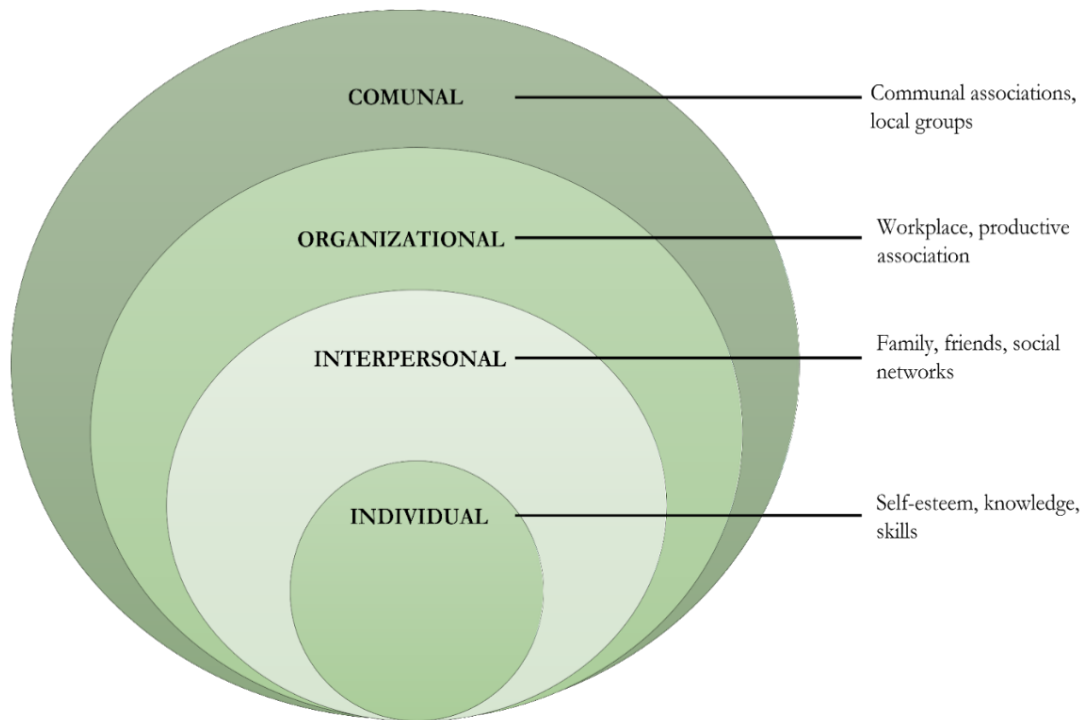


Figure 4-3. Socio-ecological Model elaborated to analyze the impacts on women of access to clean and modern energy and technology in PUE

Source: Own work. Based on the model of Jewkes et al. (2014)

Finally, some studies have criticized and discussed the limitations of this model. Mehtälä et al., (2014), studied the interactions of children and physical activity and indicated that the model oversimplified the "influences on children's activity levels". Another critique by Watts et al. (2013) is that since the model is based on systems thinking all factors influence each other and therefore the systems become mutually influential and that makes it complicated to implement in practice.



## **5 Research design materials and methods**

The following section describes the research design strategy chosen for this study, as well as the ideas and philosophical conceptualizations that have influenced this work. It also provides a description of the methods used to collect the data and a section on the methodology followed to analyze the data. Finally, a short reflection on the methodological process gives the reader a glimpse of the lessons learned and the reality of the data collection in the field.

### **5.1 Research design**

The research followed a qualitative approach, as non-numerical data was collected and analyzed to understand the opinions, experiences and effects of access to clean and modern technologies in rural communities in Bolivia, from entrepreneurship led by women. A qualitative stand was particularly helpful since it represents a set of diverse approaches, offering the opportunity for gathering detailed insights and perspectives of individuals and groups (Lê & Schmid, 2019). Due to the nature of the qualitative method, the research questions and design were influenced by a constructivist worldview. Following this philosophical approach, the researcher focuses on the participants' perspectives on the situation being assessed (Creswell & Creswell, 2018). This aligns with the research strategy since the data collected consisted of subjective responses of individuals (EnDev supported users) and considers the specific context in which people live to establish historical and cultural links to the results.

A multi-site case study (MCS), which involves collecting and analyzing data from several cases, was selected. MCS was chosen instead of a single-case study because one of its major advantages is its ability to "elicit common findings from across different settings" (Mills et al., 2010, p. 587). In addition, this method allowed the author to use the same data collection methods, instruments, and analyses in all chosen settings. By applying the MCS, it was possible to analyze the effects of the EnDev project in different contexts, which enriches the study by presenting both the differences and similarities of the sites (Mills et al., 2010). Thus, a multi-site case study contributes to a deeper understanding of the effects of the EnDev project in different settings. As can be inferred, MCS tends to evoke generalizations in the data, and if not cautiously analyzed, this can lead to overlooking context-specific knowledge and needs (Jenkins et al., 2018).

Considering the information provided above, five rural organization users of the EnDev project were selected. As can be seen in Table 5-1 two of these associations are situated in the department of La Paz, while the remaining three are located in the Santa Cruz department. Therefore, data collection was divided into two field trips. The selection criteria were as follows:

- The organization had to be led by a woman and had to have mostly women as associates.
- Each case selected has more than one year of having been implemented. Overall, all projects were implemented between 2020 and 2021. According to the GIZ, for projects considerably older, it might be challenging to recall specific changes or situations since a significant amount of time has passed. Conversely, for relatively new projects (less than one year) the impacts may not have manifested yet.
- The traveling distance. The EnDev project has its office in the Department of Cochabamba; however, the project is implemented throughout the country. Projects that met the two criteria above also needed to qualify for planning that did not exceed two weeks of traveling for data collection.

Table 5-1. Location of each organization visited

Organization	Department	Province	Municipality
Organization #1	La Paz	Juan Miguel Pando	Santiago de Machaca
Organization #2	La Paz	Ingavi	Viacha
Organization #3	Santa Cruz	Ñuflo	Concepción
Organization #4	Santa Cruz	Velasco	San Ignacio de Velasco
Organization #5	Santa Cruz	Velasco	San Miguel de Velasco

Source: Own work

## 5.2 Data collection

In the realm of qualitative research, data can be acquired using different collection methods such as interview transcripts, written documents, research diaries, direct observation, participant observation, focus groups, videos and photographs (Mills et al., 2010). Three sources of input were used to study the implications of clean technologies in rural organizations run by women: interviews, focus groups, and direct observation. In this sense, the MCS allowed data source triangulation by combining these three sources of data at different moments in time, in different social situations and with a variety of participants. Triangulation is relevant for increasing the validity of this study and enhancing the completeness of the results (Mills et al., 2010).

To collect data, a collection instrument and an interview protocol were developed. Following the constructivist line, open-ended questions were elaborated to gain insights into individuals' life experiences and perspectives on how access to clean and modern energy for productive uses has benefited their lives. Particular attention was paid to the initial protocol to ensure that it is focused on the research question and did not prompt bias in the answers; for example, the introduction was standardized.

### 5.2.1 Pilot case study

A pilot case study was conducted to validate the instrument before collecting the data, to see firsthand what the rural area in Bolivia looks like and conceptualize it (Goodsell et al., 2009). This validation was carried out in a women's organization located in the Department of Cochabamba. The pilot case study was selected based on accessibility and time convenience. Validating this instrument allowed the author to adjust the data collection instrument concerning its content and procedures to be followed. Qualitative research provides flexibility to iteratively approach data which allows the adjustment of "data collection and analysis in response to the needs of the study" (Mills, 2010, p. 505). The catalog of questions can be found in Appendix A. Note, however, that the catalog allowed for a red thread, due to the semi-structured nature of the interviews and focus groups, the actual questions asked could vary slightly.

It was also agreed that a person from the GIZ would lead the focus group for this pilot study, as she has experience on the field site and is familiar with the traditions of Bolivia's rural indigenous population. The author added comments and questions when she felt it was necessary to obtain more information. This phenomenological approach was extremely helpful because it allowed the researcher through direct observation to get a better conceptualization of rural areas (Goodsell et al., 2009) and opened the space to reflect on the author's abilities to carry out such an activity. Spanish was used in both the focus groups and interviews. However,

one challenge was that some of the interviewees spoke Quechua or other indigenous languages. Sometimes it was unclear what they were saying, as they occasionally introduced indigenous words into their sentences.

### **5.2.2 Focus groups**

Focus groups are discussions that involve a group of people with the intention to yield more data and in the hope that group dynamics will induce participants to produce more valuable information (Mills et al., 2010). The idea of conducting focus groups was that gathering a considerable number of participants would allow for obtaining as much data as possible. The aim was to gather information about the perceived benefits and impacts of the members after acquiring the technology for their productive uses. In particular, the author wanted to capture perspectives at the community, individual and organizational levels.

Limitations and criticisms of this data collection method cannot be overlooked. Researchers have pointed out that this method is “less effective than individual, in-depth interviews for obtaining a range of ideas and for various individual viewpoints” (Goodsell et al., 2009, p. 65). Additionally, participants can be susceptible due to impression management. When focus group participants want to give specific impressions, they “may be reluctant to present unbiased images of themselves” (Wooten & Reed II, 2000, p. 141).

Focus groups' answers were recorded. Additionally, notes were taken and revisited during the process. Visual aids, such as panels with colorful cards and charts representing the topic to discuss, were part of some of the focus groups. This resource is highly valuable as it keeps the group's attention, makes the exchange more dynamic, and the objective of each question asked come across easily. Nonetheless, due to time constraints, and the setting of the focus groups it was not always possible to use this.

### **5.2.3 Interviews**

According to Mills et al. (2010), there are four types of interviews: structured, semi-structured, unstructured and informal. A semi-structured interview (SSI) approach was chosen to understand both the retrospective and real-time accounts of people experiencing change. The information obtained from the interviews mainly focused on obtaining data at the individual level of impacts. Individual interviews were conducted following the focus group sessions with people who were willing to grant an interview.

Both interviews and focus groups were chosen because participants potentially behave differently due to group dynamics. Some of them would follow what others say, and others would feel intimidated in the group. Therefore, individual interviews can complement focus groups. However, it is crucial to keep in mind that women could be biased because of the responses they had just heard. On the other hand, it could be the case that they feel more confident to express themselves.

In addition to conducting interviews with EnDev project supported users, interviews were also conducted with staff from GIZ. The aim was twofold: to gain a better understanding of the project's implementation and monitoring processes and to gather their insights on gender and justice issues. As with the focus groups, individual interviews were combined with field notes and observational data, and the answers were recorded. A total of 11 interviews were conducted with members of the association and three with the personnel of the GIZ.

It should be emphasized that like all data collection methods, SSI also have limitations. Studies have revealed that during interviews and questionnaires, interviewees provide answers that are

not in line with reality, that is, what they say is not what they do in practice. Therefore, establishing trust with interviewees is crucial. This goes hand in hand with another criticism. Cultural differences regarding age, gender, religion, sexual orientation, and socioeconomic status as researchers may face difficulties in psychological access (Mills et al., 2010).

#### **5.2.4 Observations in the field**

Observational evidence consists of the notes taken on evidence observed in the fieldwork. Relevant behaviors or environmental conditions or any other event or variable of interest that is available for observation, are some examples of it (Yin, 2009). Observations can be advantageous as they can provide additional important information, for instance, “the condition of buildings or workspaces will indicate something about the climate or impoverishment of an organization” (Yin, 2009, p. 175). Since the interviews and focus groups of the present study took place in the natural setting of the case study, the opportunity for direct observations arose. Some of the observations made were the physical environment of the associations, how they do their work, how they use the technology what is the condition of it, the infrastructure and interactions among members of the association.

