CLEAN ENERGY SUPPLY FOR ALL

TOWARDS AN EQUITABLE ENERGY TRANSITION:
ACHIEVING ENERGY JUSTICE IN THE GLOBAL SOUTH -
A CASE STUDY ON SOUTH AFRICA

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Clean Energy Supply for All

Towards an Equitable Energy Transition:
Achieving Energy Justice in the Global South -
A Case Study on South Africa

by

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TU Delft

Injustice anywhere is a threat to justice everywhere.

Martin Luther King Jr.

Preface

This thesis represents the conclusion of my Master's programme in Complex Systems Engineering & Management (CoSEM) from the Faculty of Technology, Policy and Management at Delft University of Technology. Reflecting on the past seven months of hard work, this thesis has been a valuable learning experience, allowing me to combine my interest in the energy transition with the socio-technical insights gained from the CoSEM master's programme, alongside my passion for ethics and universal human rights. This journey has deepened my understanding of energy justice and provided new perspectives on ensuring fair energy access for all during the urgent transition to tackle climate change and build a sustainable future. Through this thesis, I aim to contribute meaningfully to the existing body of knowledge and offer valuable insights for both practitioners and researchers in the field.

I would like to thank my first supervisor, dr. Aad Correljé. From our first meeting a year ago, long before my thesis began, you showed great interest in my research topic. It was clear that we shared a common background in energy and international relations. From the start, you actively helped me refine my research focus and develop a strong proposal. Thank you for being consistently critical of my work and pushing me to become a better student, as the best teachers sharpen their students. Secondly, I would like to thank my second supervisor, Dr. Steffen Steinert. Your ethical perspective was invaluable in highlighting the multidisciplinary nature of my research, which was crucial for aligning the project with the CoSEM Master's programme. Our meetings and your feedback continually motivated me to improve my work, both during this project and from our first collaboration on my Bachelor's thesis. Thirdly, I would also like to thank my interviewees in South Africa for taking the time to participate in my interviews and for their valuable contributions to my thesis.

Finally, but certainly not least, I would like to express my gratitude to my family and friends who have supported me throughout my journey at TU Delft. In particular, I want to thank my parents for their warmth and support, my boyfriend for his constant encouragement and for engaging in thoughtful conversations about my thesis topic, and my best friend for providing laughter and the perfect distractions when I needed them most.

Looking back on the thesis process with a sense of fulfilment, I present this work. I hope that it sparks innovative thinking and contributes to meaningful progress in achieving a just energy transition, paving the way for a cleaner and fairer world for all.

Elif Sibel Gökbekir
Delft, September 2024

Executive Summary

The global energy transition is an urgent challenge driven by the need to combat climate change and meet the growing energy demands of an expanding population. As existing energy systems rely heavily on fossil fuels, a rapid shift toward cleaner, more sustainable alternatives is essential. Energy justice ensures that the benefits and burdens of this transition are distributed equitably. However, in the Global South, historical exploitation, economic constraints, and systemic inequalities worsen vulnerability to climate change and hinder progress toward sustainable energy solutions. Much of the current energy justice literature is Western-centric, often overlooking the Global South and focusing on a narrow definition of the concept. Furthermore, while existing studies often concentrate on qualitative analysis, quantitative measures of energy justice are underdeveloped. A robust methodology to quantify inclusive energy justice is essential, as the lack of such an index can hinder effective policy-making for equitable transitions. This thesis employs a mixed-methods approach, combining exploratory research with empirical data from a case study in South Africa, to develop new theoretical insights and a methodology for creating an energy justice index that integrates restorative justice into existing frameworks.

The research begins with a comprehensive review of existing knowledge, including theoretical frameworks and key principles to establish a foundation for further exploration of energy justice. This review focuses on the current state of energy justice, and critically examines the traditional three-tenet framework of distributional, procedural and recognition justice, as well as key decision-making principles. Recent critiques reveal that these frameworks are often too narrow, generalised, human-centred, and Western-centric. In response, this research integrates restorative justice as a key component, focusing on addressing past harms and preventing future damage to individuals, communities, and the environment as a whole. An ethical analysis using both Western and non-Western perspectives has been conducted to develop a more inclusive and diverse framework for energy justice. This approach offers a more holistic view of global ethical values in energy justice by combining the focus on individual rights from Western liberalism with the communitarian and relational values from non-Western philosophies.

In the second research phase, the study examined institutional frameworks and governance structures essential for implementing and scaling up sustainable energy in the Global South. With the ethical dimensions of energy justice thoroughly explored from the first research phase, this part transitions to a practical examination of how these frameworks and structures can support an equitable energy transition. Using the Original Institutional Economics (OIE) approach, this research highlights that achieving a just energy transition requires more than just technological innovation; it requires transformative shifts in institutional structures and cultural norms. The OIE framework provides valuable insights into how values embedded within social, political, economic, and cultural contexts impact the effectiveness of energy transition strategies. Additionally, the study integrates the Williamson framework, incorporating universal human rights law as a key layer. Recognised by international and national courts, this legal foundation strengthens the understanding of how governance structures in the Global South can support justice principles within energy governance.

Building on the ethical and institutional insights, the final research phase develops an inclusive Energy Justice Index that integrates restorative justice principles. This index serves as a comprehensive tool for assessing energy justice across the Global South, evaluating metrics related to past injustices, future compensation, and fairness across generations. Developing an Energy Justice Index is important because it quantifies and operationalises complex justice principles, allowing stakeholders to systematically evaluate, track progress, and address disparities in energy access and policies. It specifically aims to provide a robust framework for guiding energy transition projects by addressing historical disparities and supporting sustainable development. The index is applied in a case study of South Africa, demonstrating its real-world functionality. While the case study shows some progress, it also reveals critical gaps in restorative justice, community engagement, and transparency. Improving these areas is essential for achieving more equitable and effective energy justice outcomes in South Africa. This research is limited by its focus on a single case study in South Africa, which may not fully represent other Global South contexts. Future studies should apply the Energy Justice Index in diverse countries to test its applicability and refine its metrics. Additionally, exploring the impact of local socio-economic factors and human behaviour on energy justice could provide deeper insights and improve the index's effectiveness.

Contents

Abbreviations & Glossary

EU	European Union
EJI	Energy Justice Index
GHGs	Greenhouse Gas Emissions
HR(L)	Human Rights (Law)
IEA	International Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
RE	Renewable Energy
RISE	Regulatory Indicators for Sustainable Development
SD	Sustainable Development
SDGs	Sustainable Development Goals
UK	United Kingdom
UN	United Nations
US	United States
WBG	World Bank Group
WEC	World Energy Council
WEF	World Economic Forum

Global North	Refers to the economically developed countries typically located in the Northern Hemisphere, including North America, Europe, and parts of East Asia. These countries are characterised by advanced economies, high standards of living, and significant technological and infrastructural development.
Global South	Refers to the less economically developed countries primarily located in the Southern Hemisphere, including parts of Africa, Latin America, Middle East and South Asia. These countries often face challenges such as poverty, limited infrastructure, and unequal access to resources and technology. The term highlights historical inequalities and the varying levels of economic development and social progress compared to the Global North.
Net zero	The state where the amount of human-caused GHG emissions, measured with specific metrics, is offset by an equal amount of human-caused GHG removals over a set period is known as achieving net zero emissions. When this concept also includes non-CO_2 greenhouse gases, the calculation of net zero emissions involves selecting a metric for comparing the emissions and removals of various gases and determining the appropriate time frame for that metric.

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Introduction

"Well begun is half done."

Aristotle

This introduction provides a preview of the report's content. It offers an overview of the central theme, energy justice in the Global South, and outlines the research objectives of the thesis. By the end of this chapter, the reader should have a general understanding of the topic and research framework and a clear idea of what to expect from each subsequent chapter.

1.1. Problem Context

Energy justice has become a critical issue within the United Nations' agenda, driven by the latest report from the UN Intergovernmental Panel on Climate Change, which has caused widespread concern globally (IPCC, 2023). With human-induced climate change and the current global temperature increase of 1.1 degrees, all parts of the world are witnessing unprecedented changes in the climate system, including rising sea levels, more intense weather events, and the rapid melting of sea ice. One of the most alarming findings is that adverse climate impacts are already more extensive and severe than initially expected. In response to the escalating effects of climate change, countries are decisively moving towards reducing greenhouse gas (GHG) emissions, exemplified by the 196 states ratifying the Paris Agreement (UNFCCC, 2015). This shift towards sustainable energy production is essential to mitigate the consequences of climate change and positions energy as a central focus within the United Nations' Agenda for Sustainable Development Goals (SDG) (UN, 2022). Approximately 25% of world emissions are attributable to energy use, making it one of the major causes of GHG emissions (Zillman, 2018).

The success of the Paris Agreement depends on a swift global transition to sustainable energy solutions, emphasising the urgent need for worldwide cooperation and commitment to SDGs. This transition, therefore, imposes a significant demand on society and requires a complete shift in the energy sector within the next few decades. As emphasised by the IPCC, the world is nearing tipping points where climate change may become irreversible, further underscoring the growing importance of a global energy transition (IPCC, 2023). However, it is essential to acknowledge that some parts of the world, such as the nations in the Global North, are better prepared to undertake and implement an energy transition than those in the Global South. The Global North generally refers to economically developed regions such as North America, Europe, and parts of East Asia. In contrast, the Global South includes less economically developed areas, primarily in Africa, Latin America, Asia, and the Middle East. The essential concept of *energy justice* emphasises the need to ensure that the burdens and benefits of transitioning to cleaner energy are distributed equitably across different regions and communities (Sovacool, 2014).

Energy justice is strongly linked with other concerns, such as energy security, sustainability, and affordability (Shabliy et al., 2022). Recent developments in technology and law have changed the worldwide legal landscape for energy and the trajectory of energy development overall. Additionally, the UN concluded that promoting equality, energy justice, and energy innovation is essential to facilitating future energy innovation and the transition to net-zero emissions (UN, 2023). Therefore,

addressing energy justice requires a global commitment to reducing emissions and understanding the socio-technical factors influencing access to sustainable energy solutions. This involves considering factors such as income level, education, cultural norms, technological availability, affordability, reliability, and infrastructure to ensure equitable access to sustainable energy solutions (Iwinska et al., 2021).

This exploration of energy justice becomes crucial within the broader context of climate justice, particularly as countries strive for a fair and equitable energy transition in the face of the multifaceted challenges of climate change (Volodzkienė & Štreimikienė, 2023). Climate justice is about recognising that climate change affects people and communities in different ways, often unfairly, and it is about addressing these unfair issues with fair and just actions (Sultana, 2021). It becomes apparent that disadvantaged populations, usually the least responsible for GHGs, bear the most significant weight of environmental impacts (Volodzkienė & Štreimikienė, 2023). This is particularly true for the Global South, where countries not only bear a disproportionate amount of the burden from the climate crisis but are also struggling with the lasting impacts of colonialism (Tharoor, 2016). The colonial history of many nations in the Global South has left them with weakened economic structures, unequal access to resources, and systemic inequalities that increase their vulnerability to climate change. As a result, the main goal of this research is to seek equitable energy justice for the citizens of the Global South by integrating the concepts of climate justice, environmental justice and energy justice, as will be further explained in Chapter 1.2.

1.2. Energy Justice in the Context of Environmental and Climate Justice

In recent social science research, the concept of 'energy justice' has emerged as an interdisciplinary pursuit. Energy justice is a relatively new concept, whereas environmental justice and climate justice trace their origins back to the 1980s and 1990s. Energy justice is primarily described as a specific instrument for the policymaking process that aims to determine the place and time of injustices as well as the best way to recognise them (Wang, 2019; Jenkins et al., 2016; Gonzalez et al., 2018). Del Guayo et al. (2020) note that the continued emphasis on energy justice is due to the surge in social science research on energy-related topics, again within the last ten years, in a sector that until now had been dominated by economists and engineers. This movement seeks to embed principles of fairness within energy-related domains such as energy policymaking, production methods, consumption patterns, economic dimensions, and activism due to climate change (Osička et al., 2023; McCauley et al., 2013). The idea of energy justice addresses the equity of energy systems while considering the social and developmental effects of energy-related projects, policies, and technology. As a result, it functions as a framework for analysis and a tool for locating and addressing inequalities that arise in the energy sector (Apergi et al., 2024).

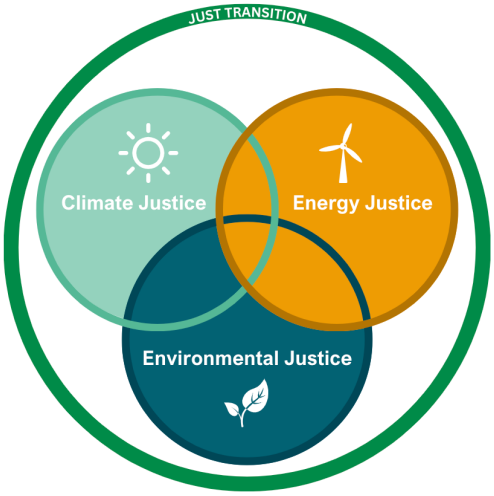

Figure 1. Positioning Energy Justice, adapted from the Initiative Energy Justice Workbook.

However, energy justice is inherently intertwined and predicated upon movements calling for both environmental justice and climate justice, as illustrated in Figure 1 (Baker et al., 2019). Environmental justice connects social justice, civil rights, and environmental protection. In essence, it acknowledges that environmental racism has historically imposed unequal environmental burdens on communities of colour (Bouzarovski et al., 2023). According to Bullard and Johnson (2000), environmental justice provides a paradigm for understanding and resolving the uneven and disproportionate environmental costs that people experiencing poverty and people of colour bear as a result of both higher exposure to toxic damage and unequal juridical protection. As a result, a fundamental principle of environmental justice is that every individual and community have a right to equal protection from the environment and equitable application of legislation (Kaswan, 1999). According to Kaswan (1999), environmental justice also calls for the fair and reasonable allocation of environmental benefits and damages, including cumulative effects over time. Therefore, environmental justice offers frameworks for halting and repairing environmental damages brought about by unfair or racist policies that discriminate against and exclude people of colour and other marginalised populations.

Environmental justice significantly impacted the emergence of the climate justice movement (Schlosberg & Collins, 2014). In its global context, climate justice provides ethical backing for international and increasingly national climate policies (Schlosberg & Collins, 2014). According to human and environmental rights concerns, historical accountability for the uneven consequences of climate change is among the principles of climate justice (Salter, 2023; Schlosberg & Collins, 2014). An example of the historical responsibility approach is the international "*polluter pays*" theory, which holds that certain governments should bear the financial consequences of their activities since they have made disproportionate contributions to the climate catastrophe (Perry, 2020; Schlosberg & Collins, 2014). According to a human rights perspective, climate change infringes upon the fundamental human rights of life, well-being, and nutrition (Perry, 2020). This perspective supports concerns related to environmental justice. It advocates for promoting transitions to clean energy while ensuring consent and active participation in decision-making processes. As a result, political and social science researchers have developed the idea of "energy justice", which incorporates procedural, distributive, and recognition justice principles. Therefore, energy justice builds on environmental and climate justice (Baker et al., 2019).