The data collection instrument that was developed for the interviews and focus groups was designed to record observations (see Annex B.3). As Yin (2009) suggested, a checklist was additionally developed to reduce the risk of skipping specific observational notes and to ensure consistency and completeness. Therefore, direct observations were both structured and unstructured as a checklist was followed and notes were taken as interviews were conducted (Yin, 2009).

As the author was unfamiliar with the setting of the case studies, this presented an advantage as the observations originate from a fresh perspective than, for example, GIZ staff, who have long worked with these communities and know their traditions well. It must be noted, however, that being unfamiliar with the setting does not free the researcher from basing observations on the author's subjective worldview (Mills et al., 2010).

### **5.3 Data analysis**

The responses from both focus groups, interviews, and observations taken in the field were analyzed in the same way. As mentioned, all interviews were recorded using a voice-recording device or an app on the phone. Afterward, the recordings were imported into *Freesubtitles.ai*, a free website that utilizes artificial intelligence to transcribe interviews. Following this step, the transcripts were run through a grammar and spelling correction program before undergoing a final, manual revision by the author. Text analysis itself was analyzed using the content analysis method, which is a systematic approach for organizing qualitative data and identifying key themes and patterns (Creswell & Creswell, 2018). The computer-assisted qualitative analysis software *Nvivo* was used to this end. Data were first deductively reduced, categorized (to identify concepts and themes), and organized (to identify patterns). The data were organized and analyzed using the SEM framework suggested by Bronfenbrenner as well as the energy justice framework. Qualitative analysis has the advantage of being an iterative process in which data analysis consists of a reduction and reconstruction process (Yin, 2009). This means that almost immediately after the data were collected, the analysis was performed, and the methods were adjusted to obtain higher quality information.

Although a content analysis commonly uses an inductive approach for analysis, the author kept an open mind for deductive analysis. According to Mills et al. (2010), “it is best to perceive data

analysis as an enterprise that is never entirely inductive or deductive in nature but rather a combination of both” (Mills et al., 2010, p. 751).

## 5.4 Reflection on Methodology

When conducting a thesis, it is crucial to consider the research context to avoid drawing invalid conclusions. It is important to acknowledge that the human world is not uniform and keep an open mind. For instance, in Bolivia, understanding the idiosyncrasies of rural areas is essential. Certain customs such as greeting everyone present when entering a place, accepting food that is offered, and sitting on the floor with them are significant signs of respect. Therefore, it is important to be at their level, gain trust with your audience, and be mindful of using appropriate language. All of these aspects should be considered before conducting the data collection. The author was always accompanied by staff from the GIZ, who are Bolivians and have a wide understanding of the rural and indigenous context. As such, the author took a lot of advice from them.

Another critical factor to consider is the methodology used to collect data. For example, leading a focus group takes a lot of skill, and using non-technical and simple language is essential while communicating what you want to say to get the information you want. A pilot study or validation test can help to develop skills and understand the context better. Knowing what the participants call each other is also crucial because it varies from region to region. In some regions, they call themselves *hermanas* (sisters), while in others, they call themselves *compañeras* (colleagues or partners).

However, just as Goodsell et al. (2009) pointed out, information from focus groups was not the easiest to obtain. It was not possible to get all women to give their opinions on the questions asked, probably due to a hierarchy within the associations or a certain level of cultural shyness. Reflecting back, focus groups were useful, nonetheless the most amount of information was taken from conducting personal interviews. Therefore, it is essential to evaluate the methodology used and make adjustments accordingly to ensure that the data collected is of high quality and reliable. Overall, a thorough reflection on the methodology used is vital to ensure the success of the thesis.

## 6 Findings

### 6.1 Overview of the case studies

This subsection provides a summary of all case studies. First, it is important to define and describe in detail what a rural productive organization is and represents, and how these organizations are formed in Bolivia. Rural associations could be described as an effort of people who know each other; men and women, who are generally from the same geographic region, and come together for a specific purpose. According to the GIZ staff, these associations can be political or economic in nature. In this particular case study, all associations are of an economic nature; that is, their objective is to generate income. However, their way of working is intuitive, they come together because they have a productive activity in common (for instance cassava cultivation). Normally, there is no clear strategy on how to generate real income from the activity, as said, it is intuitive, and there is frequently a lack of knowledge on how to manage income efficiently. Although this is not a rule, this is how it works in most cases. A working schedule is not established, as they work on demand or when members can attend the association (Interviewee 13). The organizations visited had some kind of legal status as a group, they had a legal document confirming their existence, although they did not have a registration as a business or enterprise that would give the organization a formal title.

According to the information gathered not all associations consisted entirely of women. However, all of them were led by a woman. Likewise, two of the associations are made up solely of women, while the others comprise a majority of women. It must be noted that on several occasions, it was observed that certain men involved in the organizations were husbands or sons of the members, actively supporting their wives or mothers in their work.

The age of the participants ranged from 15 to 65 years. Virtually all associations had a wide age range. The number of associates ranged between 25 and 30 members per association. Earnings are distributed based on hours worked; therefore, some members are not as active. Table 6-1 summarizes the information on the projects that were visited. The productive activities of the visited associations consisted of the production of cassava products, processing of llama meat, production of shampoo, creams and soaps, and elaboration of products from the dehydration of herbs. All associations had already been established before they became supported users of the EnDev project.

*Table 6- 1. Summarized information of rural associations interviewed.*

Organization	Economic activity	Technology acquired	Number of associates
1	Production, breeding and processing of llama meat	Meat tenderizer	16
2	Production, collection, harvesting and processing of aromatic herbs, spices, fruits and condiments.	Electric dehydrator	60
4	Cusi-based Shampoo and cream production	Solar-powered electric grinder	8
3	Cassava cultivation and processing	Electric cassava peeler	63
5	Shampoo and cream production	Electric mixer and blender	39

The author considers it necessary to give a brief explanation of what the cusi is since it is very native to the area. Cusi is a palm tree that is native to the Amazon rainforest. Different products can be prepared from its oil, among them the soap and shampoo that the organization produces. Additionally, the Figures show the different settings and technologies of the rural organizations visited.



Figure 6-1. Facilities of llama meat producers. Left: solar dehydrator. Right: llama meat product and electric meat tenderizer

Source: taken by the author



Figure 6-2. Electric dehydrator

Source: taken by the author





Figure 6-3. Facilities of the cusi producers. Left: solar panels installed for electricity. Right: cusi grinder  
Source: taken by the author



Figure 6-4. Women working with the cassava peeler  
Source: EnDev Project, GIZ



Figure 6-5. Left: organization facilities. Right: Electric mixer and blender for shampoo production.  
Source: taken by the author



## **6.2 Energy Justice in the Productive Uses of Energy Component**

According to the information gathered, the EnDev project does not include the term "energy justice" in its work; however, its main objective has a strong relationship with it: to provide greater access to modern energy in rural and peri-urban areas of Bolivia. Therefore, this project works in the direction of the goals and principles of energy justice and environmental justice, focusing its efforts on marginalized communities (Baker et al., 2019).

Although, as indicated in the methodology, the tenets of justice framework was selected for the data analysis, it is important to note that other aspects of energy justice were found to be relevant. Accessibility, affordability and sustainability are principles that were observed. First, the project selects efficient and renewable technologies (they work mainly with solar technologies). According to GIZ, they have quality indicators, energy efficiency and certifications that the equipment must have so that the technology being provided is efficient and sustainable.

In terms of accessibility and affordability, an assessment is conducted on potential energy consumption and its profitability concerning the economic capacity of the association. EnDev provides an incentive of approximately 20 euros per member of the association (one member per family). The objective is to lower the final cost of the technology, and the economic incentive is multiplied by the number of members, thus facilitating access to technologies that can be very expensive. The reason for not financing the total cost of technology is the appropriation and sustainability of the beneficiary group. According to GIZ staff, they and other development institutions have concluded that a contribution of money from the user translates into a higher probability that it will be sustained over time, and people will value it more (Interviewee 11).

### **6.2.1 Distributional justice**

Distributional justice refers to the equitable allocation of resources and opportunities among members of a society or organization. Distributional energy justice was observed in EnDev, as a mechanism to alleviate the unfair distribution of energy and technology in a more equitable manner, which enables income-generating activities in rural areas to benefit as they have fewer opportunities than the urban areas and poverty is most acute. By targeting these areas, energy justice can be promoted as unequal distribution of energy access is addressed. Therefore, findings are related to the performance of associations.

When asked about how the intervention has impacted business performance, all associations reported an increase in productivity, which translated into an increase in product supply and an increase in profits. Many of the interviewees indicate that they are investing the extra income they have generated in the organization (Focus groups 1, 4, 5). Indeed, many indicate that at the moment they are not saving money for themselves but have injected all the profit into improving their entrepreneurship. This has allowed three of the associations to be currently working on the expansion or construction of facilities. The associations also indicated that even product quality has improved because they now use specialized equipment. In addition, there is less waste of raw material. For example, the acquisition of the dehydrator has decreased dehydration times and therefore production is more efficient. Previously, the herb harvest had to wait longer to be processed, which caused the quality to decrease and resulted in decomposition and loss of product (Focus group 2).

One of the elements mentioned by all the associations was the savings in work time. The economic activities of rural associations are related to the requirement of a lot of metabolic

energy to be performed (Clancy & Dutta, 2005). Activities such as beating, grinding, and peeling, are those that were observed in the associations. For example, cusi-based shampoo producers had to grind the cusi with a stone, labor that took hours to perform and required plenty of physical effort, as shown in Figure 6-6. Thus, by systematizing the process, savings in production time have been reported. Some report investing that free time in other activities for the association, which has also contributed to increased productivity and improved the association's administrative processes (Focus group 3).



Figure 6-6. Women cutting cusi manually  
Source: EnDev Project Bolivia, GIZ

In summary, associations report higher productivity, enhanced product quality, labor time savings, increased profits, optimization and efficiency of work and greater management of resources by wasting less material.

## 6.2.2 Justice of Recognition

EnDev embraces elements of justice of recognition as the target population of the project are rural associations from low-income areas in Bolivia, which as commented for distributional energy justice, have fewer opportunities to access energy and technological resources in comparison to urban areas (Interviewee 13). In addition, EnDev staff mentioned that they follow an approach called “Leave No One Behind” in which special support is given to refugee camps, women, people living in poverty and all disadvantaged groups. Following this approach, the Women Energy Fund (FEM) was developed as an initiative that prioritizes one of the vulnerable groups they support: women (Interviewee 11).

Endev's productive uses component in conjunction with FEM is aimed at meeting women's productive needs. In rural areas, these needs include not only the acquisition of equipment but also the energy required to run it. All organizations receive training on how to operate the technology. However, the women mentioned during the interviews and focus groups that there is also a need to generate knowledge about business management and leadership to move forward. In this regard, GIZ staff have said that rural women usually receive less education than men, since they have to drop school at an early age because their role is at home, and many leave school to take care of their siblings and help with household chores (Interviewee 12). Moreover, a study by the Universidad Católica Boliviana indicates that, despite improvements in schooling over the last decade, by 2021, non-indigenous people had an average of 11 years of schooling, while indigenous people had an average of 7.3 years of schooling (Universidad

Católica Boliviana, n.d.). Therefore, many women do not have the knowledge on how to manage their business so that it generates real profits.

As a consequence, and as an important aspect of the justice of recognition, EnDev develops and provides training aimed precisely at business management for the productive organizations that are part of the FEM. The organizations that have participated in these complementary initiatives claim to be satisfied with the knowledge they have acquired. Those who have not received these courses express their wish to participate, as they recognize that this lack of knowledge hinders their improvement (Interviewee 2). EnDev has conducted workshops focused on capacity building such as business management, costs, income, and expenditures, financial issues, and indicates that it is developing training courses in technology maintenance, technology governance and preventive maintenance (Interviewee 12). Figure 6-7 shows a photo taken by EnDev at one of his workshops on business management for women.