Energy justice could directly impact the formulation of energy policies and decisions, compared to environmental justice and climate justice (Del Guayo et al., 2020). The latter two address energy-related and non-energy-related causes of (in)justice, but energy justice is limited to energy systems (Jenkins, 2018). Much relevant research on energy justice focuses on evaluating the justice effects of clean energy and low-carbon shifts, which are perceived to bring a range of societal issues and the potential for social reforms (Apergi et al., 2024). Numerous research studies have employed diverse theoretical frameworks. The three-core-tenets framework is generally accepted by the majority of research in the energy justice field (Barragan-Contreras, 2021; Apergi et al., 2024). The tenets of *procedural justice*—ensuring participation in decision-making; *distributional justice*—ensuring equitable enjoyment of energy system advantages; and *recognition justice*—addressing the needs of marginalised groups—combine a theoretical framework to conceptualise energy justice. Nevertheless, there is a lot less attention paid to how regional renewable energy practices and technologies, both existing and evolving, could increase socioeconomic disparities. The definitions of energy justice will be examined in greater depth in Chapter 3.2.

1.3. Knowledge Gaps and Research Objective

Despite the growing body of research on energy justice, significant knowledge gaps still exist. Firstly, the majority of the research on energy justice has primarily focused on developed countries. Also, core foundational literature and established networks mainly originate from Western scholars and institutions, with notable geographic roots in the UK, the US, and the EU (e.g. Jenkins et al. (2016); Sovacool et al. (2017)). This leaves a substantial gap in understanding how energy justice principles can be applied in the Global South, where additional resources and support for a smooth energy transition are often more pressing than in the Global North. Therefore, it is necessary to delve deeper into how these communities are affected by energy systems and how equitable access to sustainable energy solutions can be ensured.

Secondly, the existing literature has mainly concentrated on conceptual and qualitative analyses, with quantitative measures of energy justice still being in their early stages. The limited quantitative research conducted so far has predominantly focused on the three established tenets of energy justice: distributive, procedural and recognition justice. However, considerably less attention has been given to how existing and emerging renewable energy practices and technologies could worsen socioeconomic inequalities (Hazrati & Heffron, 2021). This oversight could be problematic because energy justice initiatives risk perpetuating existing inequities without incorporating restorative justice, which addresses past harms. A narrower focus on the three tenets overlooks the historical and systemic injustices that have led to current disparities. Without a restorative perspective, energy transitions may inadvertently reinforce patterns of marginalisation, which could undermine efforts to achieve equity and sustainability.

Considering this, this thesis argues that restorative energy justice can contribute to just energy transition initiatives in the Global South. It states that a restricted emphasis solely on the traditional tenets is no longer appropriate and that, moving ahead, the Global South's fair energy transition initiatives must include a restorative perspective. Within the framework of energy justice, the idea of restorative energy justice—which emphasises repairing harm to communities and the environment and restoring their well-being—is becoming more widely acknowledged as an understudied factor in achieving desired social, ecological, and economic outcomes through the decarbonisation of energy (Hazrati & Heffron, 2021). Given the growing disparity, particularly in the context of energy, it is essential to explore how energy justice research can address and mitigate energy injustices in the Global South. Therefore, this thesis advocates including restorative energy justice as a necessary contribution to the field.

Addressing these knowledge gaps, this thesis aims to make energy justice research more inclusive by adding restorative justice. It seeks to ensure that all communities in the Global South equally benefit from progress in sustainable energy technologies and policies to combat climate change.

These knowledge gaps lead to the following main research question:

> *"How can energy justice, as part of the broader framework of climate and environmental justice, be achieved, particularly within the context of transitioning to sustainable energy sources in the Global South, with considering restorative justice as an essential tenet?"*

The main objectives of this research are therefore:

- Develop an in-depth understanding of the concept of energy justice, advocate for the inclusion of restorative energy justice to address broader inequalities, and explore how it aligns with diverse global ethical frameworks.
- Analyse the institutional frameworks and governance structures that influence the implementation and scaling up of a just energy transition in the Global South.
- Explore the integration of restorative justice into quantitative assessment metrics to evaluate and score energy justice across different countries in the Global South, adopting a structured approach with a case study focused on South Africa in this thesis.
- Provide policy recommendations for achieving a just energy transition in the Global South.

1.4. Research Scope

This thesis is the final part of the academic studies conducted from February 2024 to September 2024. The research focuses on exploring how energy justice can be achieved in the Global South by integrating restorative justice into the broader framework of energy justice. As considered in this study, the Global South includes countries from regions such as Africa, Latin America, Asia, and the Middle East. The choice of these specific regions is due to the significant economic and social challenges these countries often face, which can intensify the difficulties of achieving a just and equitable energy

transition. For example, the COVID-19 crisis underscored the challenges faced by developing regions, revealing a lack of preparedness that could mirror their struggles in transitioning to sustainable energy to address the climate crisis. Oxfam's 2021 inequality report projected an increase in inequality in nearly every nation, highlighting the uneven impacts of domestic and international societal disruptions (Oxfam International, 2021).

Addressing these challenges is essential, as an effective transition towards renewable energy and climate change mitigation requires not only technological advancements but also social development. However, many emerging nations in the Global South struggle to prioritise the climate crisis due to more immediate development issues. Furthermore, the climate crisis worsens existing vulnerabilities by making epidemics and severe weather more frequent, which in turn deepens inequalities based on gender, race, ethnicity, and nationality (Goodrich et al., 2019).

The colonial history of the Global South, characterised by exploitation and environmental degradation, has left lasting impacts that complicate efforts to achieve a just energy transition. Colonial-era extractive industries, such as mining and plantation agriculture, caused significant environmental damage and disrupted indigenous communities, which led to long-term social and economic instability (Peša, 2024). These effects persist today, complicating sustainable energy development and potentially reinforcing existing inequalities, such as community displacement or land conflicts. While this historical context is important for understanding the challenges faced by the Global South, this research specifically focuses on integrating restorative justice into energy justice frameworks to address the fairness and inclusivity of the current energy transition. This approach aims to ensure that sustainable energy projects do not perpetuate existing disparities and contribute to a more equitable transition.

1.5. Link with the CoSEM Programme

The Master of Science Thesis Research is mandatory for obtaining a master's degree in Complex Systems Engineering & Management (CoSEM). A typical CoSEM thesis involves qualitative and quantitative policy methods and the societal relevance of complex socio-technical systems. This research tackles a situation where there is a lack of understanding of how to shape local or national policy in the Global South in a way that equitably and sustainably stimulates reaching climate goals. This research is scientifically relevant to the CoSEM programme as it provides an opportunity to do extensive interdisciplinary research that includes technological, economic, social, and even ethical aspects. The study aims to tackle complex territory by closely examining how sustainable energy solutions, such as renewable energy, interact with social justice for communities in the Global South. The complexity of the situation—including many actors with different interests (Global North vs South), institutional dynamics (Paris Agreement vs local policies), interrelated global factors (climate effects born by Global South)—makes it essential to have a complete understanding of the technological viability as well as the fair integration of these technologies into society. This fits in perfectly with the programme's multidisciplinary approach to complex problems and the specific track on energy.

1.6. Thesis Outline

This thesis is divided into five parts, as illustrated in Figure 2. The first section includes the introduction and the methodology. The second section, consisting of Chapter 3 and 4, provides an in-depth exploration of the concept of energy justice, including definitions from the literature and an analysis of ethical frameworks. The third part, Chapter 5, introduces the institutional framework for energy justice, drawing on Original Institutional Economics and the Williamson frameworks, and analysing universal human rights as a layer of Williamson. The fourth part, including Chapters 6 and 7, develops a method to quantify energy justice by introducing a new energy justice index for the Global South, applies this method in a case study focused on South Africa. Finally, the fifth section wraps up with Chapters 8 and 9 with discussions, conclusions, and policy recommendations, along with proposals for future research directions.

Part	Chapter	Research question	Method
Part 1	1 - Introduction		
	2 - Methodology		
Part 2	3 - Energy Justice Description	RQ 1	literature study and analysis
	4 - Energy Justice Ethics	RQ 2	literature study and ethical analysis
Part 3	5 - Institutional Frameworks	RQ 3	institutional analysis
Part 4	6 - Developing a Method to Quantify Energy Justice	RQ 4	development of criteria and metrics
	7 - Case Study South Africa	RQ 5(1)	semi-structured interviews and desk research
Part 5	8 - Discussion		
	9 - Conclusion & Policy Recommendations	RQ 5(2) + Main RQ	policy analysis and formulation

Figure 2. Thesis Outline

2

Research Approach and Methods

"Science is not a collection of facts;
it is a process of discovery."

Robert Zubrin

This chapter outlines the methods used to address the main research question presented in the previous chapter. It also introduces the sub-questions that guide this research, along with the specific techniques and analytical approaches employed to explore them. These methods are designed to contribute to understanding and achieving energy justice in the Global South.

2.1. Research Strategy

This research seeks to explore how energy justice can be achieved in the Global South by critically evaluating restorative justice as a key component. The study aims to develop informed policy-making recommendations that address these challenges. To accomplish this, a mixed-methods approach will be employed, integrating both qualitative and quantitative analysis, as Taherdoost (2022) outlined. Initially, a literature review has been executed. Peer-reviewed articles published in scientific journals or papers were systematically examined in this literature review process with the PRISMA method (Mishra & Mishra, 2023). The Web of Science and Scopus literature search was carried out from November 2023 until January 2024. Important research on the subject has defined synonyms for key terms. The terms were combined using Boolean operators. The search query that has been used was: ***("Energy transition" OR "energy shift" OR "sustainable energy sources") AND ("energy justice" OR "climate justice" OR "equitable energy" OR "energy access") AND ("global south" OR "southern hemisphere*")***

The research focuses on the intersection of social justice and energy distribution in the Global South. The academic knowledge gap identified in **Error! Reference source not found.**emphasises the need for a more in-depth analysis of energy justice in Global South nations. Given the limited existing research on this specific context, an exploratory approach is suitable for delving into the topic, as it allows for examining diverse perspectives and theories without being constrained by pre-existing frameworks. This approach is particularly fitting because it facilitates the discovery of new insights and patterns in an area where research is still emerging (Elman et al., 2020). This lack of clarity paves the way to developing new theoretical perspectives to close the gap between energy technology and fair social policies. After understanding how energy justice, including restorative justice, can be effectively conceptualised and achieved, it becomes interesting to test that for a state in the Global South – in this thesis, South Africa. To combine the exploratory research with a case study approach, the ultimate goal is not only to understand this complexity of energy justice but also to contribute to forming policies and

strategies that are both environmentally sustainable and socially just. The research will focus on exploring and developing new theoretical perspectives that provide a basis for promoting a fair energy transition within the broader framework of social justice.

2.2. Research Phases and Sub-Questions

To be able to answer the main research question, several matters need to be clarified. First, a clear definition of energy justice must be established together with its key components. This foundational knowledge will then facilitate the integration of restorative justice into the energy justice framework. An ethical analysis will be done to provide a solid basis for incorporating restorative justice from various ethical perspectives. Secondly, it is essential to analyse and understand the institutional frameworks and governance structures necessary to implement and scale up sustainable energy solutions. Following this, a methodology will be developed to quantify energy justice, including restorative justice, specifically within the context of the Global South. This methodology will be applied through a case study of South Africa. Based on the insights gained from this case study, targeted policy recommendations will be formulated for South Africa. The sub-questions are, therefore, as follows:

1. What are the key components of energy justice, and how is energy justice defined?
2. How can restorative justice be integrated within the energy justice framework, and how does it relate to different ethical theories?
3. How do institutional frameworks and governance structures in the Global South impact the implementation of energy justice, particularly with respect to restorative justice?
4. How can an energy justice index in the Global South, with restorative justice as a tenet, be quantified?
5. Given the renewed method including restorative justice, how does South Africa score on the energy justice index, and what policy recommendations emerge from these insights?

2.2.1 Research Phase 1: Understanding the conceptual framework of energy justice, with restorative justice as a tenet

The objective of this research phase is to develop a detailed conceptual framework for energy justice. This framework will then explore how restorative justice could be integrated within the broader context of energy justice. The aim of incorporating restorative justice is that the framework will offer a more holistic view rather than focusing solely on the three traditional pillars of distributive, procedural and recognition justice.
Secondly, energy justice, with restorative justice as a core tenet, will be examined through diverse ethical perspectives for a well-rounded understanding. This framework integrates both Western and non-Western ethical traditions. Integrating non-Western perspectives, such as Ubuntu (South Africa), Dharma (Indian philosophy), and Buen Vivir (indigenous Latin America), offer a more inclusive view of justice by emphasising collective responsibility, interconnectedness with nature, and community well-being, which are elements that are less prominent in Western approaches. Their role is to broaden the cultural and philosophical scope, so energy justice can be viewed through a global lens, in the end leading to more balanced and equitable energy policies that reflect diverse values. The following sub-questions are answered in this research phase:

Sub-question 1: *What are the key components of energy justice, and how is energy justice defined?*
Sub-question 2: *How can restorative justice be integrated within the energy justice framework, and how does it relate to different ethical theories?*

2.2.2 Research Phase 2: Analysing institutional frameworks and governance structures for energy justice, with restorative justice as a tenet

This research phase aims to analyse the institutional frameworks and governance structures that are important for implementing and scaling up sustainable energy in the Global South. This phase focuses on understanding how these institutional and governance mechanisms influence the realisation of energy justice, paying particular attention to the role of restorative justice within this framework. The

insights gained from this analysis will inform the policy recommendations for the case study and contribute to developing a more just and equitable approach to energy governance.
Additionally, this phase incorporates an analysis of universal human rights law as an essential institutional layer. The body of human rights law holds a strong legal standing in international law, recognised as such by various international and national courts. By integrating human rights law into the analysis, the research provides a robust juridical foundation for understanding how institutional and governance structures in the Global South can uphold principles of justice, including restorative justice, within energy governance. This will answer the following sub-question:

Sub-question 3: *How do institutional frameworks and governance structures in the Global South impact the implementation of energy justice, particularly with respect to restorative justice?*

2.2.3 Research Phase 3: Developing a method to quantify energy justice, including restorative justice in the Global South and formulate policy recommendations based on case study analysis

The aim of this research phase is to develop a method for quantifying energy justice in the Global South, including restorative justice as a key element. The rationale behind this is to create a versatile and replicable method that other researchers can apply to different countries within the Global South. This thesis phase includes applying the developed method to a specific case study in South Africa. The aim is to use the findings from this case study to develop targeted policy recommendations for the policy recommendations in the final chapter. This will strengthen the practical application of energy justice and restorative justice in the region. The following sub-questions are answered in this research phase:

Sub-question 4: *How can an energy justice index in the Global South, with restorative justice as a tenet, be quantified?*

Sub-question 5: *Given the renewed method including restorative justice, how does South Africa score on the energy justice index, and what policy recommendations emerge from these insights?*

Ultimately, the findings from all research phases and sub-questions are synthesised to address the primary research question:

How can energy justice, as part of the broader framework of climate and environmental justice, be achieved, particularly within the context of transitioning to sustainable energy sources in the Global South, with considering restorative justice as an essential tenet?

2.3. Research Methods

This section outlines the research methods employed across the three research phases, together with their sub-questions. Since the third phase focuses on developing a specific methodology, Chapter 6 will provide a more detailed explanation of this method.

Research Phase 1

Sub-question 1: literature study and analysis

This sub-question will be addressed through a comprehensive literature review and analysis to define energy justice and identify its key components. This process involves an extensive study of peer-reviewed scientific articles. Also, grey literature will be analysed, including reports and documents from energy justice initiatives. The aim is to synthesise existing definitions and components of energy justice, providing a solid foundation for the subsequent phases of the research. This approach will help address the sub-question of a better definition of energy justice.

Sub-question 2: literature study and ethical analysis

This sub-question will use a combination of literature study and ethical analysis to explore how restorative justice can be integrated into the energy justice framework. The literature study will examine scholarly articles and existing theories related to both concepts to identify key intersections and gaps. For the ethical analysis, both Western and non-Western perspectives will be explored in depth. Western approaches such as utilitarianism, Kantian deontological ethics, and Rawlsian theories of justice will provide insights into principles like fairness, rights, and the greatest good for the greatest number. On the non-Western side, perspectives such as Ubuntu (South Africa) will emphasise community interconnectedness and reconciliation, Dharma (Indian philosophy) will focus on duty and moral order, and Buen Vivir (indigenous Latin American thought) will highlight harmony with nature and collective well-being. These approaches often stress collective responsibility and ecological balance, offering alternative ways to integrate restorative justice into a more globally inclusive and culturally sensitive energy justice framework. By incorporating these diverse ethical perspectives, the analysis will provide a nuanced understanding of how restorative justice can be effectively applied within the energy justice framework, addressing the needs and values of different communities.

Research Phase 2

Sub-question 3: institutional analysis

To address sub-question 3, this research will employ a literature review based on Original Institutional Economics (OIE) theory and Williamson's theory of governance (Williamson, 1998). The review will analyse existing institutional frameworks and governance structures relevant to sustainable energy in the Global South. Sources will include academic articles, international treaties, and local conventions. An important aspect of this analysis includes the role of universal human rights law as a layer within the Williamson framework. Recognised by international and national courts, human rights law provides a robust juridical foundation for assessing how institutional structures can uphold principles of justice. This includes the integration of restorative justice, so that governance mechanisms in the Global South not only address energy justice but also consider human rights dimensions, that can lead to a more equitable and legally grounded approach to energy governance.

Research Phase 3

Sub-question 4: development of criteria and metrics

This sub-question will be addressed by designing a methodology to quantify energy justice in the Global South, integrating restorative justice as an essential component. The approach involves developing specific criteria and metrics through a mixed-methods strategy. Quantitative data on energy access, distribution, and socio-economic conditions across various countries in the Global South will be collected from existing datasets. This data will then be used to identify and define indicators of energy justice. Concurrently, a case study will be executed (sub-question 5 as below) to enrich the understanding of energy justice and restorative justice. These combined data sources will help establish robust criteria and metrics for assessing energy justice.

Sub-question 5: case study with semi-structured interviews, desk research and policy analysis and formulation

This sub-question will be addressed by applying the developed criteria and metrics to a detailed case study of South Africa. The case study will employ a mixed-methods approach, using the criteria and metrics created in sub-question 4 to evaluate the practical implementation of energy justice, including restorative justice, within the South African context. Desk research will be conducted to collect secondary data from scientific literature, reports, and government publications on sustainable energy in South Africa. Qualitative data will be collected through semi-structured interviews with key stakeholders (see Table 1) and content analysis of relevant policy documents. Additionally, data from international institutions will be analysed to provide further scoring to the metrics. A quantitative analysis will complement these qualitative insights, where all metrics will be indexed into a comprehensive score. Based on these findings, in the final chapter, targeted policy recommendations will be developed through policy analysis and formulation to improve the fairness of energy justice interventions in the Global South.

Stakeholders will be interviewed using a semi-structured format. This approach is widely recognised as the most frequently employed method in qualitative research (Qu & Dumay, 2011). Semi-structured

interviews involve a list of questions that can be addressed in a non-linear sequence, incorporating both open and closed questions. This flexible interview style encourages participant interaction, making it particularly effective for exploring complex topics (Johannesson & Perjons, 2014).

To identify suitable interview candidates, a preliminary stakeholder analysis was carried out, focusing on key figures in the South African energy sector and their relevance to the research objectives. Ten stakeholders were selected for semi-structured interviews due to their significant roles and expertise in the sector. Their positions in leading organisations and/or advisory roles offer valuable insights into just transition policy development, strategic planning, and community impacts. Their input is important for assessing the effectiveness of energy justice metrics and understanding the practical challenges faced in South Africa.

The stakeholders were contacted via LinkedIn, or the interviewee referred someone else to interview. These interviews aim to assess the different metrics within the scorecard, refine the understanding of energy justice and incorporate restorative justice as a key element within the framework. Before the interviews, questions were developed based on identified themes, ensuring a systematic approach. Each interview included tailored questions relevant to the interviewee while adhering to the overarching themes. The interview questions are found in Appendix B. Case Study: Interview Questions. The consent form for these interviews is included in Appendix C. Case Study: Consent Form Participation. All the interviews have been conducted via Microsoft Teams. Following the interviews, the recordings were transcribed, summarised, and coded using ATLAS.ti (Qu & Dumay, 2011).

Table 1 presents the interviewees along with their affiliated institutions and specific roles. The reference codes provided in the table's rightmost column will be used in-text to refer to these interviews.

Table 1: Conducted Interviews and their Reference Codes

Role	Institute	Reference code
Executive Director	The African Climate Foundation	ACF1
Senior Energy Adviser for South Africa Just Energy Transition	Commonwealth and Development Office	CDO1
Just Transition Project Coordinator – South Africa	Indalo Inclusive South Africa NPC	IND1
Climate Change and Energy Specialist, also Editor of 'A Just Transition to a Low Carbon Future in South Africa'	Enzi Ijayo Africa Initiative	EIAI1
Co-Founder and Managing Partner	Renew-E, an Advisory Forum advising the Minister	RNW1
Senior Specialist: Climate Change & Energy	Transnet SOC Ltd	TNS1
Head of Department: Just Energy Transition	The Impact Catalyst	TIC1
Board Member	World Energy Council	WEC1
Head of Futures Programme	South African Institute of International Affairs	SAIIA1
CEO	Energy Council of South Africa	ECSA1

2.4. Research Flow Diagram

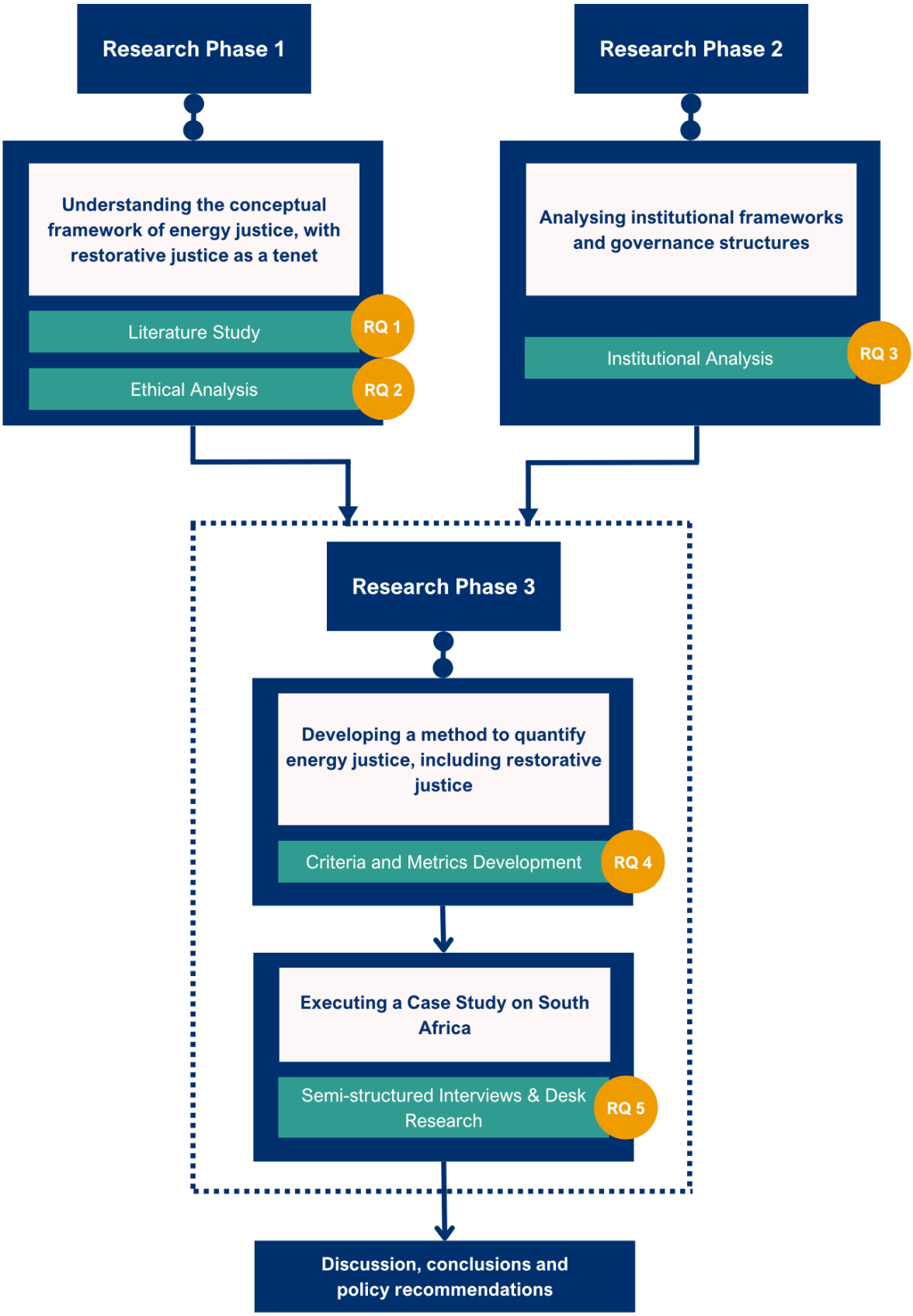

Figure 3. Research Flow Diagram

3

Energy Justice in the Energy Transition Context

"The greatest threat to our planet is the belief that someone else will save it."

Robert Swan

This chapter introduces the first phase of research, focusing on understanding energy justice within the context of energy transition. It begins by highlighting the background of energy justice, rooted in the challenges posed by climate change, which disproportionately affects vulnerable communities due to rising greenhouse gases. The chapter then examines the evolving definition of energy justice and introduces restorative justice as a key component. By exploring how restorative justice can address historical and systemic inequalities in energy systems, this chapter aims to provide a more nuanced framework for ensuring equitable transitions and guiding effective policy development.

3.1. The Background of Energy Justice: Climate Change

To better understand energy justice in the energy transition context, it is important to understand climate change, the greenhouse effect (GE), the main greenhouse gases (GHGs) that cause it, and its importance for life on Earth. As this understanding helps identify the climate changes since the start of the industrial era, a detailed explanation of climate change and the GE is provided in Appendix A. Since the Industrial Revolution in the late 18th century, there has been a considerable increase in GHG levels due to human activity, which has strengthened the GE and accelerated the pace of temperature rise (IPCC, 2023). Rising sea levels and a notable rise in the frequency and severity of extreme weather events have been linked with rising temperatures. Tens of millions of people have suffered due to this, facing issues such as displacement, food and water shortages, and increased vulnerability to natural disasters, particularly those who lack the resources to cope with climate change. It is important to note that, throughout the previous 2.5 million years, the Earth has not seen such significant temperature increases (Hartmann, 2016). This temperature rise adheres to a roughly exponential trend, and the annual percentage rise has been consistently growing. Without prompt and substantial cuts in GHGs, achieving a 2°C temperature increase limit, as stated in the Paris Agreement, will be unattainable (UNFCCC, 2015). Human-induced GHG emissions have already contributed around 1.1°C to the rise in temperatures since 1850-1900, and without swift and tangible emission curbs, global temperatures could rise between 2°C and 5°C (Hartmann 2016; IPCC 2023).

To identify the countries that have substantially contributed to greenhouse gas emissions over the years, an analysis of CO_2 emissions statistics provided by the World Bank (2016) could be done. This dataset covers the period from 1990, a commonly used baseline year for setting emission reduction goals, to 2016, the year for which data is accessible for these countries in the World Bank records. China is frequently reported as the primary CO_2 producer, and Europe accounts for only about 9% of the overall emissions (Attinà, 2023). However, these statements often lack clarity regarding whether they refer to the total emissions of a single country or per capita or whether they pertain to a particular year or emissions in total over an extended duration. The diagram in Figure 4 sets out the total CO_2

emissions from the leading seven contributors, both in total (left) and per capita (right). The per capita figures were calculated by dividing the total emissions by the average mid-year population.

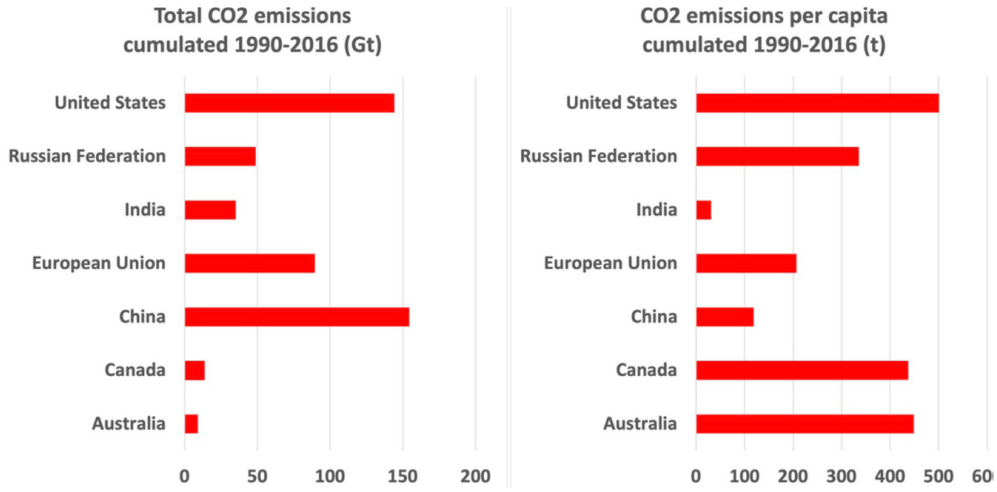

Figure 4. Total and Per Capita CO2 Emissions (1990-2016)

Between 1990 and 2016, these seven countries collectively released 68% of the world's CO_2. China and the US dominated, with the European Union next in line and additional significant emitters like Australia and the Russian Federation also playing noteworthy roles. These numbers demonstrate how challenging it is to compare total emissions between states with different populations. In order to give a more equitable evaluation that considers each person's access to energy resources, it is imperative to consider per capita emissions.