Figure 6-7. Training for women in business management, FEM 2022, Organization Palacio Tambo de Chuquisaca

Source: EnDev project Bolivia, GIZ

In addition, EnDev understands that rural women have a range of responsibilities and needs that are not only limited to productive needs. Based on this, it is necessary to adapt the interventions and the support provided. Some of the considerations when planning any training or meeting are to adapt training and capacity building activities considering that women might bring their children to meetings, they have limited time to attend these meetings, and they are not used to sitting for hours paying attention to a lecture.

*" Women, not only in the countryside but also in the city, are thinking all the time: if I go to work, who will take care of my child? At what time does she eat? Does she have milk? Diapers? At what time do we pick them up from school? Who takes care of them afterward? Homework?"*

*Dinner? Besides, there's your husband, when is he going to eat? What will he eat? All those things are part of the woman's thoughts every day. Knowing this we have to design our trainings to make them possible for women to attend"* (Interviewee 13)

EnDev, therefore, recognizes and takes into account the productive needs of women, as well as other factors that may influence the way they are addressed in interventions, such as the skills to run a business. Nonetheless, an interesting aspect is that in a pre-study conducted for this thesis, the GIZ said that they consider themselves implementers and therefore did not formally monitor gender aspects. It was acknowledged that a gender vision is fairly new in their field and that this is a common problem among practitioners (Interviewee 13). For instance, it was not until four years ago that they developed their gender policy and since then, the organization has made efforts to incorporate a gender mainstreaming and transformative approach to their projects.

However, EnDev is aware that their interventions may be benefiting the organizations as a group, but there exists a possibility of adverse consequences on women's individual lives. For instance, a few women reported experiencing domestic problems with their spouses due to the time they allocate to the association's activities. According to the interviewees, such issues arose distrust and discomfort. As an illustration, one woman recounted how she had to pick up her friend when it was her turn to work at the association. She did this to show her partner that it was true that what she was going to was an association gathering. She needed approval from her partner to go out (Interviewee 9).

*"...we hope to "do no harm" because sometimes you think that you're implementing some measures and these are going to make women's lives easier, but it can happen that in reality, you are complicating their family life"* (Interviewee 13)

Understanding the potential for these interventions to both harm and benefit women is a matter of justice. Interventions in productive uses of energy have the potential to propagate change in household power dynamics "when coupled with men's thoughtful and supportive engagement" (Serra et al., 2023, p. 85). From the GIZ point of view, information and data that unveil the factors and implications of how interventions impact is considered essential for the improvement of all projects towards sustainable development and gender equity. Therefore, to achieve real transformation in terms of gender equality it is necessary to address the multiple factors that contribute to gender inequality in households, communities and society at large. Researchers have argued that a development organization needs to move beyond providing income-generating opportunities and adopt a more holistic approach that encompasses various aspects of well-being (Serra et al., 2023). This also requires involving both men and women instead of solely focusing on women.

### **6.2.3 Procedural justice**

The justice of recognition paves the way for procedural justice, as recognition and acknowledgment of vulnerable groups and their necessities are the starting points for implementing procedural justice concerns. Two main elements of procedural justice came up from the data analysis: fairness in the decision-making process as well as distribution of necessary information.

#### **Participation in the process and consultation**

The involvement of women in the project design and implementation process is primarily attributed to the fact that the associations are the ones to request support for the project on



their initiative. Thus, the associations have to take organizational steps to present a formal request. Then the GIZ carries out a field assessment to determine the functioning and type of association as well as the accessibility of energy. In addition, the supported users are consulted on their perspectives, needs and concerns, thus their opinions are considered prior to the selection of technologies. As a result, the project not only ensures a fair process by including the stakeholders but also facilitates the selection of a technology that is suitable and well-received by the association.

*“With FEM, we are trying to prioritize a little from the issue of technological innovation or at least that the technology is more adapted to women, to their physical needs. Sometimes the technology is very heavy, very large, it is physically very difficult to operate, so there have been some adaptations to make them more ergonomic or adapted to the processes that women need”*  
(Interviewee 11)

A relevant element of procedural justice that was seen in the EnDev project is co-design. Co-design basically consists of designing the technology from scratch or adapting some already existing technology (adaptive technological innovation), for the specific necessities of the users (more ergonomic for example) and of the product. For example, in one of the places visited, a workshop was held where the women participated in the process of selecting the material for the machine, suggested using solar panels to generate electricity and were also consulted about the processing capacity (Interviewee 5). Figure 6-8 is a photo taken of the organization during this consultation process.



*Figure 6-8. Consultation process for the design of the cusí grinder*  
Source: EnDev project Bolivia, GIZ

This element within procedural justice is essential since it has been seen in other studies that without the input of female users, the acceptance and appropriation of the team have not been successful (United Nations Development Programme, 2001). Thus, the project considers elements of procedural justice by including all partners in the design and implementation stages. This is done with the vision of fully understanding the needs of women.

## Access to information

The first aspect evaluated regarding access to information was whether the supported users were provided with sufficient information to ensure that the women could use the machine effectively. Members reported that when they went to install the technologies, they were given training on how to operate them. When asked about maintenance, some indicated that they were taught how to clean and receive information about the warranty. Overall, they did not have much knowledge of the problems that could potentially occur. The GIZ staff confirmed that they, or the institution installing the machine, are obliged to provide training on how to operate the technology. However, they mentioned that it is common that at the moment of training, not all members are present, or women send their daughters or sons because they do not have time to assist.

The majority of the rural organizations affirm that they have not encountered any issues with the machines, and in case they do, they are aware of the appropriate channels to address the problems. Thus, they possess the necessary knowledge and skills to handle such situations. Nonetheless, there was a particular incident where it was brought to attention that the solar panels were not providing adequate energy supply at a certain point. Although the organization was uncertain about the exact nature of the problem, they did suspect that the batteries were the problem. In addition, they said that they were left with a manual to consult, however, the manual was written in English, which no one speaks in the community. In the communities where access to electricity was limited or there was no access to it at all, the optimization of the energy supply and consumption is still a relevant issue. It should be mentioned that EnDev has a monitoring plan in which when a problem is detected, help is usually provided by putting the organization in contact with a partner who can assist them with what they need.

The second aspect observed has to do with access to information on credit-related. Enabling rural associations access to information about credit opportunities and the best ways to invest in energy efficient solutions as well as accessible and sustainable technologies relate to procedural energy justice. Many women in Bolivia are unaware of available microcredit systems, especially those who have not lived in urban areas (Interviewee 12). Moreover, accessing credit for equipment investments can be challenging for these associations as the financial institutions ask for requirements that are not easy to comply with (such as legal documentation and high interest rate). Another additional point is that in Bolivia financial institutions provide mostly individual loans (a single person is responsible, in the name of the company or group). Very little has been seen so far of associative credits so that it is not just one individual who bears all the responsibility (and risks, punishments, penalties, etc.). Therefore, associations often turn to well-known institutions such as GIZ for assistance. When asked about their access to credit, some associations were not aware of it as an option and only viewed their bank accounts as a saving tool (Interviewee 13).

*“The financial system is very much in the urban area and has not realized the potential that can have in the rural area. Although, in rural areas, you can't have the same requirements, times or rates.”* (Interviewee 13)

## 6.3 Impacts of access to clean and modern energy and technology

As previously mentioned, to understand the effects and impacts of access to clean and modern energy and technologies on women in the rural Bolivian context, female associates of rural organizations were interviewed. Questions were asked to obtain women's perspectives and to gain an idea of what this implied in their lives both within the organization and their households and for themselves. Based on the data analysis, a SEM model was developed which is

represented in Figure 6-9 to illustrate the impacts detected at each socio-ecological level. In the following subsections, a more detailed explanation of these effects will be provided. By understanding these impacts, valuable insights can be gained into the role that these energy interventions can play in improving women's lives.

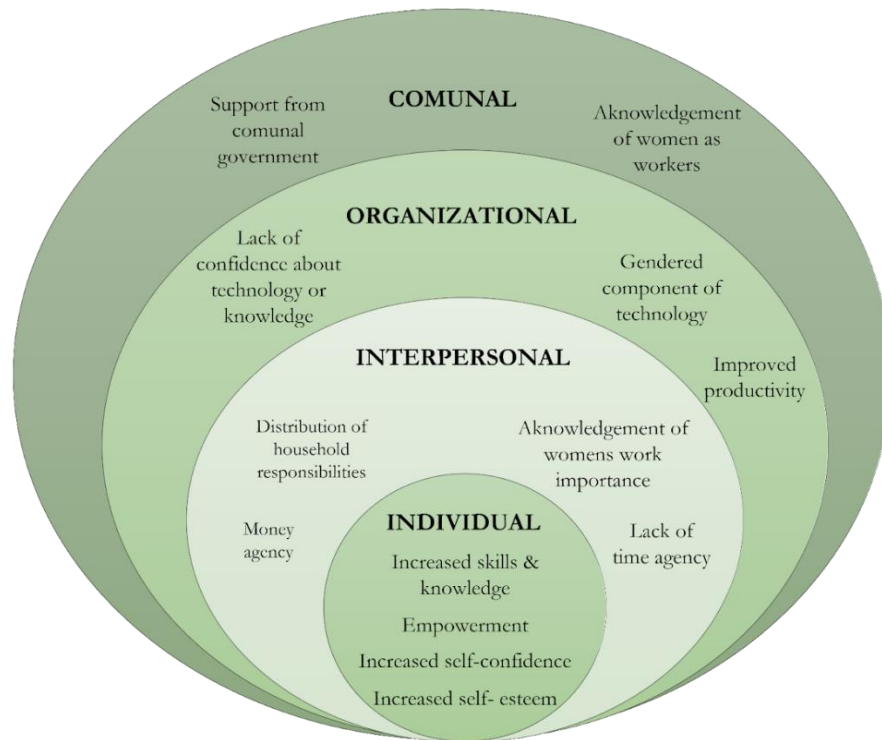


Figure 6-9. Socio-ecological model of the impacts of clean and modern energy and technologies on rural women in Bolivia

Source: Own work

### 6.3.1 Individual impacts

To capture insights at the individual level, respondents were asked to reflect on the impacts of these technologies as a woman, whether being in contact with technology and the changes that have arisen around it have had any effect on a personal level. The women's answers reflected a high level of satisfaction with the machine and reported a positive influence on their lives and how they perceived themselves. However, it should be noted that this aspect is determined by the fact that all projects have had a high level of technology appropriation.

To describe the effect this intervention had on them personally and as women, the interviewees used the terms empowerment, self-confidence, and self-esteem. Most interviewees pointed out increased income as a cause of their sense of empowerment. Several studies indicate the benefits and positive relationship between increased income and asset ownership in women. Among them, increased agency perceived empowerment and self-confidence have been highlighted (Serra and Davidson, 2020; ENERGIA, 2019). In this regard, interviewees stated that:

*"More empowerment within the household, yes. More decision-making. I'm going to buy this or this because it's also my money." (Interviewee 9)*

Thus, this financial opportunity has allowed rural women in Bolivia not only to actively contribute to their household income but has also given them the freedom to invest the money as they want. Since many of them were housewives before joining the association, they indicated

that they have always had to ask their husbands for money to buy personal things. The women were happy to say that they can now buy their shoes, makeup and “*things that women always need*” (Interviewee 10). They said they did not feel comfortable asking their husbands for money and one of the women interviewees even said that now “without fear” she could go and buy what she needed.

The statement above could be misleading since it suggests that there is an increased agency in money management. Not only do women feel more empowered to contribute to their households, but also have been given an opportunity to invest money in themselves. However, not all women have this option to save and spend money on themselves, although they demonstrate a desire to. Their low-income context simply does not allow them to do so: “My husband works anyway, but it's not enough. And even though I work” (Interviewee 2). In addition to the context of poverty, another reason for only giving the money earned to the family is that women are always thinking about their families and perceive that women bear the greatest responsibility within the housework (Interviewees 4,7,9).