The right section of Figure 4 illustrates the cumulative per capita emissions over the same timeframe, spanning from 1990 to 2016. Notably, there is a significant disparity between countries in this regard. For instance, an individual living in the US has emitted 500 tonnes of CO_2 over this period, whereas someone in China has emitted approximately 120 tonnes. Australia, Canada, and Russia now rank among the highest contributors. Interestingly, the average person in India has only emitted around 30 tonnes of CO_2 over 26 years, comparable to what individuals in the most emitting four states release into the atmosphere in only two years. When comparing these figures to the global mean of 115 tonnes of CO_2 emissions per individual, it is noteworthy that those who live in the four largest polluters emit roughly fourfold the amount as the mean, while those who live in the EU emit roughly double, those who live in China emit the same as the average, while residents of India produce emissions at a rate four times lower.

As economies evolved, so did the hierarchy of emissions. Based on 2016 data from the World Bank, China leads in total emissions, comprising about 29%, trailed by the US at 15% and the EU at 8.5%. Yet, per capita, the US, Canada, and Australia maintain dominance, emitting roughly 15 tonnes per person, compared to approximately seven tonnes for China, 6.5 tonnes for the EU, and 1.8 tonnes for India. The 2016 global average CO_2 per capita was about 4.5 tonnes, emphasising significant disparities among states in emissions, with some emitting around four times more than the global mean and others emitting roughly four times less. So, the highest GHG emitters per capita are mainly in the Global North, contributing far more than countries in the Global South. Despite lower emissions, the Global South often faces the harshest impacts of climate change, showing a clear imbalance in responsibility and consequences.

All in all, amid the ongoing climate crisis, countless individuals face the threat of losing their lives, homes, and sense of self. As countries adopt various approaches to address climate change, adaptation and mitigation measures must include everyone. These disparities highlight the critical need for energy justice, which ensures that the burdens and benefits of the global energy transition are distributed fairly. Therefore, the following sub-chapter will explore the concept of energy justice in greater depth.

3.2. Diverse Views in the Literature on the Concept of Energy Justice

As stated in Chapter 3.1, energy justice has gained significant prominence in recent years due to challenges posed by climate change and the global shift towards sustainable energy solutions. Initially focused on equitable access to energy resources and fair distribution of benefits and drawbacks in energy production and consumption, the concept of energy justice has evolved. This sub-chapter, therefore, explores diverse perspectives on energy justice, including a thorough examination of restorative justice as an essential component in addressing historical and systemic inequalities within the energy transition.

3.2.1 The Concept of Justice

To begin, it is essential to understand the essence of justice. The concept of justice is often centred around three core ideas: increasing welfare, safeguarding freedom, and promoting virtue Sandel (2010). Justice is thereby a fundamental concept in ethics and social philosophy (Killen et al., 2021). Aristotle believed that justice means giving people what they deserve. To decide who deserves what, it is essential to identify which virtues deserve honour and reward. According to Aristotle (350 B.C.E./1925), laws should not be neutral about what makes a good life. In contrast, modern political thinkers, like Immanuel Kant in the eighteenth century and John Rawls in the twentieth century, argue that justice should not depend on any particular idea of virtue or the best way to live. They believe a just society should respect everyone's freedom to choose their own idea of a good life. Thus, ancient theories of justice focus on virtue, while modern theories focus on freedom.

Today, justice is centred on pursuing fairness and equality in human interactions and social structures (Killen et al., 2021). It involves treating individuals and groups with respect for their inherent dignity and rights, ensuring equal opportunities, fair distribution of resources, and upholding fundamental freedoms (McCrudden, 2008; Summers & Smith, 2014). In a broader sense, justice is not only about distributing goods and resources but also about creating a just society. This involves addressing structural inequalities, combating discrimination and promoting inclusion and participation at all levels of society. Understanding these ethical dimensions is essential for ensuring that energy transitions are fair and equitable. With a foundation in the general principles of justice, the focus now shifts to their specific application within the context of energy justice.

3.2.2 Initial Search for Energy Justice Definitions

Energy justice links justice with energy; the primary principle of social institutions is justice, and energy is a basic need that promotes human development. The notion of energy justice is relatively new but has recently gained much attention. As Pelligrini-Masini et al. (2020) mentioned in their article, the term was first used to describe distributional challenges such as energy poverty, but it has since expanded to include more aspects of energy-related processes, such as treating different populations fairly and promoting social justice in relation to the adverse impacts of energy production and infrastructure (Sovacool et al., 2017). Considering how the notion of energy justice is still evolving, it becomes necessary to examine the most widely recognised definitions available today to find common ground.

In the scientific research on energy policy, the oldest known definition of energy justice in the literature was provided by Guruswamy (2010). In his article, he stated that energy justice seeks to bring fundamental justice concepts, including fairness, to the apparent injustice experienced by those who lack access to sustainable energy —a group known as the "*energy-oppressed poor*". Additionally, he noted that the widely acknowledged grundnorm[1], or cornerstone of international law and policy, sustainable development (SD), includes energy justice as an essential and integrated aspect (Brundtland, 1987; Guruswamy, 2010). This notion was formulated by the World Commission on

[1] Hans Kelsen proposed the term "Grundnorm", which translates from German to "Basic Norm", to refer to the guiding principles that will eventually control a legal system. It serves as the foundation or basis upon which all other obligations and rights can be affirmed or refuted. General Theory of Law and State 110-13, by Hans Kelsen (Harvard Univ. Press, 1946).

Environment and Development in 1987, now known as the Brundtland Commission, a sub-organisation of the UN. The concept of SD gained popularity because of this publication. They drew attention to the severe poverty in developing countries and proposed a distributional concept named SD. The organisation argued that SD would provide social and economic development—both elements necessary for environmental protection—and satisfy the essential requirements of the world's poor.

In the literature, energy justice is also referred to as "energy equity", and it is an important component of the just transition framework as it integrates elements of "deep democracy", collaboration, and regeneration and tackles issues of fairness and equality within the energy system. There are other related facets of energy justice, such as:

- Energy burden, which is the amount spent on energy in relation to the overall earnings of the household (Hernández & Bird, 2010; Guruswamy, 2010);
- Energy insecurity, which describes the difficulties households have in providing for their most fundamental needs (Hernández & Bird, 2010);
- Energy poverty, defined as not having access to energy in general (Guruswamy, 2010); and
- Energy democracy, which holds that local people need to have a voice and agency in determining how they will use energy in the future (Burke & Stephens, 2017; Fairchild & Weinrub, 2017).

3.2.3 The Three Tenets of Energy Justice

Early in 2013, the notion of energy justice gained popularity in the literature and developed to be researched. At this point, academics began to formulate its conceptual definitions and frameworks.
In the beginning of 2013, McCauley et al. (2013) gave a notable definition. According to McCauley et al. (2013), distributive, procedural, and recognition justice are the three central tenets of energy justice, referred to as the triumvirate of tenets. Although derived from environmental and climate justice theory, these "tenets" are sometimes called the foundations of energy justice (Jenkins et al., 2014). The concept of distributive justice in energy focuses on how the costs and benefits of the energy system are allocated across different segments of society (Walker, 2009; Sovacool & Dworkin, 2015). According to Sovacool & Dworkin (2015), procedural justice demands that procedures include stakeholders in a meaningful and equitable manner that is accessible and free from discrimination. Equal representation, political equality, and freedom from dismissal based on poverty, race, culture, ethnicity, gender, or other traits are all goals of recognition justice (Sovacool & Dworkin, 2015).

The third tenet, recognition justice, however, received criticism from scholars (Byrne & Lee, 2019; Bouzarovski et al., 2023). The main criticism is that it should not exist as a separate pillar but instead be seen as part of the existing procedural justice, as it is already procedural in nature. Freedom from discrimination and equal political rights in the pursuit of justice are inherently procedural, as they are part of the process of achieving just outcomes. Next, equal political rights and freedom from discrimination are fundamental human rights based on international moral standards (United Nations, 1966). According to Bouzarovski et al. (2023), treating recognition justice separately implicitly requires a reassessment of universal human rights. However, in line with Jenkins et al. (2016) and many other scholars, this thesis maintains that recognition justice is a distinct tenet. While procedural justice focuses on how decisions are made and ensuring fair processes, recognition justice emphasises acknowledging the identities and needs of different groups. By explicitly addressing the different challenges marginalised communities face, recognition justice aims to ensure their voices are heard and respected within the broader justice framework. This approach complements procedural justice by enhancing representation and inclusivity, thus making energy justice initiatives more equitable overall.

Similar to the three tenets, Jenkins et al. (2016) define energy justice in terms of the "*what*", "*who*", and "*how*" of social justice. The "*what*" is related to equitable distribution and entails identifying problems and possible solutions. This includes understanding how energy resources, benefits, and burdens are distributed across different communities and social groups and ensuring that these distributions are fair and just. The "*who*" refers to those who should be granted authority or those who are marginalised. It stresses the need for marginalised groups to have a say in decisions that affect their lives. The "*how*" refers to the processes and frameworks guaranteeing that injustices are rectified and that future judgments are just. This includes the development and implementation of procedural mechanisms that ensure fairness, transparency, and accountability in energy-related decision-making.

3.2.4 The Core Principles of Energy Justice

Another important definition is the eight core principles of energy justice developed by Sovacool & Dworkin (2015), as illustrated in Figure 5. These principles include energy availability, sustainability, affordability, due process, transparency and accountability, intragenerational and intergenerational equity, and the responsibility to protect the environment. Two other principles, resistance and intersectionality, were added three years later (Sovacool et al., 2017). Resistance involves communities opposing unjust energy policies and advocating for their rights. Intersectionality recognises that energy justice affects individuals differently based on overlapping social identities, such as race, gender, and socioeconomic status, emphasising the need to address these different dimensions in energy justice issues. This core principles method addresses all aspects of energy-related justice issues, from extraction to end usage.

Sovacool & Dworkin (2015), the architects of these principles, have examined them within the framework of human rights, Western philosophy, and other factors. Environmental and climate justice themes are also strongly emphasised in the principles themselves. The Ten Concepts of Climate Justice are another example of how environmental and climate justice concepts are embodied in the core principles. The prevention of energy poverty and the equitable supply of high-quality energy services to everyone is necessary for accessibility, affordability, and intragenerational justice (International Climate Justice Network, 2002; UN, 2015; Sovacool & Dworkin, 2015). Numerous tools, such as social and environmental impact assessments and unbiased and informed consent processes, can establish due process, transparency, and accountability (International Climate Justice Network, 2002; UN, 2015). It Is important to recognise that the three tenets framework and core principles are closely connected, as the core principle framework also addresses procedural and distributional concerns. As a result, they have been integrated (Lappe-Osthege & Andreas, 2017).

3.2.5 Evolving Definitions of Energy Justice: Integrating Restorative Justice

Critical viewpoints on energy justice, particularly those emerging from political ecology, indigenous rights, and non-anthropocentric perspectives, argue that current concepts of energy justice often rely on broad, universal notions of justice based on Western philosophical traditions (Baasch, 2023). These perspectives contend that such ideas are too narrow, overly generalised, and predominantly human-centred and, therefore, fail to account for the diverse needs of marginalised communities and the environment.

Addressing this critique, Heffron (2021) advocates for a more inclusive and comprehensive approach in his last book on the challenges of energy justice. He states that energy justice is centred on:

- The normative goal of improving the world, i.e., making it more equitable and sustainable.
- The fundamental ideas of justice that form its foundation are distributive, restorative, procedural, and recognition justice.
- The application of human rights across the energy life cycle.

It can be seen here that in addition to the three tenets—distributive, procedural, and recognition justice—Heffron (2021) introduces restorative justice. This concept, which emerged from societal responses to injustice, focuses on healing and repairing harm rather than solely punishing offenders. Restorative justice addresses the damage done to individuals, communities, and the environment and seeks to prevent future harm (Heffron, 2021). For example, if an energy project causes environmental damage to a community, restorative justice would involve compensating the affected individuals and working to restore the environment and prevent similar issues in the future. This might include measures such as environmental remediation and implementing safeguards to avoid the recurrence of the harm. The true value of restorative justice lies in its application at the beginning of a process, where it ensures that all parties are aware of their responsibilities in case of any harm. It is a proactive approach that aims to prevent problems and strategically address risks for those who might be adversely affected by energy issues, such as being “energy-victims” or “energy-poor” (Heffron, 2021). It emphasises the importance of considering future generations in the energy transition.

It is surprising how little restorative justice is applied today, especially given that the fossil fuel industry often neglects decommissioning and effective waste management related to carbon emissions (Heffron, 2021). If restorative justice were implemented, there would likely be significantly reduced climate change and environmental damage, along with adequate financial resources to address any harm caused (Baker et al., 2019; Heffron, 2021).

No.	Principle	Description
1	Availability	People deserve sufficient energy resources of high quality (suitable to meet their end uses)
2	Affordability	All people, including the poor, should pay no more than 10% of their income for energy services
3	Due process	Countries should respect due process and human rights in their production and use of energy
4	Transparency and accountability	All people should have access to high quality information about energy and the environment and fair, transparent, and accountable forms of energy decision-making
5	Sustainability	Energy resources should be depleted with consideration for savings, community development, and precaution
6	Intragenerational equity	All people have a right to fairly access energy services
7	Intergenerational equity	Future generations have a right to enjoy a good life undisturbed by the damage our energy systems inflict on the world today
8	Responsibility	All actors have a responsibility to protect the natural environment and minimise energy-related environmental threats
9	Resistance	Energy injustices must be actively, deliberately opposed
10	Intersectionality	Expanding the idea of recognitional justice to encapsulate new and evolving identities in modern societies, as well as acknowledging how the realisation of energy justice is linked to other forms of justice e.g. socio-economic, political and environmental

Figure 5. The Ten Principles Descriptions Defining EJ According to Sovacool et al. (2017)

The potential impact of applying restorative justice is substantial and can offer a way to transform energy justice from theory into effective practice. For example, restorative justice extends beyond the traditional application of law by addressing harms in ways that standard legal systems often cannot. Typically, legal compensation for wrongdoing falls under tort law, which shares some origins with restorative justice (Appel, 2011). Tort law deals with civil wrongs where an individual seeks compensation for harm or injury caused by another party's actions or negligence (Abelkop & Kimmell, 2014). However, restorative justice is particularly useful in situations where there is no clear individual or group directly harmed or where the harm is not easily documented. In many environmental cases, the damage might be widespread, affect non-human entities, or impact future generations. The existing legal system, which focuses on tort liability, often struggles to address environmental harms when there is no direct, identifiable damage. This limitation has led some scholars to argue that tort law alone is insufficient for effective environmental regulation. Restorative justice, on the other hand, can address these issues by focusing on victims such as future generations, the environment itself, or national heritage, where traditional legal remedies fall short (Preston, 2011). This broader application of restorative justice is a significant advantage in addressing complex environmental challenges, and its institutional aspects will be discussed in more depth in Chapter 5 on the Institutional Analysis of Energy Justice.

The Fit of Restorative Justice within the Tenets Framework

The four types of justices, distributive, procedural, recognition, and restorative, are deeply interconnected. Distributive justice is related to restorative justice because restorative justice is applied to restore a distributive injustice caused by energy projects. Often, many energy projects place the primary burden on the environment, governments, and even (local) communities. Restorative justice aims to address these harms and correct the unfair distribution of benefits and burdens resulting from energy systems. Without this correction, the distribution remains unjust (Sovacool & Dworkin, 2015). This is where procedural justice intersects with restorative justice, particularly concerning the inadequacies in laws and policies for environmental restoration after energy activities. When existing laws are ineffective or lacking, it creates a procedural issue, as explained in Chapter 3.2.3. Recognition justice connects with restorative justice in advocating for fair representation and acknowledging the diverse perspectives of ethnic, racial, and sexual minorities, as well as gender differences. In the energy justice framework, merely recognising that some groups face distributive injustices is insufficient (Heffron, 2021). Greater attention must be paid to marginalised and vulnerable communities, including those who are underrepresented or misrepresented, to ensure their inclusion and fair treatment. Here, restorative justice emphasises the need to address all parts of society equally during the process of remedying harms and injustices. This is where procedural justice, with its focus on inclusivity, becomes crucial. It ensures that not only potentially affected communities are considered, but also that women, the poorest individuals, indigenous groups, and other marginalised communities have their access to justice ensured.

In summary, human rights, environmental justice, and climate justice frameworks have served as the cornerstones of energy justice theory. It is essential to recognise that energy justice is a temporal continuum that develops from environmental and climate justice. To prevent disproportionate harm to marginalised communities and achieve a just energy transition, energy justice must address both historical and ongoing injustices. Consequently, this thesis defines energy justice not merely through the traditional three core tenets but as a more comprehensive concept that includes restorative justice as a fourth critical tenet, as illustrated in Figure 6.

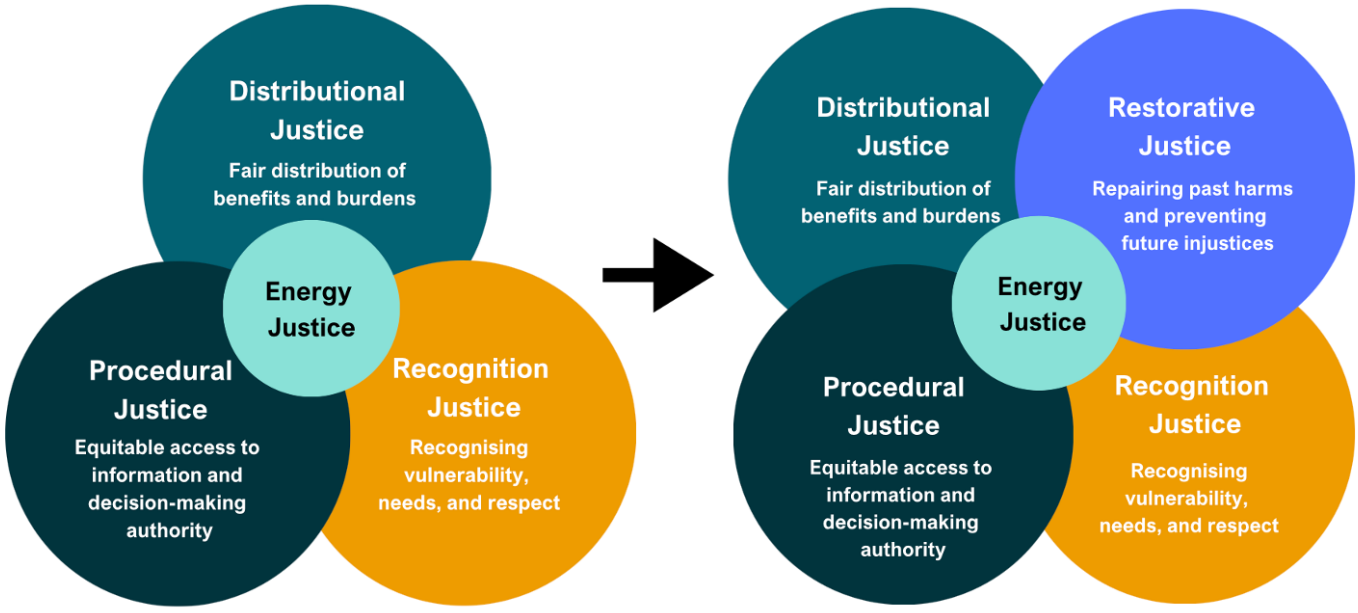

Figure 6. Restorative Justice: A New Tenet in the Existing Framework

3.3. Main Conclusion

This chapter answered the first research question: *"What are the key components of energy justice, and how is energy justice defined?"*

It examined the development of energy justice in the context of energy transition, focusing on its essential elements and the need for a broader framework. Energy justice is fundamentally about addressing inequalities in energy systems, which have serious consequences for vulnerable communities, especially with the impacts of climate change. Climate change makes these inequalities worse by affecting those who are least able to handle its effects. The chapter outlined the development of the concept of energy justice, emphasising its link to climate change and the need for fair energy systems.

Initially, energy justice was defined by three main tenets: distributive justice, procedural justice, and recognition justice. Distributive justice concerns how energy benefits and burdens are fairly shared. Procedural justice focuses on fair and inclusive decision-making processes. Recognition justice involves understanding and addressing the needs of marginalised groups. The chapter introduces restorative justice as a significant improvement to the existing tenets of energy justice. Restorative justice focuses on repairing harm and addressing both historical and systemic injustices, extending beyond the traditional human-centred aspects. It encompasses the prevention and mitigation of environmental damage, fairness across generations, and the financial compensation necessary for rectifying harm. By prioritising compensation for affected communities and ensuring remediation efforts, restorative justice adds depth to the framework, offering a more holistic approach to energy justice that considers not only current but also future impacts on both people and the environment.

In conclusion, integrating restorative justice into the framework of energy justice provides a more thorough approach to addressing both past and ongoing injustices for the people and the environment. This expanded framework ensures that energy transitions are not only fair in the present but also sustainable and equitable for future generations. The next chapter will build on this framework by examining how different ethical perspectives can further influence the application of these principles in energy transitions, particularly focusing on how restorative justice can be applied within the context of the Global South.

4

Ethical Perspectives on Energy Justice

"Ethics is knowing the difference between what you have a right to do and what is right to do."

Potter Stewart

This chapter provides an ethical analysis of achieving a fair energy transition in the Global South, building on the expanded definition of energy justice introduced in Chapter 3, which includes restorative justice as a fourth tenet. As the concept of energy justice evolves, examining its ethical dimensions becomes crucial. This chapter will explore how various ethical perspectives can influence energy transitions, focusing not just on technological changes but also on the moral implications for different stakeholders. Historical evidence shows that significant shifts often arise from socioeconomic and political changes rather than technological advancements alone. By integrating restorative justice, this chapter aims to offer a comprehensive ethical framework for energy justice, addressing current inequities, anticipating future impacts, and incorporating diverse values from both Western and non-Western perspectives. Their role is to broaden the cultural and philosophical scope, so energy justice can be viewed through a global lens, in the end leading to more balanced and equitable energy policies that reflect diverse values.

4.1. The Rationale for Conducting an Ethical Analysis

As discussed in the previous chapters, transitioning towards clean energy resources is one of the most critical decisions for safeguarding human habitability on Earth. Yet, historically and across different parts of the world, energy-related decisions have often lacked ethical consistency, particularly in how they have sometimes inadequately addressed the needs and rights of marginalised groups or have prioritised short-term economic gains over long-term environmental sustainability (Bethem et al., 2020). As population growth and energy demand continue to rise amidst the impacts of climate change, maintaining this inconsistent approach is no longer viable. Energy decisions can have profound ethical implications and affect current as well as future generations in terms of environmental sustainability, public health, and social equity (Miller, 2014). In some situations, these choices can lead to irreversible environmental degradation or lock societies in harmful energy systems and infrastructures. For these reasons, it is crucial that ethics become integral to energy decision-making.

Taking note of these moral implications, an increasing number of energy scientists and academics support more ethical research, ethics education for energy workers, and the creation of "Hippocratic Oaths" for decision-makers in the energy sector to guarantee they "do no harm" (Sovacool, 2014). Using an ethics framework with a chosen set of eight views from both Western and non-Western traditions, this framework could help decision-makers incorporate ethical issues methodically. The selection of eight ethical theories includes influential Western approaches such as utilitarianism,

deontological ethics (Kantian ethics), liberal egalitarianism (Rawlsian ethics), and the capability approach. These frameworks were chosen for their significant roles in discussions of justice, fairness, and equality in policy analysis. Complementing these Western views are non-Western perspectives, including Ubuntu from South Africa, Dharma from Indian philosophy, Confucianism from China, and Buen Vivir from the indigenous cultures of Latin America. These non-Western frameworks offer valuable contributions and mostly emphasise community well-being, harmony with nature, and collective responsibility, which may often be overlooked in the strong individualist tradition in Western philosophy (Vintiadis, 2021).

The decision to limit the framework to these eight perspectives rather than include a wider array of ethical theories was made to balance diversity and practical applicability. These eight perspectives represent a wide variety of cultural contexts and philosophical traditions. Incorporating diverse ethical perspectives from different geographical origins, cultural contexts, and philosophical traditions, especially non-Western viewpoints, provides a holistic understanding of energy justice. With this diverse integration, energy policies could be more globally inclusive and culturally sensitive, which, in the end, can lead to more equitable outcomes. This approach strengthens subsequent research phases and could contribute to more robust policy analyses and recommendations for the evolving energy landscape.

4.2. Western Perspectives

4.2.1 Utilitarianism

The fundamental idea of utilitarianism is that the highest principle of morality is to maximise happiness, defined as the overall balance of pleasure over pain (Bentham, 1789). "Utility" refers to the measure of pleasure or satisfaction gained from an action. The correct action is the one that maximises utility, a principle that applies to both individuals and lawmakers. When determining which laws or policies to implement, the government should aim to maximise the happiness of the entire community. Therefore, both citizens as legislators should consider whether the total benefits of a policy, after subtracting the costs, will generate more happiness than the alternative options.

One significant criticism of utilitarianism is its failure to respect individual rights (Graafland, 2009). Utilitarianism could overlook and harm individual people by focusing solely on the overall sum of satisfactions. Consequently, if strictly followed, utilitarian principles might justify actions that violate fundamental norms of decency and respect toward individuals. The second criticism of utilitarianism is that it claims to offer a scientific approach to morality by measuring and calculating happiness and treating all preferences equally (Sandel, 2010). This method is appealing and influences economic reasoning, but it requires reducing all values to a single scale. Critics argue that this reductionist approach, evident in cost-benefit analyses where even human life is assigned a monetary value, oversimplifies complex moral values (Graafland, 2009; Sandel, 2010).

Mill aimed to address utilitarianism's criticisms by presenting it as a more humane doctrine. He emphasised that individual freedom should be upheld as long as it does not harm others, arguing that the government should not impose beliefs or restrict personal liberty (Mill & Crisp, 1998). Unlike Bentham, who treated all pleasures as equal, Mill distinguished between higher and lower pleasures, arguing that human dignity and individuality should be considered alongside utility (Mill & Crisp, 1998). This approach aims to reconcile individual rights with utilitarian principles and address concerns that utilitarianism reduces complex moral values to mere calculations of pleasure and pain.

Application to Energy Justice

Utilitarianism can be applied to energy justice by focusing on maximising the overall well-being derived from energy systems. This involves assessing policies and practices based on their ability to improve collective happiness while minimising harm. However, the criticisms of utilitarianism on individual rights are very important, especially in the context of energy justice. As discussed by Sovacool & Dworkin (2015), utilitarianism must address the negative externalities associated with energy production, such as environmental degradation and public health issues. For example, extractive industries for scarce materials needed for the energy transition, nuclear waste, and air pollution disproportionately affect marginalised communities and can infringe on their rights.

Integrating restorative justice, utilitarian approaches could include using carbon tax revenues to fund health services and environmental cleanup in affected areas or supporting renewable energy projects and job training through environmental bonds. Accurate pricing of energy could be coupled with subsidies for disadvantaged communities to ensure they are not unduly burdened. while reflecting true environmental costs. These solutions are grounded in utilitarian principles because they aim to internalise the external costs of energy production and consumption. By reflecting the true social and environmental costs in energy prices, these strategies work to minimise overall harm and promote policies that enhance collective well-being. In doing so, they align with the utilitarian goal of maximising happiness and reducing suffering for the greatest number of people.

From a utilitarian perspective, energy policies that reduce environmental harm and promote sustainability increase long-term well-being and benefit current and future generations, only if it contributes to the greatest happiness for the greatest number. Economic policies are justifiable if they increase overall happiness, but cost-benefit analyses must include environmental and social impacts. Building on Mill's idea of higher and lower pleasures, energy justice should consider both the quantity and quality of happiness. For instance, access to clean energy improves individual dignity but also aligns with the utilitarian aim of reducing suffering and promoting well-being. Thus, utilitarianism supports an energy system that balances environmental sustainability with equitable benefits, ensuring the greatest overall happiness.

4.2.2 Deontological Ethics – Kantian Ethics

Kantian ethics offers a different perspective on morality, grounded in the belief that humans are rational beings who deserve dignity and respect (Sandel, 2010). According to Kant, morality is rooted not in maximising happiness but in treating people as ends in themselves rather than as means to an end. His seminal work, *Groundwork of the Metaphysics of Morals* (1785), critiques utilitarianism by arguing that ethical actions must adhere to universal moral laws and respect individual rights. Kant's philosophy underpins the concept of universal human rights, focusing on principles of duty and respect rather than consequential outcomes. Kant opposes the utilitarian view that the right action is the one that maximises welfare (Wuerth, 2014). He argues that basing rights on what generates the most happiness makes those rights "unstable", because they would shift with changing circumstances and outcomes, making them unsuitable as the foundation for universal moral principles.