However, all of the interviewees indicated that they manage their own money. None of them give money to their husbands. In their report on gender equality and development, the World Bank (2012), showed that in Latin America in many cases, women are obliged to give their earnings to their husbands. Although, in the present Bolivian case study, this circumstance was not evident, considering as well that the data come from two different geographic zones (the highlands and the subtropical zone). On the contrary, women report maintaining a joint fund with their partners and, in some cases, saving a little money for their personal expenses.

Owing to the time savings in processing the products, the women were asked in what ways they used the time that was freed up. This was done in order to understand whether there is any increase in time agency (ownership and decision-making on how to manage one's time). Most of them mentioned that the time available was used for household chores such as washing, cooking, and taking care of domestic animals (such as cows, sheep and llamas, an activity that demands a large amount of time and effort). Other less frequent responses were the use of their time for other generating-income activities, mainly selling fruits, vegetables, or cosmetic products. Leisure activities were not mentioned at any moment, and some even claimed that there was no time available to rest.

*“I go home, do laundry, and all that. There's no free time”* (Interviewee 5)

On the other hand, the acquisition of knowledge and skills for managing entrepreneurship and handling technology have also influenced women's empowerment and self-confidence. This transformative effect was reported by several women claiming that, in the beginning, it was difficult for them to interact with technology because they were afraid to manipulate it. They felt that they were not capable, even one of the interviewees said she felt useless. Nonetheless, they currently have no problem operating any machine or technology and understand their functionality.

As women see their efforts materialized, interaction among the members of the association is enhanced and they feel more encouraged and motivated to continue growing. In this sense, the intervention has helped to strengthen the entrepreneurship and give it greater stability. Consequently, the association becomes a comfortable place and generates a safe space for women. According to the GIZ staff, rural women have a strong sense of friendship and support for each other, more than in urban areas (Interviewee 13). However, due to women's lack of time agency and gender norms of always taking care of everything related to the house, they do not have the space to relax and talk about themselves and their problems. Therefore, the associations open up this space of companionship and venting their problems, which are



strengthened by these interventions. One of the interviewees referred to the association as her "second home" implying that it creates a place where women feel freer and can talk and share their problems:

*"We call this our second home because we come here and some women talk about their problems at home, we all unburden ourselves here. We support each other so we can go back home with strength, and say I can do it, I have to keep moving forward. So we feel freer"* (Interviewee 6)

### 6.3.2 Interpersonal impacts

As highlighted above, societal and familiar role expectations regarding gender roles may be quite limiting, particularly for women. In the Bolivian rural areas, women are expected to stay home, take care of their husbands, take care of their children, do all housework and, as is usual in rural areas, take care of their livestock. Nonetheless, women who engage in income-generating activities have an opportunity to change their status within their household and bring about change in gender relations (ENERGIA, 2020). In fact, in conversations with the EnDev project staff this is their vision and the gender impact they would expect to have with their projects:

*"We hope that their income and their positions at the household level will improve. That it frees up their time, that they will have more money now, and will bring more money to the house, so maybe their position will improve a little bit. This is aimed at transforming the roles and relationships of the general household and women in the community"* (Interviewee 11)

The results show two manners in which the gender dynamics within households are impacted. On the one hand, some women indicate that once they have managed to generate income their partners have become supportive and more understanding since previously the family dynamics did not develop in this way. Some women said that, at the beginning, their partners accused them of wasting time. Most women reported feeling supported by their partners and emphasized that without this, it would not be possible for them to be part of the association. The supporting ways mentioned are childcare, more equitable distribution of housework to a lesser extent, and the recognition of women's work outside the home as valuable.

*"And we also feel the support of our husbands. Before they used to say to us that we were wasting our time. But now they support us"* (Interviewee 6)

On the other hand, despite the apparent support and willingness to change, it is clear that progress has been made but inequality at the household level persists. When delving more deeply into this topic, women highlighted the fact that housework and childcare responsibilities still overwhelmingly fall to them and some even feel that this is the natural order of things. As one of the interviewees stated: *"it's really more the mom who does the housework isn't it? He is the one who is more dedicated to bringing home the economic part"* (Interviewee 4) Additionally, there are other women who said that there is still a long way to go, and report ongoing struggles with their partners when it comes to participating in outside activities such as joining an association.

Another impact identified was an increase in status at the family level. Women perceive that their family members appreciate the effort women make and support them to move forward because they see that they are being successful. This directly influences the sense of empowerment and self-esteem of women.

*"It encourages you, they cheer you up, they congratulate you and like that's a plus that you get. And you feel happy"* (Interviewee 9)

### **6.3.3 Organizational impacts**

Impacts at the organizational level were not evident in all associations in terms of gender dynamics, as some of them comprised only women (or mostly women). Likewise, it was mentioned that often men who were part of the associations consisted of the partners' husbands, sons, or brothers of women.

However, in the case of two organizations, it was interesting to observe and note that although there was only one man present at the time of the visit, they were the ones who showed and explained the production process as well as the technologies. Indeed, in one of those cases, it was the man who had all the data on wastage, operation, and parameters, and he was the main person in charge of the machine. Related to this, the women of the cassava peeler laughed as they recounted that at the beginning when the technology was acquired, they were afraid to even touch the equipment, so they appointed a man to carry out the tests. Despite this, women currently say that they feel comfortable doing everything.

It was observed (in these cases) that women relied on men to explain the technical details. From the author's perspective, in these specific situations, men felt more confident than women in engaging in conversations about technology. This does not mean that women were dependent on men to operate technology and energy, or that they do not know how to use it, but rather that they do not feel comfortable enough and feel insecure about their knowledge.

Another aspect of the organizational issue is that younger women feel more confident about using machines than older women do. Older women comment on how the younger ones are much better at handling technology. This situation is evident in all generations worldwide, since, in general, younger generations have grown closer to technology, and rural Bolivia is no exception. Therefore, it is easier for young women to understand how energy and equipment work. However, this does not suggest that only younger women should be in charge of the new technology, but rather that detailed and reinforced training should be applied considering the age of the women. Although it is not part of the cases analyzed, it is worth mentioning the case seen in the pilot plan. The reason why the women were not using the machine was because the members who knew how to operate it were no longer active. Although the women had received training on how to use the machine, they did not fully comprehend it and felt hesitant to attempt to use it. They mentioned that younger women were more skilled at handling the machine, but the older women were afraid to even try due to lack of confidence.

### **6.3.4 Communal impacts**

At the communal level, the main subject to explore was whether participation in the EnDev project and the acquisition of technology and energy changed the relationship of the community (meaning the place where they live because of geographical reasons) with a women's association in any way. Two themes emerged: the community's perception of the association, and the level of involvement and inclusion of the association in community activities, such as having a voice and vote in neighborhood councils or being invited to community events and community fairs.

On the one hand, some indicated that having "more machines with energy" made them visible as an association in the eyes of neighbors, community institutions, and even the mayor's office, since in the past they had never taken them seriously. As a matter of fact, access to the technology has allowed them, as already mentioned, to strengthen and grow as an association. For the associations, this implied increasing their networking and an opportunity to reach more markets.

*"We were never taken into consideration, we had little support. In spite of this, we kept working and moving forward. Now, this year's authorities have given us their support (...) Yesterday they even came to name us godparents for the school's celebration. But other years we were never given importance"* (Focus group 4)

On the other hand, other organizations have said that there has been no real change and that they have tried to arrange meetings with the authorities, but they do not want to meet with them. Unfortunately, they perceive that while small producers are usually not given much support or importance, this is intensified in their case because they are women. In other words, the results show that an association made up of only women seems to be a determining factor in terms of visibility and relevance given to it at the community level. This is evidence that women perceive and feel marginalized at the community level.

As an anecdote, one of the interviewees told how small producers and especially those who are women are disregarded. And even how the authorities have taken advantage of them. She tells how the local government and the mayor asked their association once to make a demonstration plot for the Ministry of Productive Development and that "they have taken pictures and attributed the work as if it was done by themselves" meaning that they did not give credit to the work done by the association without the help of the authorities (Interviewee 3).

*"We also need the authorities of the village itself to recognize their women who are producing. That is still missing"* (Focus group 5)

Finally, in the Bolivian rural context, there is a strong sense of cooperation not only among the members of the community itself but also between communities (Interviewee 13). The growth that the associations have had together with this visibility has reached the ears of other communities. Some associations allow people from different communities to use their facilities and equipment, or it is simply people from other communities who provide them with raw materials. Thus, the benefit of generating a little money is extended to other communities as well, and recognition of women's entrepreneurship is enhanced.

## 7 Discussion

### 7.1 A path to promoting energy justice in PUE

The EnDev project's provision of access to energy and clean technologies for rural women's organizations supports the promotion of energy justice in Bolivia. Particularly, three of the eight principles of energy justice proposed by Sovacool & Dworkin (2015) were particularly noticeable in the EnDev project: affordability, accessibility and sustainability. First affordability by reducing the price of technologies necessary to run the business. Second, accessibility by providing the energy necessary to supply the needs of the business either by connecting to the grid or by providing solar energy. Third sustainability since the entrepreneurship project promotes the use of solar technologies and bases the choice of technologies on energy efficiency criteria.

The findings suggest that the implementation of technology and energy in rural women-led organizations has resulted in improved performance, productivity, and profitability of the economic activities they perform. This approach ensures equitable access to energy and technology, allowing these associations to compete on a more leveled playing field and promoting economic growth in areas with acute poverty. These findings fit in the realm of distributional justice as outlined in the works of McCauley et al. (2019) and Jenkins et al. (2016) which emphasize the importance of equitable access to resources for all individuals and communities.

A very visible and widely applied energy justice component is the justice of recognition. The project has a strong awareness of the needs of rural women and makes an effort to understand each project individually. Recognizing the vulnerabilities of a group and providing them with economic incentives is insufficient. The justice of recognition is not only about identifying those who are the most vulnerable but also about jointly analyzing and understanding their needs in order to adapt the interventions to them, deeply reflecting on where injustice emerges (McCauley et al., 2019; Feenstra & Özerol, 2021). For instance, acknowledging that women's rural organizations in Bolivia have meaning beyond profit generation for their members is crucial for the EnDev project. According to the findings, being part of the organization gave women a sense of safety, empowerment and motivation, while also providing additional income. It has been pointed out in the literature that women's motivations to run enterprises are often driven by necessity rather than ambition, and even considered this a constraint to growing the business (ENERGIA, 2018). Whether women are driven by necessity or ambition, the understanding of the role of women's organization is crucial for EnDev for ensuring that energy interventions in PUE are designed to meet their specific needs and aspirations. This suggests that energy justice research and also interventions should go beyond simply recognizing vulnerable populations toward providing economic incentives to address their needs.

Elaborating further on the issue of recognition, the findings show that the women interviewed are generally less educated and therefore need extra support to fully benefit from interventions. Serra et al. (2023) indicate that in these contexts there is a systemic gender inequality in education which results in a low level of human capital (knowledge and skills of individuals that are valuable in economic activities) among women and girls. The research results align with other studies that encourage the fact that capacity building matters and it can help to overcome gender-based barriers to participation and ensure that rural women do not limit their potential to benefit from modern energy technologies success (Clancy & Dutta 2005; Terrapon-Pfaff et al., 2018; United Nations Development Programme, 2001). However, it is important to recognize that there are several complex factors at play, which must be considered in the design and implementation of capacity-building initiatives. These may include cultural norms, lack of

access to financing, and limited access to markets, among others (further elaboration can be found in subsection 7.3).

The procedural justice component also has a strong influence on the EnDev project, especially because it incorporates the voice of stakeholders in the project. Procedural justice has three main pillars: access to information, meaningful participation and decision making and access to justice (Moniruzzaman & Day, 2020). Of these, equity in the decision-making process and a participatory approach stand out in EnDev. On the one hand, training, maintenance, and access to manuals are key components to ensure that the technology is used effectively. On the other hand, co-design and exhaustive field visits make EnDev's approach successful. User input increases acceptance and ownership of the technology.