Kant asserts that each individual deserves respect, not due to self-ownership, but because of their capacity for rational thought. Individuals are autonomous entities, capable of making free choices and acting independently. It is not about selecting the best means to achieve a given goal; rather, it involves choosing the goal itself for its own value, a decision that only humans can make. Thus, the moral value of an action is determined not by its outcomes, but by the intention behind it, known as the 'motive'. The motive is the reason for acting out of a sense of duty, rather than personal satisfaction or pleasure. The importance lies in doing what is right because it is inherently right, not for any personal satisfaction it might bring. In Kantian ethics, if individuals help others merely for the pleasure they provide, their actions lack moral value. However, if individuals recognise a duty to assist others and act based on that duty, the pleasure they derive from it does not diminish the moral worth of their actions.

Humanity can be regarded as an intrinsic value and an end in itself. The principle of treating humanity as an end requires one to act in a manner that always respects humanity, whether in oneself or in others, never merely as a means but always as an end as well. Kantian respect involves valuing humanity as such, which supports the concept of universal human rights. According to Kant, justice necessitates upholding the human rights of every individual, regardless of their location or our similarity with them, simply because they are human beings and thus deserving of respect.

Application to Energy Justice

In the context of energy justice, universal human rights demand protecting individuals' dignity throughout energy production and use, in line with Kant's principle of respecting people as ends in themselves. Violations, such as death and civil conflict, often occur in the pursuit of energy resources and technological advancements (Sovacool & Dworkin, 2015). Energy production can worsen military conflicts and environmental damage, compromising rights and autonomy. Energy justice thus involves assessing how policies impact human rights and dignity, such as the effects on communities near extraction sites. Restorative justice emphasises addressing and rectifying historical and ongoing

injustices, ensuring that energy policies prevent harm and repair past damages to uphold individuals' dignity. Kantian ethics would demand that these communities are not treated merely as means to an end, such as economic gain or resource acquisition, but as ends in themselves, deserving of protection and respect.

Several measures could address these injustices. Firstly, transparency in resource extraction such as detailed reporting and accountability mechanisms can help uphold human rights by ensuring that extraction processes are conducted ethically and do not exploit or harm local communities (Sovacool & Dworkin, 2015). This means that companies and governments must disclose information about their extraction practices, financial transactions, and environmental impacts. Establishing energy truth commissions and inspection panels could ensure accountability and address past wrongs in energy production practices. These bodies would investigate past and ongoing injustices, offering affected communities a platform for concerns and redress. Improved social and environmental impact assessments are crucial for ensuring energy projects respect human rights and avoid harming vulnerable communities. Conducted before project initiation, these assessments would involve input from local communities, environmental experts, and human rights advocates, evaluating potential health and environmental impacts and mitigating foreseeable risks.

Providing legal support to those affected by energy injustices could help protect their rights and make sure justice is realised. Access to legal aid allows marginalised groups to challenge unjust practices and seek compensation for damages incurred. It also empowers them to participate in decision-making processes, ensuring their voices are heard and their rights are considered. Moreover, policies could be developed to ensure equitable distribution of energy resources and benefits. This involves prioritising access to clean and affordable energy for all, particularly for marginalised and disadvantaged communities. Energy justice requires a commitment to sustainable practices that do not compromise the ability of future generations to meet their own needs, reflecting Kant's principle of treating humanity as an end in itself. These possible solutions are designed to ensure that energy production and use respect human dignity and autonomy, which aligns with Kantian ethics and could contribute to a more just and equitable energy system.

4.2.3 Liberal Egalitarianism – Rawlsian Ethics

Rawls is well known for his "veil of ignorance" concept (Moser, 2023). This introduces the idea of a social contract, imagined in a hypothetical "original position" where everyone is equal and unaware of their personal circumstances—such as their social status, abilities, or personal goals (Rawls, 2005). This "veil of ignorance" guarantees fairness by preventing individuals from using their specific advantages or disadvantages to influence the outcome of the contract. This way, the principles chosen would be fair and just for everyone, regardless of their eventual position in society (Rawls, 2005).

According to Rawls, two principles of justice emerge from this hypothetical contract (Rawls, 2005). The first guarantees equal basic liberties for all, such as freedom of speech and religion, and takes precedence over considerations of social utility or welfare. Behind the veil of ignorance, people would agree on protecting fundamental rights and liberties, fearing oppression if they were in a minority. Therefore, these rights would not be sacrificed for general welfare. The second principle allows for social and economic inequalities only if they benefit the least advantaged members of society. This means that while income and wealth do not need to be equally distributed, any existing disparities must improve the situation of those who are worst off, so that their condition is better than it would be in a less equitable society.

At an individual level, supportive families offer clear advantages, such as access to quality education, healthcare, and infrastructure, which provide significant benefits. However, if participants start from unequal positions, competition is inherently unfair. Rawls argues that even with formal equality of opportunity, the free market’s income and wealth distribution is unjust (Rawls, 2005). To address this, a just meritocracy must correct social and economic disadvantages, offering equal chances to all. Hence, individuals from disadvantaged backgrounds have the same opportunities as those from privileged ones. Rawls contends that while meritocracy addresses some inequities, it still falls short of true justice, as it relies on morally arbitrary criteria. He advocates for a system where individuals share in each other's fates and only exploit natural and social advantages if it benefits everyone collectively.

Application to Energy Justice

Using the veil of ignorance to address energy access, an energy system would be designed without knowledge of one's own position in society, ensuring fairness in policy-making. Rawlsian principles advocate for equal access and subsistence, thereby aiming to create a system where everyone can obtain the energy they need. Restorative justice complements this by addressing historical and ongoing injustices, focusing on rectifying past disparities for equal access to energy. This includes investing in infrastructure improvements for marginalised communities and supporting those most affected by inadequate energy access. For example, initiatives could focus on upgrading energy technology and alleviating the burdens of traditional fuel collection, which often impact women and children in emerging economies (Sovacool & Dworkin, 2015). By integrating restorative justice, energy policies can ensure equal opportunities and the repair of historical wrongs, aligning with Rawlsian ethics' emphasis on creating a fairer society.

An example of a Rawlsian approach to energy justice is prioritizing the needs of the least advantaged, particularly those who have been impacted by past injustices. In line with Rawls' second principle, which permits social and economic inequalities only if they benefit the most disadvantaged, this approach would lead to policies ensuring that vulnerable populations have access to clean, affordable energy. Investments would focus on energy infrastructure that supports underserved communities, such as rural electrification and renewable energy projects. Initiatives like solar home systems and improved cookstoves would address immediate needs, while mechanical energy solutions for irrigation and agricultural processing would ease the burdens of fuelwood and water collection, which could improve the quality of life in the Global South (Sovacool & Dworkin, 2015).

Furthermore, by applying Rawlsian ethics, energy policies are designed to be inclusive and participatory. This means involving local communities in decision-making and ensuring their voices are heard. For instance, community-based renewable energy projects can give people control over their resources, improving local economic development. Education and training on sustainable energy technologies also empower disadvantaged communities, improving self-sufficiency and creating job opportunities. In addition to these measures, international cooperation and support are essential for achieving energy justice on a global scale. Developed countries have a moral obligation to assist developing nations in building sustainable and equitable energy systems. This can be done through financial aid, technology transfer, and capacity-building initiatives. By having global partnerships, the international community can help supporting that all countries have the resources and support needed to achieve energy justice.

4.2.4 Capability Approach

Sen's Capabilities Approach distinguishes between “functionings” and “capabilities” when evaluating life quality in various cultural contexts (Sen, 2004). “Functionings” refer to the various states of being and doing that a person can achieve, such as having access to clean energy or using energy-efficient appliances. For instance, driving an electric vehicle represents a specific function that results from the capability to access and use sustainable energy options. However, the focus is not only on achieving such outcomes but also on ensuring that individuals have the freedom and opportunities, the “capabilities”, to achieve them. This distinction highlights the need to address both the actual achievements (functionings) and the underlying opportunities (capabilities) necessary for achieving a high quality of life. According to Sen (2004), justice involves creating conditions where everyone has the actual ability to pursue valuable functionings. This means addressing systemic barriers and inequalities to improve individuals' capabilities so they can lead lives they have reason to value. Thus, policies should not only focus on achieving specific functionings but also on expanding people's capabilities, thereby promoting justice through equitable access to opportunities that improve life quality.

Unlike Sen's approach, Nussbaum’s capabilities approach, drawing from Aristotle and Marx, emphasises that functionings should reflect human dignity and the full range of human potential. She argues that for a functioning to be valuable, it must be carried out in a way that fully expresses and respects human capacities and capabilities (Nussbaum, 2011). She criticises Sen for failing to provide a set of essential capabilities and openly opposing cultural relativism. Nussbaum has a list of essential capabilities, and examples of these key capabilities for a just society include maintaining bodily health,

controlling one's environment, and participating in political processes to influence resource access and policy decisions.

Practical reason and affiliation are two other critical capacities that Nussbaum emphasises as essential for leading a free and honourable life in which individuals can choose their own paths while connecting with others (Nussbaum, 2011). She clarifies that while her list of competencies is comprehensive enough to outline what a good life entails, it is also flexible enough to allow individuals to decide how they use these competencies. Additionally, Nussbaum believes that society should use institutions to ensure that every individual has a minimum degree of these essential capacities. Nevertheless, she is aware that it might not be sufficient to only reach this fundamental level to attain full justice.

Application to Energy Justice

In order to support various capabilities relevant to daily life, access to energy services is essential for activities like mobility, cooking, heating, and cooling. In today's digital world, reliable energy is also crucial for accessing information, staying connected, and engaging with government services. Without adequate energy, multidimensional capacity shortages can quickly arise. Day et al. (2016) describe energy scarcity as the inability to achieve necessary capabilities due to a lack of affordable, reliable, and secure energy, while considering available alternatives. They argue that defining energy scarcity in terms of capacities highlights its effects on well-being and human flourishing. For instance, driving a gasoline-powered vehicle enhances mobility but also contributes to environmental damage, affecting global capacities and introducing a justice component to these externalities.

Encouraging everyone to reach a threshold of certain capabilities—as Nussbaum (2000) argues—requires not only ensuring access to energy but also mitigating the past and current negative effects of energy generation. This threshold is typically measured by evaluating whether individuals can achieve essential capabilities such as maintaining bodily health, controlling their environment, and participating in political processes. Using the capabilities lens to address energy scarcity shifts focus from energy itself to its intended outcomes (Day et al., 2016). Sovacool and Dworkin (2015) argue that everyone has a right to a basic level of energy, reflecting Nussbaum's essential competencies. Hillerbrand (2018) suggests that the Capability Approach provides a comprehensive framework for understanding the interplay between technology, the environment, and human well-being. Unlike preference-based utilitarianism, it offers an objective measure of well-being, facilitating comparisons and addressing justice concerns.

According to Wood and Roelich (2019), while fossil fuels increase well-being, they also drive climate change, which undermines well-being overall. Reducing fossil fuel use is essential for combating climate change, but it may disproportionately impact households already facing energy scarcity. In line with the Capability Approach, researchers suggest that electrification programmes should focus on improving individuals', families', and communities' capabilities, not just increasing electricity availability (Tarekegne 2020; Jodoin 2021; Chi-pango 2021). These studies found that while sustainable energy improvements generally increased overall capabilities, the benefits were not distributed equitably among all people. Gender was a significant factor (Cole, 2018), and Arnaiz et al. (2018) even came to the conclusion that in particular instances, certain capabilities and functions were diminished by the abrupt change and some households were unable to pay the expenses of electricity or electrical devices (Malakar 2018; Cole 2018). Integrating the Capability Approach into energy justice frameworks, therefore, could offer a more holistic and inclusive understanding of how energy systems contribute to, or diminish, human flourishing across diverse energy contexts.

4.3. Non-Western Perspectives

4.3.1 Ubuntu of South Africa

Ubuntu is an African philosophy originating from South Africa and is central to the ethical and moral frameworks of many African societies. The term "Ubuntu" is derived from the Nguni Bantu term "*umuntu ngumuntu ngabantu*", which translates to "*a person is a person through other persons*". This concept shows the interconnectedness of all people and the idea that an individual's humanity is tied to the humanity of others. It represents a cultural and philosophical perspective that highlights human dignity, which is realised through fostering strong interpersonal connections and ensuring social harmony (Metz, 2011). Ubuntu, therefore, nurtures a sense of community, mutual care, and respect, all of which

are crucial for maintaining this social harmony (Gade, 2011). Ubuntu is often characterised by the values of compassion, reciprocity, dignity, harmony, and humanity, which are used to build and maintain community.

People are considered integral members of society, which itself is embedded within the larger biosphere and cosmos (Chuwa, 2014). This perspective entails a responsibility toward fellow individuals and a duty to safeguard the health of the natural environment. For instance, traditional Ubuntu practices often involve communal decision-making about resource use, where the well-being of the community and the environment is considered alongside individual needs. This approach differs with more individualistic ethical frameworks, where personal rights and interests are often prioritised (Metz, 2011). Instead, Ubuntu's focus on the collective well-being encourages a balance between personal and communal responsibilities, reflecting the principle of "*cognatus sum, ergo sumus*", meaning "*I am recognised, therefore we exist together*" or "*a person becomes a person through the presence of others*" (Chuwa, 2014). This principle aligns with the concept of recognition justice, by promoting mutual recognition and interdependence, Ubuntu supports the idea that personal dignity and identity are deeply connected to the collective well-being, and thereby highlight the importance of recognising and valuing each person's role within the broader social context.

Interdependence also supports the notion that non-human beings should be granted moral consideration because of their relationships with humans. Ubuntu, grounded in communitarian values, sees justice as caring for and being responsible to others, with the common good and improving life quality as key outcomes. In practice, Ubuntu promotes a culture where collective well-being is prioritised, and individuals are encouraged to contribute to the common good. It is not merely an abstract idea but a way of life that influences various aspects of society, including governance, law, and conflict resolution. For instance, the Ubuntu philosophy has been applied in South Africa's Truth and Reconciliation Commission (TRC), which aimed to foster national unity and healing by acknowledging victims' experiences and promoting forgiveness and restitution (ZA, n.d.). Ubuntu has been instrumental in South Africa's transition to democracy, especially in promoting reconciliation and restorative justice during the post-apartheid era (Ramose, 2002).

Application to Energy Justice

The Ubuntu philosophy's emphasis on interconnectedness and mutual care aligns with the goals of energy justice, which seeks to ensure that energy systems are fair and inclusive. In the context of South Africa and other parts of the Global South, where energy access disparities are significant, Ubuntu could guide policies and practices that aim to reduce inequalities and promote shared benefits. The principle of communal responsibility implies that energy systems should be designed and managed in a way that benefits the entire community, including the most vulnerable members. This could involve community-based renewable energy projects that are locally managed and owned, so that the benefits of energy generation are distributed fairly among all members of the community. For example, initiatives that provide solar power to off-grid rural areas could improve energy access but also empower communities by involving them in the decision-making processes and management of these resources (Baker, 2012).

Furthermore, Ubuntu's emphasis on restorative justice could complement initiatives aimed at remedying historical and current injustices related to energy access and distribution. In many cases, energy projects have led to the displacement of communities and the disruption of their traditional livelihoods. Ubuntu here can support reparative actions that focus on restoring dignity and increasing the well-being of the affected people. For example, if a community is displaced by the construction of a hydroelectric dam, Ubuntu would advocate for comprehensive reparative measures such as financial compensation for lost land and resources, which helps residents rebuild their lives. Additionally, Ubuntu emphasises involving affected communities in decision-making for future energy projects. For instance, when planning a new renewable energy initiative, Ubuntu would support including community members in discussions so their needs and concerns are addressed in how energy resources are managed.

By incorporating Ubuntu principles into energy policies and practices, the aim is to build more equitable and resilient energy systems. Ubuntu's focus on collective action and mutual support aligns with creating energy solutions that are fair and sustainable. This approach not only addresses the historical and ongoing injustices associated with energy access but also strengthens community bonds and resilience. In doing so, Ubuntu aims to a more just energy transition that respects the interconnectedness of all people and nature and that energy benefits are shared equitably.

4.3.2 Dharma in the Indian Subcontinent

Dharma is a central concept in Indian philosophy, particularly within Hinduism, Buddhism, Jainism, and Sikhism. It refers to the moral law, duty, and righteousness that govern individual conduct and societal order. In Hinduism, Dharma includes the duties, rights, laws, conduct, and virtues that uphold the cosmic order (*Rta*). It is both a personal and social ethic, with the aim of guiding individuals in their roles and responsibilities within their families, communities, and the broader world (Klostermaier, 2007). The concept of Dharma is fluid and context-specific and renders itself to different social realities, meaning that what constitutes righteous action can vary depending on one's age, caste, gender, and stage of life. Despite this variability, the overarching principle is maintaining balance and harmony in the universe. Dharma's association with the idea of duty can be compared to the ethics of duty as articulated by Immanuel Kant. Like Kantian ethics, which emphasises adherence to universal moral laws and duties irrespective of consequences, Dharma also emphasises fulfilling one's obligations to uphold social and cosmic order. This includes duties towards oneself, one's family, society, and the environment (Doniger, 2010). However, while Kantian ethics focuses on universal principles and individual autonomy, Dharma integrates these duties into a broader, context-sensitive framework that reflects both personal and communal responsibilities.

In the broader context of Indian philosophy, Dharma is also linked to the pursuit of justice and the common good. It represents a set of principles and ethical standards that guide individuals and institutions in their actions. Specifically, Dharma emphasises the importance of maintaining societal order, ensuring long-term prosperity, and increasing the well-being of the community (Halbfass, 1988). These principles are not merely abstract ideals as they could offer practical guidance for judicial and policy-making bodies in making decisions that promote fairness and equity. For example, Dharma advocates for equitable resource distribution, which can influence policies related to social welfare and economic justice. By integrating these ethical considerations, policymakers in turn could better address the needs of marginalised groups and contribute to a more just and harmonious society.

Beyond its application in justice and societal well-being, Dharma also offers insights into ethical and environmental care. It emphasises living in harmony with nature, advocating for practices that preserve ecological balance and promote sustainability. This perspective encourages a long-term view of environmental responsibility, which is increasingly relevant in the context of global challenges such as climate change and resource depletion (Clooney, 2005). Dharma's emphasis on interconnectedness and respect for all forms of life provides a valuable ethical framework for addressing contemporary issues like EJ, where the impact on both human and environmental health must be considered.

Application to Energy Justice

Dharma's principles offer a valuable framework for addressing energy justice by emphasising fairness, responsibility, and sustainability. In the context of energy policies, Dharma would advocate for the equitable distribution of resources, so that all communities, especially marginalised ones, have fair access to energy. It promotes policies that consider the long-term impacts of energy projects on both people and the environment, aligning with the idea of preserving balance and harmony. For instance, Dharma would support initiatives that provide compensation and support to communities displaced by energy projects, such as those affected by the construction of hydroelectric dams, so that they receive fair treatment and resources to rebuild their lives.

Moreover, Dharma's focus on environmental stewardship can guide energy practices towards more sustainable solutions. It would encourage the adoption of renewable energy sources in a way that minimise ecological harm and safeguard natural resources for future generations. By integrating Dharma into energy planning, policymakers can develop strategies that balance immediate energy needs with long-term environmental goals, promoting practices that reduce carbon footprints and protect ecosystems. This approach aligns with Dharma's holistic view, which sees human and environmental well-being as interconnected.

Finally, Dharma's emphasis on community involvement and ethical conduct reinforces the importance of inclusive decision-making in energy projects. It supports engaging affected communities in the planning and implementation of energy initiatives, making sure their voices are heard and their needs addressed. By applying Dharma, energy policies could be formulated in a way that reflects the values of justice, respect, and mutual support, which leads to more equitable and sustainable outcomes. This, in turn, would build resilience and trust within communities, which is essential for achieving energy justice.

4.3.3 Confucianism from China

Confucianism, originating from the teachings of Confucius (Kongzi) in the 6th century BCE, is a philosophical and ethical system deeply rooted in Chinese culture. According to Cline (2014), Confucianism is characterised as a form of virtue ethics that emphasises both the welfare of social groups and the personal development of individuals. It centres on the concept of "*dao*" or *"The Way"* and its relationship with "de" or virtue (Cline, 2009). The Way encompasses both correct actions and the goodness they produce, integrating right conduct with beneficial outcomes. However, Confucianism emphasises acting correctly and cultivating virtue, rather than solely focusing on immediate results (Angle, 2012; Cheng, 1997). Therefore, an action is deemed correct if it reflects virtues and develops human character, with moral advancement being achieved through the cultivation of qualities like compassion, justice, propriety, wisdom, and integrity, along with a strong sense of fairness (Cline, 2009; Angle, 2012).

While justice is not a final goal in itself, having a strong sense of justice among people supports the broader aims of creating a humane and harmonious society. In Confucianism, justice involves avoiding harm to others and assisting them in attaining virtue, especially those who are marginalised (Cline, 2009; Cheng, 1997; Qiyong, 2013). Confucius taught that a just society is one where rulers are virtuous and lead by example, and where individuals fulfill their roles and responsibilities within the social hierarchy. This emphasis on moral duty and the collective good is therefore central to Confucian ethics, by promoting a vision of social harmony and moral integrity (Tu, 1998).

Confucianism has been highly influential in shaping social and political institutions in China and continues to be relevant in contemporary discussions about ethics and governance (Bell, 2010). It offers insights into ethical leadership and policy-making by emphasising the alignment of personal integrity with public responsibility. Its principles advocate for governance that prioritises moral character and social equity, suggesting that leaders should model virtue and prioritise the common good. These values are increasingly pertinent as contemporary societies tackle complex issues like climate change, where global cooperation and ethical stewardship of resources are essential. By integrating Confucian values, such as moral education and virtue cultivation, modern policies can address inequality and foster a more equitable and sustainable future.

Application to Energy Justice

Confucian principles could provide a robust framework for addressing energy justice by integrating ethical leadership and social responsibility into energy policies and practices. Central to Confucianism is the concept of "The Way", where importance is put on both ethical conduct and its positive outcomes. This means that developing and implementing energy policies should not only seek efficient and sustainable energy solutions but must also reflect virtues such as fairness, integrity, and concern for the welfare of all community members. By ensuring that energy projects are conducted with a focus on long-term benefits and minimal harm, Confucianism advocates for a balanced approach that harmonises environmental sustainability with social equity.

The Confucian approach to justice can directly impact energy justice initiatives by addressing the importance of helping marginalised groups, while also ensuring that leaders act virtuously. This perspective promotes a just distribution of energy resources, so that disadvantaged communities should receive equitable access and benefit from energy projects. Moreover, Confucianism's focus on moral duty extends to restorative justice, suggesting that past harms of energy projects should be addressed through reparative measures. This might include providing restitution to impacted communities, actively engaging them in decision-making, and incorporating their perspectives into future energy strategies to create a more inclusive and supportive energy system.

As global energy systems evolve towards sustainability, Confucianism's emphasis on virtue and the common good offers valuable guidance for energy justice. By advocating for responsible resource management and emphasising the importance of moral leadership, Confucian values align with the goals of a just energy transition that balances ecological health with social equity. Integrating these principles into energy policies can lead to more equitable and resilient systems, so that the benefits of sustainable energy transitions are broadly shared and that future generations inherit a more balanced and just energy landscape (Bell, 2010).

4.3.4 Buen Vivir from Latin America

Buen Vivir, or "*Good Living*", is a concept that is deeply embedded in the indigenous cultures of Latin America, particularly among the Andean communities. It represents a vision of well-being that interweaves ecological balance, social equity, and cultural richness. Acosta (2018) describes Buen Vivir as a philosophy that advocates living in harmony with nature, emphasising collective well-being over individual wealth accumulation. This perspective challenges conventional economic models by prioritising environmental sustainability and communal life rather than solely material gain. A core criticism of Western lifestyles is their perceived neglect of human obligations and responsibilities toward the natural environment (Manno & Martin, 2015). Buen Vivir envisions development as a process that not only supports human prosperity but also nurtures the health of the natural world and the integrity of cultural traditions, focusing on a holistic approach to progress (Gudynas, 2011).

In practical terms, Buen Vivir calls for development strategies that respect the intrinsic value of nature and focus on improving community welfare. It supports policies that harmonise economic activities with ecological conservation and social justice. For example, Buen Vivir promotes initiatives that ensure fair distribution of resources and protect indigenous territories from exploitation and environmental degradation. Moreover, it encourages participatory decision-making, where communities directly impacted by resource management have an active role in shaping policies and practices. This aims to address and correct historical inequalities, with an equitable framework for development that aligns economic activities with both social and environmental responsibilities (Acosta, 2018; Gudynas, 2011).

The principles of Buen Vivir advocate for cultivating a cultural mindset that recognises the interconnectedness of all life forms, emphasising a way of living through responsibility and respect for oneself, others, and the natural world. This perspective promotes development practices that are informed by long-term experience and adherence to cultural protocols, aiming to avoid disruptive changes to ecosystems and stressing the need for ecological restoration (Sovacool et al., 2017). By embracing Buen Vivir's values, development initiatives can reflect a profound respect for ecological balance and cultural heritage, so that progress is achieved with careful consideration of its environmental and social impacts. This approach supports a sustainable way of living that aligns with the broader goals of maintaining harmony with nature and enhancing collective well-being (Acosta, 2018).

Application to Energy Justice

Buen Vivir offers a holistic approach to energy justice by emphasising the integration of ecological and social considerations into energy policy and practice. This concept advocates for energy systems that prioritise long-term sustainability and respect for natural and cultural systems. By embedding principles of Buen Vivir into energy planning, policymakers are able to guarentee that energy transitions do not merely focus on technological advancements but also address the preservation of ecological integrity and cultural values. This approach calls for energy solutions that are developed through a thorough understanding of their impacts on both ecosystems and communities, promoting responsible resource use and minimising environmental disruption (Acosta, 2018).

In practical terms, applying Buen Vivir to energy justice involves designing policies that support equitable resource distribution and incorporate the needs and perspectives of marginalised and indigenous communities. This means actively involving these communities in decision-making processes, so they have an important role in shaping energy policies and projects that affect their lives and territories. For instance, Buen Vivir principles would support energy projects that not only provide fair benefits but also protect local ecosystems and cultural sites from degradation. By prioritising community engagement and environmental stewardship, energy systems can be developed in a way that addresses historical injustices and promotes a more inclusive and equitable energy future (Gudynas, 2011; Sovacool et al., 2017).

The application of Buen Vivir to energy justice also entails cultivating a mindset that values the interconnectedness of all life forms and adheres to long-standing cultural practices. This perspective encourages energy policies that are informed by a deep respect for ecological balance and cultural heritage, ensuring that energy transitions are conducted with careful consideration of their long-term impacts (Acosta, 2018). By supporting development practices that align with Buen Vivir's principles, societies can create energy systems that increase collective well-being and environmental health, ultimately supporting a more sustainable and just energy landscape.

4.4. Synthesis of Ethical Perspectives

Integrating diverse Western and non-Western ethical frameworks offers a better understanding of justice, fairness, and responsibility in energy systems. Each perspective provides unique insights into how energy systems should operate, reflecting a variety of values and principles. This synthesis sets out the similarities and differences between these ethical viewpoints and explores how they can address the development of equitable and sustainable energy governance.

4.4.1 Convergence: Shared Ethical Foundation

Interconnectedness & Collective Responsibility

Both Western and non-Western perspectives value interconnectedness, but they prioritise it in different ways. In Western thought, ideas such as in utilitarian or Rawlsian perspectives seek the greatest happiness shared by all and a more just society where inequalities are remediated particularly for the least advantaged in society. While Ubuntu and Buen Vivir share with the Western tradition its commitment to collective well-being, they do so from a perspective that sets much greater emphasis on community, relationality and the nature of all beings, both human and non-human beings. In both frameworks there is also a recognition that individual rights and responsibilities must be balanced with the needs of the community and the environment. Ubuntu expresses this through the idea that “a person is a person through other persons”, while Rawls’ Theory of Justice aims to arrange societal structures so that even the least advantaged benefit from resource distribution. These perspectives come together on the principle that energy systems should be designed not only to increase efficiency but also to make sure that the most vulnerable are not left behind.

Justice & Equity

There are different approaches to justice in these two traditions, but both take the concept of justice as a foundational principle. Western theories, such as Rawls’ justice as fairness and Kantian deontology, stress individual rights and the impartial application of rules in order to guarantee just outcomes for all parties involved. However, the individual remains the primary focus in these perspectives. Non-Western frameworks such as Dharma and Confucianism in contrast, place greater emphasis on duties and relationships and position justice as a relational process in society that maintains order within society and between humans and nature. This difference provides a valuable complementarity as Western perspectives endow rights upon individuals by focusing on procedural fairness and entitlements of the individual, while non-Western views focus on collective responsibilities toward communities, humanity, and ecosystems. By integrating these perspectives, a more holistic view of justice comes out, namely one that balances individual rights with communal responsibilities. This balance shows that energy justice needs to be both inclusive and participatory so that communities affected by (historical) injustices have a say in shaping energy policies and that decision-making processes reflect collective interests from the ground up.