## 7.2 Uncovering the gendered impacts in PUE

Literature suggests that the acquisition of energy and technology for productive uses benefits communities, families, and entrepreneurship. Among these benefits are individual and economic empowerment, self-confidence and more participation within their communities (Clancy & Dutta 2005; ENERGIA, 2020; Glemarec et al., 2016; Pueyo & Maestre, 2019). By providing significant social and economic benefits such as income generation, empowerment through the acquisition of technical skills, women's status in the community and household rises (United Nations Development Programme, 2001). The results of the fieldwork did not deviate from the conclusions of these studies. As can be inferred and understood from the results, women referred to a series of positive impacts at the individual, interpersonal and communal levels. Specifically, the women perceive themselves as more empowered, with increased self-confidence and self-esteem. This finding is consistent with previous studies that have shown that the benefits of such interventions are significant in terms of increasing women's self-confidence (Sahraikorpi & Bandi, 2021; United Nations Development Programme, 2001).

Two main factors were identified as contributing to women's sense of empowerment. Firstly, the increase in income resulting from the augmented performance of entrepreneurship has given them greater financial independence. Secondly, the sense of being able to manage a productive organization together with other women. The collective nature of the organization allowed them to support each other and further contribute to enhancing their self-confidence. Additionally, and considering the interactions of the SEM, these individual-level impacts interact with the other socio-ecological levels, influencing each level as well. Thus, an increase in decision-making at home and an improvement in the perception of status within the family and even at the community level is evidenced. In other words, the sense of empowerment is related to the enhancement of socio-economic status. When compared to literature, other studies on the impacts of access to energy and technology on women have also concluded that an increase in income can improve women's status not only in their intra-household environment but also in society (Clancy & Dutta, 2005; ENERGIA, 2019; United Nations Development Programme, 2001).

In this regard, it is important to delimitate the context of these projects. The associations involved were not newly established businesses, women came from low-income families but they possessed numeracy skills and were able to read and write. Moreover, some of them had completed formal education and even received technical training. In addition, these organizations included young women members who are more familiarized with social media and technology in general. The author and GIZ staff were impressed by the interviewed women's level of awareness regarding gender equity and the utilization of terminology such as empowerment. Thus, it can be speculated that the impacts described above could be conditioned not only to the fact of the intervention but also to the level of education of the

women. This could have even been potentiated by a gradual shift in mentality in rural areas, potentially due to awareness campaigns conducted in Bolivia (as stated by EnDev's project coordinator; Interviewee 13).

Therefore, the positive impacts observed in the improved distribution of household chores, financial decision-making and greater individual autonomy cannot be solely attributed to the EnDev project interventions. Rather, these transformations are influenced by a combination of contextual factors embedded within societal shifts that typically require a lot of time to manifest. As a matter of fact, research suggests that women's empowerment is a complex and nuanced concept, and access to energy and technology serves as one of many components that enhance agency (Clancy & Dutta, 2005; Glemarec et al., 2016). As such, analyzing the local context and taking into account specific socio-cultural, economic and educational dynamics are crucial because it allows implementers to design interventions that are tailored to the specific needs, challenges and opportunities of the community. Among the contextual factors, the educational level, awareness campaigns, access to a smartphone, radio and television also provide more insights to rural women along with the work that some support institutions or NGOs may have done on awareness of gender issues in rural communities. By understanding the local context, interventions can be better aligned with existing social structures and practices, increasing the chances of acceptance.

Lastly, taking a look at the findings at the organizational level, it was already stated that observations were mainly on the performance of the associations rather than on gender dynamics. This may be attributed to the fact that most of the associations are composed of women and are often led by women, so there has always been an important role for women. However, on two occasions (when there were men present), men took the lead when talking about technical details suggesting that technologies have a gender component. This could be the reason for the dynamics generated during the conversation, the usage of energy technologies and technologies in general display rooted gender norms, as women tend to underestimate their knowledge and abilities (European Institute for Gender Inequality, 2020). Moreover, studies on gender patterns in the use of technology indicate that women experience feelings of fear and failure and doubt their abilities in technology management (Goswami & Dutta, 2015). These gender-based barriers could limit women's ability to access other economic opportunities and hinder their participation in the decision-making process related to energy and technology. Therefore, it is crucial to address this issue to promote energy justice, again with an emphasis on providing gender-sensitive training and support that promotes women's leadership.

### **7.3 Remaining challenges preventing interventions' benefit**

As discussed in the previous subsection, the impacts of access to clean and modern energy and technology can benefit women and the environment they relate to. Nonetheless, the findings revealed that women still face underlying challenges that hinder their ability to fully benefit from these interventions. Some of these challenges have already been mentioned in this section, such as the lack of education that some women have, which makes it difficult for them to operate technology or manage a business more efficiently. Another one is the lack of local recognition of women's organizations and them as producers, which prevents them from accessing more help to continue growing. Interviewees claimed that, they have not been taken into account for activities within the community due to being a women. Local authorities do not give them importance, so they are not able to make themselves known or obtain local support.

Researchers examining links between energy access and technology and gender have found several barriers. These include access to credit, which was briefly touched on in the findings, differences in access to skills and education, unequal distribution of care responsibilities,

agency (low decision-making power) and low access and control over resources (ENERGIA, 2018; Glemarec et al., 2016; Serra et al., 2023). The following paragraphs will elaborate further on these challenges observed.

A highly evident challenge, which was already pointed out in the findings, was the lack of time-agency women experience. Studies have consistently shown that women often bear disproportionate responsibilities for domestic work in comparison to men (Eissler et al., 2022; Glemarec et al., 2016). In the present research, it was evident that the additional time they earned due to increased efficiency in their activities at the organization ended up becoming a trade-off with their household chores as well as with other activities of the organization. This trade-off demonstrates the complex dynamics of energy justice, in which access to energy and technology may alleviate some burdens but can also introduce new challenges and conflicts related to the allocation of time and responsibilities. Addressing these challenges requires a comprehensive understanding of energy justice that incorporates gender perspectives. It involves not only providing access to energy but also ensuring that the benefits are distributed in a way that empowers women and allows them to participate fully in decision-making processes, alleviating their domestic workload.

Moreover, linked to the lack of time agency is the gendered division of labor. This refers to the unequal distribution of unpaid care work, such as cooking, cleaning, and taking care of the children. Hereby, the results suggest that these are tasks carried out primarily by women (Eissler et al., 2022). According to literature, women in the energy field tend to increase their domestic responsibilities once they have access to energy. This phenomenon is influenced by gender power dynamics and local gender norms that dictate how women should allocate their time (Eissler et al., 2022; ENERGIA, 2018; Pueyo & Maestre, 2019). However, other factors, such as socioeconomic status can also influence women's behavior. For instance, many of these women have limited financial resources due to living in low-income contexts, coming from traditional family structures or having children. As a result, it is argued that their potential increase in time agency is limited by their socioeconomic context of poverty too.

The internalization and normalization of gender roles – along with a lack of time agency, knowledge and skills – are significant barriers that prevent women's ability from benefiting from access to clean and modern energy and technology. These challenges may limit women's opportunities to engage in the organization's activities, as they face significant constraints in balancing their household and caregiving responsibilities with other pursuits. Additionally, some women face resistance from their male partners or other family members who may not view such activities as relevant to women's traditional roles. This can further perpetuate gender inequalities and hinder women's economic empowerment (ENERGIA, 2018; Winther et al., 2020).

Considering the consequences and impacts as well as the challenges of energy and technology access, the potential for these interventions to impact women's lives beyond improving business performance becomes relevant as it could address the root causes of gender inequality. Thus, by implementing and reinforcing through parallel interventions such as training and leadership programs, different socio-ecological levels are impacted consequently empowering and benefiting women by creating opportunities for greater gender equality. Clancy & Dutta (2005) came to a similar conclusion, highlighting that the mere provision of energy technologies is insufficient to empower women. Instead, it is the process and outcomes that result from this accessibility that can have a transformative impact on women's livelihoods.

## 7.4 Final reflection: Beyond the three tenets of energy justice

Effective implementation of technology and energy access for women requires parallel training efforts to accompany such interventions. It is essential to contextualize where such projects will take place and work in conjunction with women to achieve optimal results (ENERGIA 2019). It is not feasible to assume that immediate benefits will result from technology access or that technology alone will lead to benefits, as this is a process rather than a simple outcome. Authors have also pointed out that the expectation that a single technology will bring about women's empowerment and better life quality is somewhat unrealistic. (Clancy & Dutta, 2005; Winther et al., 2020)

On the same line, this study also argues that the expectation that a single technology will bring about energy justice is unrealistic. Reflecting further on the findings from both frameworks used, the author realized a few limitations of the energy justice framework. While it focuses on ensuring that all individuals and communities have access to affordable, reliable, and sustainable energy, it was evident that it does not fully address the gendered and intersectional dimensions of energy inequalities (meaning how energy access and use are shaped by factors such as race, ethnicity, class, age, etc). These were more evident when analyzing impacts with SEM and of course, adding the gender dimension to the analysis. In his critique, Tornel (2023), shares a similar perspective by emphasizing the limitations of the energy justice framework in its tendency to impose a Westernized understanding and implementation of justice.

Additionally, the author agrees with Bell et al. (2020) who discusses that the energy justice framework does not fully account for the gendered division of labor and the importance of care work, which can limit women's ability to access and benefit from clean energy technologies. Therefore, the use of SEM has the potential to add an intersectionality perspective and to feed the energy justice framework by analyzing how different identities and experiences intersect with energy and technology access. In resonance with the call by Mejía-Montero et al. (2023) to include the concept of intersectionality in a decision-making framework such as energy justice, the author believes that when considering the intersectionality of individuals and communities, energy justice can become a more inclusive and effective framework for promoting equitable and sustainable energy systems. As such, the approach used in this research by analyzing impacts through a SEM contributes to expanding the conceptual framework of energy justice to include intersectionality and socio-ecological factors and also highlights the importance of including the gender dimension in any energy project.

Drawing on this critique, the author suggests an improved approach to understanding the gendered impacts of energy and technology access by combining the energy justice framework and the socio-ecological model. This way the intersectionality perspective would be incorporated in the energy justice framework. This proposed framework acknowledges that gender dynamics can vary significantly based on social, economic, and political contexts, as well as the diverse identities and experiences that influence access to energy and technology. The key idea behind this framework is to consider all socio-ecological factors in assessing each aspect of justice, thereby encompassing individual and socio-environmental considerations. With this framework, the author aims to emphasize the need for targeted strategies, interventions and policies that not only ensure the traditional equitable distribution of energy resources but also address gender biases and promote inclusivity.

A visualization of the proposed framework is presented in Figure 7-1. The diagram depicts a circle divided into three quadrants, symbolizing the principles of energy justice. Each quadrant encompasses concentric circles representing socio-ecological levels. According to Bonfenbrenner's explanation, these levels interact with and impact one another (Rosa & Tudge,



2013), as denoted by the gray arrows. Consequently, the interpretation of the figure suggests that a comprehensive understanding of energy justice necessitates analyzing all socio-ecological levels. This approach enables scholars as well as practitioners to comprehend the various forces that influence behavior and the effects of interventions across all levels.

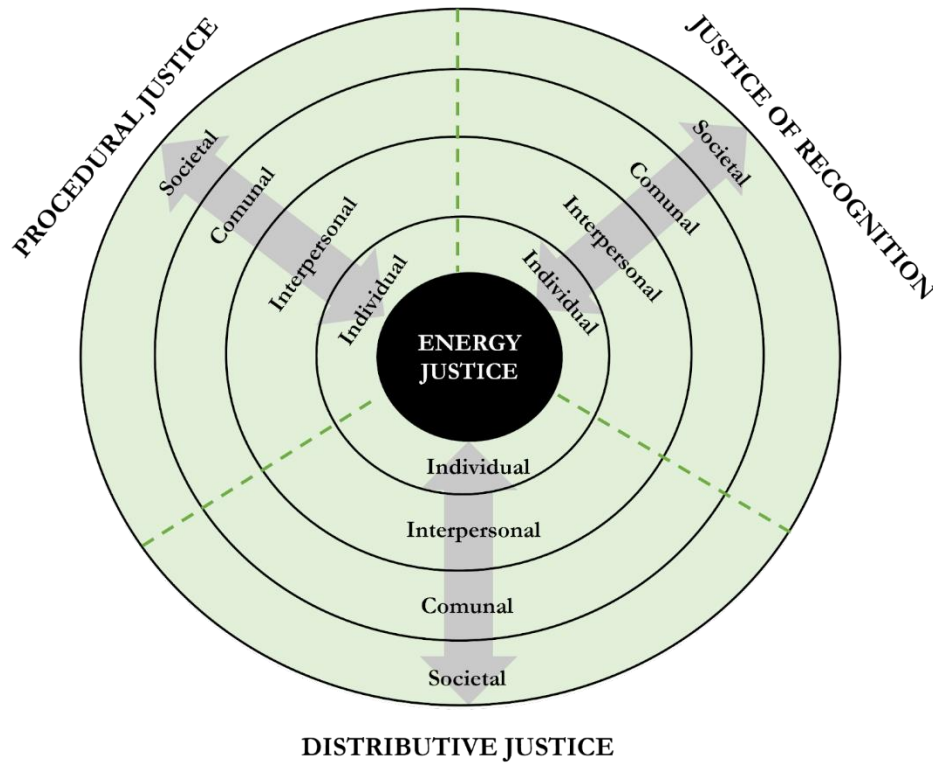


Figure 7-1. Proposed combined framework: Integration of the Energy Justice Framework and Socio-ecological Model

Source: Own work.

Table 7-1 below provides a few examples of factors/impacts that could be potentially considered to guide an analysis using the framework. The factors presented in this table draw upon the author’s personal experience and existing literature, serving as an illustrative example rather than rigid guide. Researchers must recognize the uniqueness of their own context and identify relevant factors accordingly.

Table 7- 1. Guideline on factors or impacts to look for when using the proposed framework

Socio-ecological level	Distributional	Recognition	Procedural
<b>Individual</b>	<ul style="list-style-type: none"> <li>• Income level</li> <li>• Affordability and accessibility of energy</li> <li>• Access to infrastructure and economic opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Recognition of marginalized groups, such as women and LGBTQ+ individuals</li> <li>• Societal norms and biases</li> <li>• Stereotypes, and cultural attitudes toward specific groups</li> </ul>	<ul style="list-style-type: none"> <li>• Access to information, knowledge, and decision-making power, which may be influenced by factors such as education level, agency, personal empowerment</li> </ul>
<b>Interpersonal</b>	<ul style="list-style-type: none"> <li>• Intra-household dynamics</li> <li>• Decision-making power</li> <li>• Gender division of labor</li> </ul>	<ul style="list-style-type: none"> <li>• Gender roles, expectations, generational dynamics and cultural practices that limit women’s contribution to energy related activities</li> </ul>	<ul style="list-style-type: none"> <li>• Gender dynamics affecting women’s decision-making in energy related matters.</li> <li>• Intersectional challenges that individuals face within families</li> </ul>
<b>Communal/ Organizational</b>	<ul style="list-style-type: none"> <li>• Support to women-led-businesses and cooperatives in PUE</li> <li>• Economic opportunities and hiring practices for women and marginalized groups</li> </ul>	<ul style="list-style-type: none"> <li>• Recognition and protection of marginalized individuals</li> <li>• Need for mentorship and leadership programs in the energy sector for marginalized individuals</li> </ul>	<ul style="list-style-type: none"> <li>• Inclusivity of decision-making structures, community engagement practices</li> <li>• Access to forums and spaces that address that prioritizes marginalized groups</li> </ul>
<b>Societal</b>	<ul style="list-style-type: none"> <li>• Policies and regulations that promote equitable access to energy resources across regions and populations.</li> <li>• Availability of subsidies and financial incentives for marginalized groups</li> </ul>	<ul style="list-style-type: none"> <li>• Policies and regulations that prioritize the needs and rights of marginalized individuals in energy systems and decisions making</li> </ul>	<ul style="list-style-type: none"> <li>• Laws and regulations that mandate inclusivity and participation.</li> <li>• How systemic biases are addressed in energy decision-making at the societal level</li> </ul>

## **8 Conclusions and future research**

### **8.1 Conclusions**

Energy interventions of access to energy and clean and modern technology have been shown to provide benefits to women in rural areas. While most gender in energy research primarily focused on the household level and the distributional, recognition and procedural aspects of the impacts, evidence suggests that women can also benefit from interventions in productive uses of energy. The results of this thesis support such claims: access to energy and technologies not only improved business performance but also provided women with a sense and feeling of empowerment, self-confidence and self-esteem.

The implications of these impacts for women at different socio-ecological levels can be significant, as access to energy and technology can challenge harmful gender norms and encourage gender equality. At the individual level, women can experience increased self-esteem and self-confidence, and at the household level, there can be a more equitable distribution of household work and caregiving responsibilities. At the community and organizational levels, empowering women and promoting gender equality can enhance their status and promote a more equal society.

Overall, one of the main findings is that when women are provided with appropriate opportunities, they are willing to work, acquire new skills and are able to perform in the field of PUE. However, in order to realize their potential, women require comprehensive support, including capacity building in technology, business skills, leadership skills; marketing knowledge and access to finance. Furthermore, they must be supported in overcoming societal and cultural obstacles such as limited literacy, restricted access to finance, education, and the burden of caregiving. Failure to invest adequately in overcoming these challenges is likely to perpetuate poverty and gender inequality. Notably, any energy intervention in rural areas has the potential to be transformative of power dynamics and gender norms. However, parallel interventions in conjunction with energy projects that impact different socio-ecological levels, could be particularly useful to empower and benefit women while offering greater opportunities for more gender equality and therefore a more sustainable development.

The EnDev project actively works towards promoting energy justice by addressing its various aspects such as distributional, procedural, and recognition justice. It is committed to promoting fair access to modern energy and technology, recognizing the needs and contexts of vulnerable groups, such as women, and ensuring their participation in the project. The project's cross-collaborations with institutions that tackle gender inequalities could further enhance its effectiveness in promoting energy justice.

The energy justice framework proved to be a useful framework for incorporating the gender dimension into the justice debate; however, a limitation of the framework became evident. The energy justice framework needs to be expanded to incorporate a gendered and intersectionality perspective to fully capture the potential impacts of these interventions. Merely examining the energy justice framework alone does not provide a complete understanding of the potential and impacts of interventions. A more comprehensive understanding of the context is necessary to determine whether it is just or not. Thus, the energy justice framework in addition to the recognition, distribution and procedural aspects of energy justice needs to be expanded to always consider gender norms and contextual factors.

This research, by combining energy justice and SEM, has revealed that there are factors beyond the energy justice framework that prevent women from fully benefiting from access to clean

and modern energy technology. Thus, the combination of frameworks has proved a fruitful conceptualization for improving the energy justice framework.

To conclude, empowering women and promoting gender equality are crucial for ensuring fair access to modern energy and technology. Policies and interventions that prioritize gender equality can help women access modern energy and technology, while community-based interventions can challenge harmful gender norms and encourage gender equality. Any, energy justice discussion cannot be centered around technological solutions only but should address simultaneously social, political and economic dimensions. Focusing on technological innovation only overshadows the need for systemic changes and can overlook power dynamics and perpetuate injustices.

## **8.2 Future research**

The current literature on the impacts of energy at the level of productive use in rural women is limited. To be more concise, there are virtually no studies that provide an energy justice analysis of such a topic. Therefore, more research is needed on PUE in different contexts that incorporate the gender dimension. Future research should focus on contextualizing gender dynamics within a justice approach that considers the social, economic, and political context. In addition, an intersectionality approach should be incorporated into these studies to gain a more nuanced understanding of the impacts of energy projects on marginalized communities and individuals.

Furthermore, future research needs to examine the potential for scaling up successful initiatives that promote gender transformative access to clean and modern energy and technology. By analyzing the factors that contribute to the success of these projects, researchers could provide recommendations for policy and program design that better address the gendered dimensions of energy access and technology.

Finally, future research should focus on using the framework proposed to conduct empirical studies that analyze the intersectional impacts of energy access and technology on rural women's productive uses of energy. Additionally, the limitations of the framework need to be explored while areas for improvement are to be identified. For instance, the framework may not fully capture the complexities of the intersections between identities and experiences, and there may be gaps in the understanding of the links between energy access and sustainability, and gender inequality. As such, future research needs to refine the framework and further develop its theoretical underpinnings.

## Bibliography

- Alstone, P., Gershenson, D., & Kammen, D. M. (2015). Decentralized energy systems for clean electricity access. *Nature Climate Change*, 5(4), 305–314. <https://doi.org/10.1038/nclimate2512>
- Arévalo, J. (2021). *Recomendaciones para la inclusión de usos productivos en proyectos de electrificación rural*. EnDev Bolivia.
- Backe, S., Zwickl-Bernhard, S., Schwabeneder, D., Auer, H., Korpás, M., & Tomasgard, A. (2022). Impact of energy communities on the European electricity and heating system decarbonization pathway: Comparing local and global flexibility responses. *Applied Energy*, 323(July), 119470. <https://doi.org/10.1016/j.apenergy.2022.119470>
- Baker, S., DeVar, S., & Prakash, S. (2019). *The Energy Justice Workbook*. <https://iejusa.org/workbook/>
- Banco Interamericano de Desarrollo. (2021, March 24). *Usos productivos de la energía y el empoderamiento económico de las mujeres en Bolivia*. <https://blogs.iadb.org/energia/es/oportunidades-para-promover-el-empoderamiento-economico-de-las-mujeres-en-bolivia/>
- Banco Mundial. (2020). *Índice de Gini - Bolivia*. <https://datos.bancomundial.org/indicador/SI.POV.GINI?locations=BO>
- Bell, S. E., Daggett, C., & Labuski, C. (2020). Toward feminist energy systems: Why adding women and solar panels is not enough. *Energy Research and Social Science*, 68(April), 101557. <https://doi.org/10.1016/j.erss.2020.101557>
- Buechler, S., & Martínez-Molina, K. G. (2021). Energy justice, renewable energy, and the rural-urban divide: Insights from the Southwest U.S. *Energy and Climate Change*, 2(June), 100048. <https://doi.org/10.1016/j.egycc.2021.100048>
- Cannon, C. E. B., & Chu, E. K. (2021). Gender, sexuality, and feminist critiques in energy research: A review and call for transversal thinking. *Energy Research and Social Science*, 75(November 2020), 102005. <https://doi.org/10.1016/j.erss.2021.102005>
- Clancy, J., & Dutta, S. (2005). *Women and Productive Uses of Energy: Some light on a shadowy area*.
- EnDev Bolivia (n. d.). *Energía para usos productivos*. Retrieved January 4, 2023, from <http://endev-bolivia.org/es/Nuestro-Proyecto/Endev-bolivia-objetivos-y-alcance>
- Creswell, J., & Creswell, D. (2018). *Research Design Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE Publications.
- Das, I., Klug, T., Krishnapriya, P., Plutshack, V., Sapparapa, R., Scott, S., Sills, E., Jeuland, M., Kara, N., & Pattanayak, S. (2020). A VIRTUOUS CYCLE? Reviewing the evidence on women's empowerment and energy access, frameworks, metrics and methods [White paper]. Women in Environmental Economics for development. <https://energyaccess.duke.edu/wp-content/uploads/2020/11/White-paper-on-gender-and-energy-access-Oct-2020.pdf>
- Ding, W., He, L., Zewudie, D., Zhang, H., & Binte, T. (2019). *Gender and renewable energy study in Tibetan pastoral areas of China*. 133, 901–913. <https://doi.org/10.1016/j.renene.2018.10.065>
- Domegni, K. M. S., & Azouma, Y. O. (2022). Productive uses of energy: A solution for promoting energy justice in rural areas in West Africa. *Renewable and Sustainable Energy Reviews*, 160(February), 112298. <https://doi.org/10.1016/j.rser.2022.112298>
- Eissler, S., Heckert, J., Myers, E., Seymour, G., Sinharoy, S. and Yount, K. (2022), Measuring Women's Empowerment: Gender and Time-use Agency in Benin, Malawi and Nigeria. *Development and Change*, 53: 1010-1034. <https://doi.org/10.1111/dech.12725>
- Endev Bolivia. (n.d.a). Componentes Proyecto Endev. <http://endev-bolivia.org/es/Nuestro-Proyecto/Endev-bolivia-objetivos-y-alcance>
- EnDev. (n.d.b). *Fondo Energía de Mujer*. [Brochure].

EnDev Bolivia. (2022a). *EnDev Bolivia - Acceso a Energía* [Fact sheet]

EnDev Bolivia. (2022b). *Usos Productivos de la Energía en Bolivia. Lecciones aprendidas en 16 años de implementación del Proyecto EnDev/ GIZ*

ENERGETICA. (2020). Situación Energética De Bolivia y Desafíos. In *WWF-Bolivia*.  
[https://wwflac.awsassets.panda.org/downloads/1\\_situacion\\_energetica\\_bolivia\\_25\\_02\\_optimized.pdf](https://wwflac.awsassets.panda.org/downloads/1_situacion_energetica_bolivia_25_02_optimized.pdf)

ENERGIA. (2018). *Unlocking the benefits of productive uses of energy for women in Ghana, Tanzania and Myanmar*. 100.  
<https://www.energia.org/cm2/wp-content/uploads/2019/03/RA6-Unlocking-the-benefits-of-productive-uses-of-energy.pdf>

ENERGIA. (2019). *Gender in the transition to sustainable energy for all : From evidence to inclusive policies*.

ENERGIA. (2020) Modern energy for women in the street food sector in Rwanda, Senegal and South Africa. *Newsletter* <https://www.energia.org/assets/2020/03/Energia-News-March-2020.pdf>

European Economic and Social Committee. (2022, November 24). #EnergyPoverty – Women more likely to be affected than men. <https://www.eesc.europa.eu/en/news-media/news/energy-poverty-women-more-likely-be-affected-men#:~:text=Energy%20poverty%20makes%20the%20gender.and%20producers%20of%20household%20energy>

European Institute for Gender Inequality. (2020). *Gendered patterns in use of new technologies*.  
<https://eige.europa.eu/publications/gender-equality-index-2020-report/gendered-patterns-use-new-technologies>

Fathallah, J., & Pyakurel, P. (2020). Addressing gender in energy studies. *Energy Research and Social Science*, 65(November 2019), 101461. <https://doi.org/10.1016/j.erss.2020.101461>

Feenstra, M., & Özerol, G. (2021). Energy justice as a search light for gender-energy nexus: Towards a conceptual framework. *Renewable and Sustainable Energy Reviews*, 138(November 2020).  
<https://doi.org/10.1016/j.rser.2020.110668>

Galopo Pinto, A. D., & Carlo Santos, J. C. (2017). Impacto de la electrificación rural en Bolivia. *Revista de Análisis*, 26(0), 83–102.

Glemarec, Y., Bayat-Renoux, F., & Waissbein, O. (2016). Removing barriers to women entrepreneurs' engagement in decentralized sustainable energy solutions for the poor. *AIMS Energy*, 4(1), 136–172.  
<https://doi.org/10.3934/energy.2016.1.13>

Goodsell, T. L., Ward, C. J., & Stovall, M. J. (2009). Adapting Focus Groups to a Rural Context: Challenges and Strategies. *Community Development*, 40(1), 64–79. <https://doi.org/10.1080/15575330902924731>

Goswami, A., & Dutta, S. (2016). Gender Differences in Technology Usage—A Literature Review. *Open Journal of Business and Management*, 4(4), 51–59. <https://doi.org/http://dx.doi.org/10.4236/ojbm.2016.41006>

Hopwood, B., Mellor, M., & O'Brien, G. (2005). Sustainable development: Mapping different approaches. *Sustainable Development*, 13(1), 38–52. <https://doi.org/10.1002/sd.244>

IEA, IRENA, UNSD, World Bank, WHO. (2022). *Tracking SDG 7: The Energy Progress Report*. World Bank.  
[https://trackingsdg7.esmap.org/data/files/download-documents/sdg7-report2022-full\\_report.pdf](https://trackingsdg7.esmap.org/data/files/download-documents/sdg7-report2022-full_report.pdf)

Instituto Nacional de Estadística. (2020a, April). *Aspectos Geográficos*.  
<https://www.ine.gob.bo/index.php/bolivia/aspectos-geograficos/>

Instituto Nacional de Estadística. (2020b, April). *Aspectos Políticos y Administrativos*.  
<https://www.ine.gob.bo/index.php/bolivia/aspectos-politicos-y-administrativos/>

International Energy Agency. (2022). *Global Energy Review: CO2 Emissions in 2021*.  
<https://iea.blob.core.windows.net/assets/c3086240-732b-4f6a-89d7-db01be018f5c/GlobalEnergyReviewCO2Emissionsin2021.pdf>

- Intergovernmental Panel on Climate Change. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. <https://doi.org/10.1017/9781009325844.Front>
- Jenkins, K., McCauley, D., Heffron, R., Stephan, H., & Rehner, R. (2016). Energy justice: A conceptual review. *Energy Research and Social Science*, 11, 174–182. <https://doi.org/10.1016/j.erss.2015.10.004>
- Jenkins, E. K., Slemon, A., Haines-Saah, R. J., & Oliffe, J. (2018). A Guide to Multisite Qualitative Analysis. *Qualitative Health Research*, 28(12), 1969–1977. <https://doi.org/10.1177/1049732318786703>
- Jewkes, R., Flood, M., & Lang, J. (2014). From work with men and boys to changes of social norms and reduction of inequities in gender relations: A conceptual shift in prevention of violence against women and girls. *The Lancet*, 385(9977), 1580–1589. [https://doi.org/10.1016/S0140-6736\(14\)61683-4](https://doi.org/10.1016/S0140-6736(14)61683-4)
- Johnson, O. W., Gerber, V., & Muhoza, C. (2019). Gender, culture and energy transitions in rural Africa. *Energy Research and Social Science*, 49(November 2018), 169–179. <https://doi.org/10.1016/j.erss.2018.11.004>
- Kapungu, C., Juan, C., Jesse, C., & Edmeades, J. (2018). *A Socio-Ecological Approach To Understanding the Gendered Drivers of Poor Adolescent Mental Health in Low-and Middle-Income Countries* (Vol. 1).
- Kilanowski, J. F. (2017). Breadth of the Socio-Ecological Model. *Journal of Agromedicine*, 22(4), 295–297. <https://doi.org/10.1080/1059924X.2017.1358971>
- Lê, J. K., & Schmid, T. (2019). An integrative review of qualitative strategy research: presenting 12 “Designs-in-Use”. *Standing on the Shoulders of Giants*, 11, 115- 154.
- Marquéz, L. (2023, January). *Usos Productivos de la Energía* [PowerPoint slides].
- McCauley, D., Heffron, R., Stephan, H., & Jenkins, K. (2013). Advancing energy justice : the triumvirate of tenets and systems thinking. *International Energy Law Review*, 32(3), 1–5. [https://dspace.stir.ac.uk/bitstream/1893/18349/1/IELR\\_2013.pdf](https://dspace.stir.ac.uk/bitstream/1893/18349/1/IELR_2013.pdf)
- McCauley, D., Ramasar, V., Heffron, R. J., Sovacool, B. K., Mebratu, D., & Mundaca, L. (2019). Energy justice in the transition to low carbon energy systems: Exploring key themes in interdisciplinary research. *Applied Energy*, 233–234(November 2018), 916–921. <https://doi.org/10.1016/j.apenergy.2018.10.005>
- Mehtälä, M. A. K., Sääkslahti, A. K., Inkinen, M. E., & Poskiparta, M. E. H. (2014). A socio-ecological approach to physical activity interventions in childcare: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 11(1). <https://doi.org/10.1186/1479-5868-11-22>
- Mejía-Montero, A., Jenkins, K. E. H., van der Horst, D., & Lane, M. (2023). An intersectional approach to energy justice: Individual and collective concerns around wind power on Zapotec land. *Energy Research and Social Science*, 98(March), 103015. <https://doi.org/10.1016/j.erss.2023.103015>
- Mills, A. J., Eurepos, G., & Wiebe, E. (2010). *Encyclopedia of Case Study Research*. In SAGE Publications (Vol. 1).
- Ministerio de Hidrocarburos y Energías. (2021, October 13). *Cobertura eléctrica llegará al 94,6% de los hogares del país hasta diciembre próximo*. <https://www.mhe.gob.bo/2021/10/13/cobertura-electrica-llegara-al-94-6-de-los-hogares-del-pais-hasta-diciembre-proximo/#:~:text=Gracias%20a%20las%20inversiones%20realizadas,en%20todo%20el%20territorio%20nacional>
- Ministerio de Hidrocarburos y Energías. (2022). *Balance Energético Nacional (2006 - 2021)*. <https://www.mhe.gob.bo/balance-energetico-nacional-2006-2021/>
- Moniruzzaman, M., & Day, R. (2020). Gendered energy poverty and energy justice in rural Bangladesh. *Energy Policy*, 144(November 2019), 111554. <https://doi.org/10.1016/j.enpol.2020.111554>
- Moniruzzaman, M. (2016). *Rural women, energy poverty and energy justice in the east central region of Bangladesh*. University of Birmingham.
- Nogales, Q. (2020). *Exploring energy justice in rural Bolivia*. Massey University.



- ONU Mujeres. (2020). *Hacia la igualdad. Boletín trimestral* N° 15. <https://bolivia.un.org/sites/default/files/2021-10/15to%20BOLET%C3%8DN%20ONU%20MUJERES.pdf>
- Opoku, E. E. O., Kufuor, N. K., & Manu, S. A. (2021). Gender, electricity access, renewable energy consumption and energy efficiency. *Technological Forecasting and Social Change*, 173(July), 121121. <https://doi.org/10.1016/j.techfore.2021.121121>
- OXFAM. (2020). *Bolivia Cambio Climático, Desigualdad y Resiliencia*. <https://www.oxfam.org/es/informes/cambio-climatico-desigualdad-y-resiliencia-en-bolivia>
- Peláez, M. (2017). *Estudio sobre el aporte económico del trabajo y del cuidado al sistema económico de los municipios de Cokapirhua y Quillacollo del departamento de Cochabamba y Vallegrande de Santa Cruz*. Instituto de Formación Femenina Integral.
- Papadis, E., & Tsatsaronis, G. (2020). Challenges in the decarbonization of the energy sector. *Energy*, 205, 118025. <https://doi.org/10.1016/j.energy.2020.118025>
- Pueyo, A., & Maestre, M. (2019). Linking energy access, gender and poverty: A review of the literature on productive uses of energy. *Energy Research & Social Science*, 53, 170–181. <https://doi.org/10.1016/j.ERSS.2019.02.019>
- Rosa, E. M., & Tudge, J. (2013). Urie Bronfenbrenner's Theory of Human Development: Its Evolution From Ecology to Bioecology. *Journal of Family Theory & Review*, 5(4), 243–258. <https://doi.org/10.1111/jftr.12022>
- Rutgers. (2019). *Adopting the gender transformative approach in sexual and reproductive health and rights, and gender-based violence programmes*. <https://rutgers.international/wp-content/uploads/2022/01/Rutgers-GTA-manual-module-1-2022-V3.pdf>
- Sahrakorpi, T., & Bandi, V. (2021). Empowerment or employment? Uncovering the paradoxes of social entrepreneurship for women via Husk Power Systems in rural North India. *Energy Research and Social Science*, 79(June), 102153. <https://doi.org/10.1016/j.erss.2021.102153>
- Samarakoon, S., & Zalengera, C. (2022). *Framing Energy Justice : Perspectives from Malawi 's Off-Grid Solar Market*. Springer International Publishing. <https://doi.org/10.1007/978-3-031-13825-6>
- Serra, R, Kendall, M, Towns, A, & Hummer, J. (2023). Promoting Gender Equity in Livelihoods Projects: Practitioners Perspectives Through the Lens of a Socio-ecological Model. *Progress in Development Studies*, 23 (1), 82-98. <https://doi.org/10.1177/14649934221129427>
- Sovacool, B. K., Bell, S. E., Daggett, C., Labuski, C., Lennon, M., Naylor, L., Klinger, J., Leonard, K., & Firestone, J. (2023). Pluralizing energy justice: Incorporating feminist, anti-racist, Indigenous, and postcolonial perspectives. *Energy Research and Social Science*, 97(October 2022), 102996. <https://doi.org/10.1016/j.erss.2023.102996>
- Sovacool, B. K., & Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. *Applied Energy*, 142, 435–444. <https://doi.org/10.1016/j.apenergy.2015.01.002>
- Sustainable Development Goals. (n.d.). Ensure access to affordable, reliable, sustainable and modern energy. <https://www.un.org/sustainabledevelopment/energy/>
- Terrapon-Pfaff, J., Gröne, M. C., Dienst, C., & Ortiz, W. (2018). Productive use of energy – Pathway to development? Reviewing the outcomes and impacts of small-scale energy projects in the global south. *Renewable and Sustainable Energy Reviews*, 96, 198–209. <https://doi.org/10.1016/j.rser.2018.07.016>
- Tornel, C. (2023). Decolonizing energy justice from the ground up: Political ecology, ontology, and energy landscapes. *Progress in Human Geography*, 47(1), 43–65. <https://doi.org/10.1177/03091325221132561>
- Tsagkari, M. (2022). The need for a gender-based approach in the assessment of local energy projects. *Energy for Sustainable Development*, 68, 40–49. <https://doi.org/10.1016/j.ESD.2022.03.001>
- United Nations Development Programme. (2001). *Generating opportunities. Case studies on energy and women*. [https://esmap.org/sites/esmap.org/files/DocumentLibrary/GeneratingOpportunities\\_2001.pdf](https://esmap.org/sites/esmap.org/files/DocumentLibrary/GeneratingOpportunities_2001.pdf)



- United Nations Economic Commission for Europe. (n.d.). *Access to justice*. <https://unece.org/environment-policy/public-participation/access-to-justice>
- United Nations Industrial Development Organization. (2015). *Mutual Benefits of Sustainable Energy and Empowering Women for Inclusive and Sustainable Industrial Development*. [https://www.unido.org/sites/default/files/2016-01/FINAL\\_Gender\\_Energy\\_NEXUS\\_Brochure\\_27Jan\\_0.pdf](https://www.unido.org/sites/default/files/2016-01/FINAL_Gender_Energy_NEXUS_Brochure_27Jan_0.pdf)
- Universidad Católica Boliviana. (n.d.). Años promedios de educación de la población de 24 años o más. Instituto de Investigaciones Socio- Económicas. <https://iisec.ucb.edu.bo/indicador/anos-promedios-de-educacion-de-la-poblacion-de-24-anos-o-mas>
- Watts, J; Cockcroft, K; Duncan, N. (Eds.). (2013). *Developmental Psychology* (2nd ed.). Juta & Company Ltd.
- Wiese, K. (2020). Energy 4 all? Investigating gendered energy justice implications of community-based micro-hydropower cooperatives in Ethiopia. *Innovation: The European Journal of Social Science Research*, 33(2), 194–217. <https://doi.org/10.1080/13511610.2020.1745059>
- Winther, T., Matinga, M. N., Ulsrud, K., & Standal, K. (2017). Women’s empowerment through electricity access: scoping study and proposal for a framework of analysis. *Journal of Development Effectiveness*, 9(3), 389–417. <https://doi.org/10.1080/19439342.2017.1343368>
- Winther, T., Ulsrud, K., & Saini, A. (2018). Solar powered electricity access: Implications for women’s empowerment in rural Kenya. *Energy Research and Social Science*, 44(March), 61–74. <https://doi.org/10.1016/j.erss.2018.04.017>
- Winther, T., Ulsrud, K., Matinga, M., Govindan, M., Gill, B., Saini, A., Brahmachari, D., Palit, D., & Murali, R. (2020). In the light of what we cannot see: Exploring the interconnections between gender and electricity access. *Energy Research & Social Science*, 60, 101334. <https://doi.org/10.1016/J.ERSS.2019.101334>
- Wood, N. (2023). Problematising energy justice: Towards conceptual and normative alignment. *Energy Research and Social Science*, 97(May 2022), 102993. <https://doi.org/10.1016/j.erss.2023.102993>
- Wooten, D. B., & Reed II, A. (2000). A Conceptual Overview of the Self-Presentational Concerns and Response Tendencies of Focus Group Participants. *Journal of Consumer Psychology*, 9(3), 141–153.
- World Bank. (2012). *World Development Report 2012. Gender Equality and Development*. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/492221468136792185/main-report>
- World Bank. (2015). *Bolivia : Challenges and constraints to gender equality and women’s empowerment*. <https://documents1.worldbank.org/curated/en/339531468190181959/pdf/103087-WP-P154195-Box394854B-OUO-8-Bolivia-Gender-Report-ENGLISH-WEB.pdf>
- World Bank. (2022). *Poverty & Equity Brief - Bolivia* (Issue April). [https://databankfiles.worldbank.org/public/ddpext\\_download/poverty/987B9C90-CB9F-4D93-AE8C-750588BF00QA/previous/Global\\_POVEQ\\_BOL.pdf](https://databankfiles.worldbank.org/public/ddpext_download/poverty/987B9C90-CB9F-4D93-AE8C-750588BF00QA/previous/Global_POVEQ_BOL.pdf)
- Yañez, E., & Echenique, N. (2019). *Brechas de Género en el empleo. Evidencia para las Áreas Urbanas de Bolivia*. [https://www.inci.gob.pe/media/MenuRecursivo/publicaciones\\_digitales/Est/Lib1444/libro.pdf](https://www.inci.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1444/libro.pdf)
- Yin, R. K. (2009). *Case study research: design and methods*. In *SAGE Publications* (4th ed, Vol. 5). SAGE Publications.



## Appendix A. Interviews list

### A.1. Interviewees list

Interviewee	Organization/role	Date	Duration (min)	Form of interview
1	Founder and member of organization # 1	01/03/2023	16	Face to face
2	Member of organization #1	01/03/2023	21	Face to face
3	Manager of Organization #2	02/03/2023	25	Face to face
4	Member of organization #2	02/03/2023	23	Face to face
5	Member of organization #3	08/03/2023	20	Face to face
6	President organization #3	08/03/2023	17	Face to face
7	President organization #4	08/03/2023	15	Face to face
8	Member of organization #4	08/03/2023	20	Face to face
9	President organization #5	09/03/2023	21	Face to face
10	Member of organization #5	09/03/2023	12	Face to face
11	GIZ/ Monitoring and Evaluation Advisor	17/02/2023	32	Face to face
12	GIZ/ Productive uses and energy technical advisor	22/02/2023	23	Face to face
13	GIZ/Project coordinator EnDev Bolivia	27/03/2023	47	Face to face

### A.2 Focus group list

Focus group	Department	Date	Duration (min)	Number of participants
1	La Paz	01/03/2023	80	3
2	La Paz	02/03/2023	60	6
3	Santa Cruz	08/03/2023	22	15
4	Santa Cruz	08/03/2023	52	9
5	Santa Cruz	09/03/2023	27	8

## Appendix B. Focus groups interviews guidelines

### B1. Focus group guideline

#### Introduction

Thank you all very much for attending this meeting. My name is Adriana and as you may notice my accent is different and this is because I am from another country, Costa Rica. With GIZ we are conducting a study to find out how you have been doing with the machine that was given to you. So I am going to be asking you some questions. We are going to put the answers here on this panel. There are no good or bad answers, we just want to hear your opinion and know about your experiences.

#### Questions

- How was the procedure done before obtaining the machine? Was any different fuel used? How much time was invested?
- What motivated you to seek/apply for this technology?
- Did you receive any training on the use and maintenance of the machine, business management (accounting, costing), or leadership? Who provided the training?
- Do you know that this machine is of good quality and efficient? Did someone explain to you why this is important?
- What has happened to the intervention, how has the organization changed?
- What benefits or positive things would you say have been gained after getting this technology?
- Have there been any other impacts that you consider negative, for example any increase in expenses?
- Do you feel you have more free time in the organization? \*What have you done with the time you now have available?
- After the technology was installed, were any changes made internally in the organization? Example: shifts for the use of the machine (how was it before?), is there now someone responsible for the use, maintenance, and security?
- Have you earned more money since the machine was installed? How do you distribute the profit? How does that make you feel?
- How do you think the community perceives you after the intervention? More important? Do you feel that the community values or respects you more now? How, why?
- After the intervention, have you participated in any community or political organization? Why? Do you think it would be important?

### B1. Interview guideline for members of rural organizations

- Who lives in your home?
- How many hours a week/day do they work outside their home?
- Do they feel they have more time now for other activities? What activities?
- What skills would you say you have learned after the intervention? How does that make you feel?

- What things have you realized now that you didn't know before, what are you more aware of now? How does that make you feel?
- Do you feel that both your knowledge and the extra money you now have has influenced you to participate more actively in decision-making in your household? For example, what to buy, when do you feel more confident to make decisions?
- How does being able to bring more money into your household make you feel?
- Do they feel that both their knowledge and the extra money they now have in any way influence how they perceive them in their household? For example, more importantly, with more respect
- What do they invest the profits from the business in? Household needs or also in some other activity? Is it possible to save money

## **B2. Interview guideline for GIZ personnel**

- What is your role position at the GIZ?
- How would you define rural organizations in Bolivia? And their importance for women
- How do the associations become aware of the existence of the EnDev Project? What efforts do you make to make it known and to reach the greatest number of associations?
- What barriers do you think the associations have to access credit, for example, instead of being the target of a project like EnDev? Are there structural barriers?
- Would you say that the organization's perspective is included when a project at EnDev is developed? In what way? Are women active participants in this process?
- What are the productive and energy needs of rural women in Bolivia?
- In what ways do you think that EnDev and specifically the PUE component has an impact on women's lives? In other words, what impacts do you think these projects have? Have you been able to see any of them? Or what do you expect to see?
- From your experience, what would you say are the main gender problems at the individual, family and community levels in rural areas?
- What more could EnDev do to include or have a better perspective of women's needs at the productive level? Do you think other complements could be done to intervene at other levels such as interpersonal, communal, etc.?
- Do they have an easy way to communicate with EnDev, is it normal for them to communicate to ask for help with training?
- What benefits would you say are gained by having this co-design perspective? Are there ways to reduce the cost would you say that the co-design has contributed to this

## **B3. Observation Checklist**

- Number of assistants, age
- Interactions between members of the organization
- Technology condition
- Facilities, environment
- How do they work? Were they working that day?
- Attitude toward questions