Environmental Sustainability

Both Western and non-Western ethical perspectives show concern for environmental sustainability in distinct manners. In Western ethics, perspectives such as Kantian ethics, liberal egalitarianism, the capabilities approach, and utilitarianism mainly consider nature primarily in terms of its value to human well-being. Kantian ethics might advocate for treating nature with respect because of its intrinsic value, but mainly as it relates to human duties and responsibilities. Liberal egalitarianism tends to focus on a fair distribution of resources, including environmental resources, to support equality among people. The capabilities approach focuses on the need to preserve natural resources to support individuals' capabilities. Utilitarianism, on the other hand, emphasises maximising overall happiness, which includes considering the benefits and harms of environmental policies on human well-being. At the same time, non-Western ethical frameworks, as Buen Vivir and Dharma, often adopt a perspective that is less anthropocentric and more integrative of nature. These traditions view the environment as an essential part of a broader web of life, with its own intrinsic value and importance. Buen Vivir advocates for living in harmony with nature, focusing on sustainable practices that respect both the environment and cultural traditions. Dharma similarly stresses a balance between human activities and ecological harmony and thereby reflecting a view that goes beyond human-centred concerns to consider the well-being of all life forms.

4.4.2 Divergence: Varied Ethical Foundation

A major point of departure between Western and non-Western moral philosophy is the way in which individualism contrasts with communitarian ethics. Western ethical theories, especially liberalism and Kantian ethics put forward a strong focus on individual autonomy, rights and moral agency. These frameworks often evaluate justice based on how well they protect individual freedoms, as seen in the work of John Stuart Mill and Immanuel Kant. In energy justice discourse, this could mean that policies prioritise personal energy access, consumer choice, and market-based solutions. In contrast, non-Western perspectives as Ubuntu, Confucianism, and Dharma focus on community well-being and the moral importance of fulfilling one's duties to others. Rather than putting an emphasis on individual rights, these perspectives view justice as emerging from the fulfilment of communal responsibilities and the maintenance of social harmony. In energy justice, this perspective could mean encouraging collective ownership of energy resources, participatory governance, and solutions that prioritise the needs of the whole community over individual preferences.

4.5. Main Conclusion

This chapter addresses the second research question of phase 1: *"How can restorative justice be integrated within the energy justice framework, and how does it relate to different ethical theories?"*

Chapter 3 provided an overview of the key components of energy justice, including the introduction of restorative justice as an essential addition to the existing tenets. It established the groundwork for understanding how energy justice can be expanded to include considerations of historical and systemic injustices. By integrating diverse ethical perspectives, this chapter highlights how different traditions contribute to a more nuanced understanding of energy justice. Western theories such as utilitarianism, Kantian ethics, Rawlsian ethics, and the capability approach provide valuable insights into maximising well-being, respecting individual rights, and ensuring fair distribution of resources. Non-Western perspectives like Ubuntu, Dharma, Confucianism, and Buen Vivir emphasise community well-being, ecological harmony, and collective responsibility. These insights collectively enrich the ethical framework for energy justice by balancing individual rights with communal and environmental considerations. The chapter illustrates how restorative justice can be integrated into the energy justice framework by addressing historical and ongoing injustices and ensuring that energy policies not only prevent harm but also repair past damages. Restorative justice complements ethical theories by focusing on healing and reconciliation, which aligns with both Western and non-Western values of fairness and respect for all stakeholders.

Building on the ethical foundations explored in Chapter 4, Chapter 5 will transition to a practical examination of institutional frameworks and governance structures. This next chapter will build on the ethical insights from Chapter 4 to assess how institutional mechanisms can support equitable and sustainable energy transitions, in alignment with research phase 2. Understanding the ethical dimensions discussed in Chapter 4 will provide a basis for analysing how institutions can integrate restorative justice principles and ensure that energy policies are not only ethically sound but also effectively implemented in practice.

5

Institutional Analysis of Energy Justice

"Nothing is possible without men,
but nothing lasts without institutions."

Jean Monnet

As discussed in Chapter 4, integrating diverse ethical perspectives enriches the understanding of energy justice by highlighting the important of addressing both historical and ongoing injustices through restorative justice. Building on this, Chapter 5 transitions to examining how these ethical principles van be operationalised within institutional frameworks. To address energy justice in the Global South, it is essential to go beyond focusing on technologies alone. Achieving a just energy transition requires transforming the institutional structures and societal norms that govern energy systems. This includes rethinking the implementation, management, and financing of sustainable energy solutions to ensure they are equitable and accessible to all, particularly disadvantaged and marginalised communities. Institutions play a critical role in shaping these outcomes, and their analysis is crucial for understanding how to achieve fair and inclusive energy transitions. Therefore, this chapter employs the Original Institutional Economics (OIE) framework and the Williamson framework to analyse the institutional dimensions of energy justice in the Global South. Next, it analyses the universal human rights law as an essential layer of Williamson.

5.1. An Original Institutional Economics Approach to Energy Justice in the Global South

Institutions are the formal and informal laws, customs, and behaviours that govern social interactions and mould economic and behavioural patterns (Hodgson, 2006). They provide the framework that allows society to function and change, including everything from rules and laws to traditions and rituals. Institutions have a critical role in maintaining social order, affecting economic performance, and directing both individual and collective behaviour. In order to better understand value change within the complex structure of socio-technical transitions which characterise the energy transition, this section conducts an institutional analysis using the original institutional economics (OIE) approach to energy justice. OIE offers a valuable framework for guiding these transitions by highlighting how values are embedded within social, political, economic, and cultural contexts. This is especially relevant in the Global South, where energy transitions must address complex socio-economic conditions, power dynamics, and historical inequalities. These regions face challenges like poverty, limited infrastructure, and exclusion from decision-making, making it important to ensure energy transitions are both technologically effective and socially equitable (Johnson et al., 2020).

Given how deeply embedded energy supply shifts are in domestic, economic and social life, novel observations are likely to generate new views (Correljé et al., 2022). In the Global South, perceptions of energy poverty, access inequalities, and environmental justice have shaped how people view energy supply shifts and their broader impact on society. These experiences can influence values, which may

then drive collective action to change the institutions that manage energy production and distribution, as well as the design or selection of technologies. As stated by Correljé et al. (2022), a framework that facilitates an examination of evolving values and how people handle ethical issues connected to their relationships with nature, technology, and institutions in the context of the economy and cultural environments can be helpful. By focusing on the institutional aspects of energy systems, such as ownership structures, regulatory frameworks, and governance practices, OIE could guide the development of policies and practices that promote energy justice in the Global South.

Adkisson (2010) summarised the key components of an OIE approach to economics, highlighting the significance of values. Correljé et al. (2022) further developed this perspective by incorporating the role of nature, as seen in Figure 7. They note that humans have physical and mental capacities to interact with and manage the natural environment.

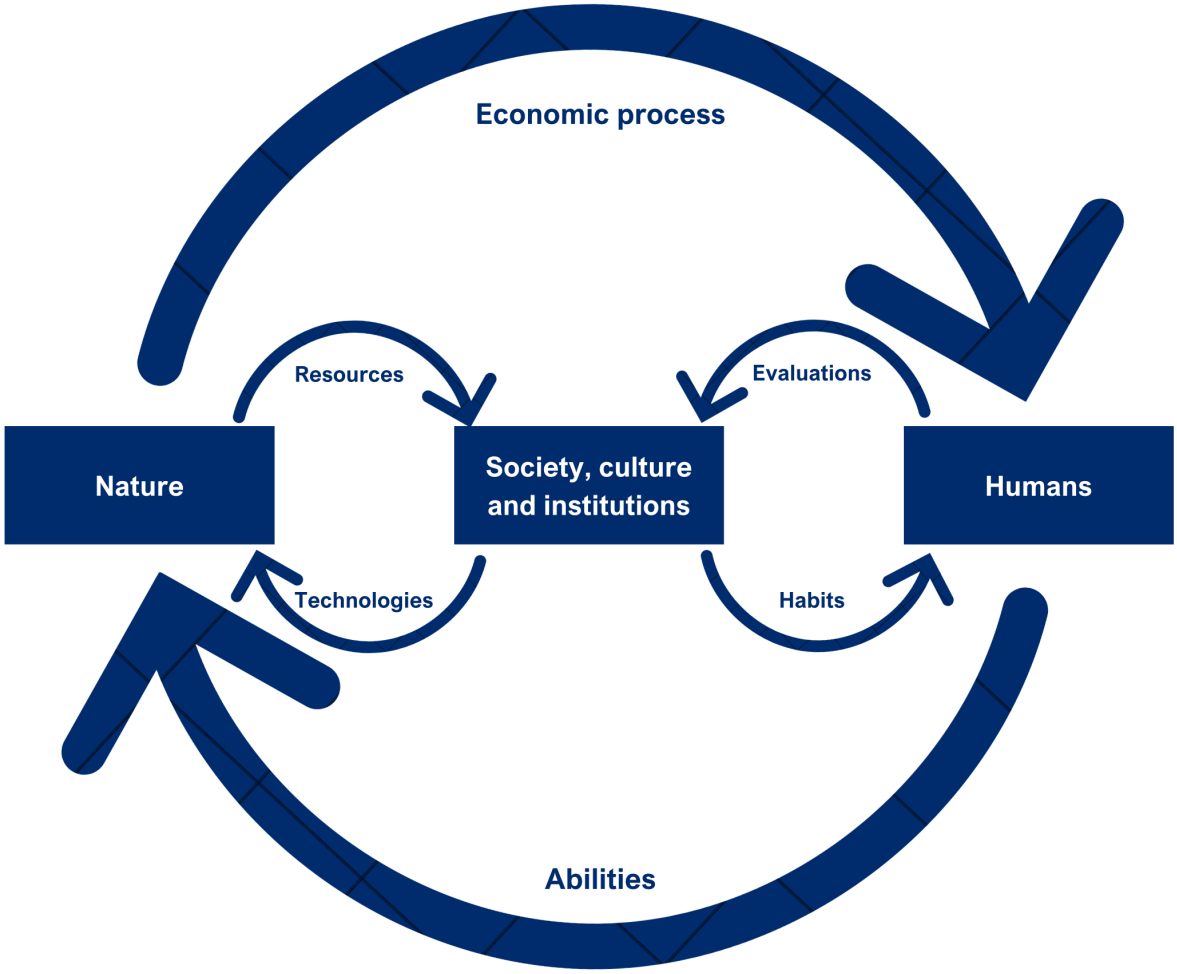

Figure 7. OIE: Humans in Society Handling Nature (Correljé, 2022)

Nature, Humans and Technology in the Context of Energy Justice in the Global South

In the context of OIE and energy justice in the Global South, the relationship between nature, humans, and technology is essential for understanding how energy systems evolve and are shaped by societal and environmental factors. OIE considers humans as an inherent component of nature, but with unique capacities that differentiate them from other animals, such as to employ the resources offered by nature using both physical tools and socio-cultural ways (Moran, 2000). This is important in energy systems, where technological advancements play a crucial role. Within this perspective, technology includes more than simply tangible instruments; it also includes the knowledge and abilities needed to deal with and adapt to the natural world. In the Global South, where energy access is often limited and unevenly distributed, technology could play a critical factor in enabling energy justice by providing the tools and

solutions necessary to bridge gaps in energy access. This dimension aligns with the four tenets of energy justice: distributive justice with ensuring fair access to energy resources, procedural justice, with inclusive decision-making processes, recognition justice by acknowledging the needs of marginalised communities, and restorative justice by addressing and rectifying past harms. By improving energy availability and affordability, technology could reduce the inequalities that initially contributed to energy poverty so that marginalised communities can gain more equitable access to energy resources. This link between technology and energy justice is important for fair and sustainable energy transitions as it allows communities to use their natural resources better and develop sustainable energy solutions.

Additionally, OIE views technology as a collaborative, dynamic process (Kauffman, 2017). Technology development and application involve not just technical expertise but also social coordination, communication, and conformity to set standards or operating guidelines. This method includes considering the specific needs and difficulties faced by local populations in the Global South, which are often quite different from those in developed countries, conforming with recognition justice. In contrast to the robust infrastructure and economic stability in developed nations, the Global South often faces underdeveloped infrastructure, reduced access to modern technology, unreliable supply and economic constraints that only worsen energy poverty (Sovacool, 2012). Therefore, these technological solutions need to be acceptable, inclusive, and sustainable. The development of new technologies should then be constantly evaluated by a range of stakeholders, including policymakers, researchers, and the local communities themselves. This evaluation process helps technological progress build on previous innovations while also addressing any emerging issues or unintended consequences. In this way, this process could lead to innovation in technology, leading to a more equitable distribution of energy resources and benefits rather than exacerbating already-existing disparities. By integrating energy justice principles, in particular restorative justice, the process could help rectify current injustices and ensure that the benefits of energy advancements are shared more fairly, supporting a just transition for all affected communities.

Economic Process in the Context of Energy Justice in the Global South

In the view of the original institutionalist, an economy is a mechanism by which a community supports itself (Campbell, 2001). A civilisation that is not adequately supported cannot survive and procreate, let alone flourish (Adkisson, 2010). The dynamic interplay between resource consumption, innovation in technology, and human needs is highlighted by the OIE viewpoint on the economic process. Similar to other natural resources, energy resources are dynamic and subject to change based on the needs and behaviours of different cultures. The economic process can be understood as a collaborative system in which communities use and convert natural resources into energy services by applying technology. In this context, Zimmermann's (1951) idea that "*resources are not, they become*" highlights the fluid nature of energy resources that are shaped by the changing needs and actions of people, particularly in regions where access to energy is uneven and often inadequate.

In the Global South, actions taken to protect communities from environmental problems, create sustainable living conditions, and convert natural resources into usable energy are important to addressing energy poverty. These actions then involve not only technological innovation but also the adaptation of existing resources to meet local needs, reflecting Zimmermann's (1951) view that resources are defined by their ability to fulfil specific functions or satisfy human needs. By addressing the four dimensions of energy justice, efforts can more effectively close gaps in energy access, ensure fairer distribution of resources, and support a more equitable energy transition. When communities in the Global South gain more understanding and technological capabilities, they could better exploit their natural resources to create sustainable energy solutions. However, this process is dynamic, evolving with changing social goals and the continuous reassessment of what is necessary and desirable. This aligns with the idea that resources must adapt to the shifting purposes and objectives of those who use them. Thus, to achieve energy justice, a continuous process of evaluation and reflection, where communities collectively determine whether their energy systems are fair, inclusive, and sufficient to meet their needs, is important. This process is influenced by cultural contexts and communication so that energy resources are not only developed but are aligned with the values and aspirations of the people they are meant to serve (Mayhew, 2018).

Society, Culture and Institutions in the Context of Energy Justice in the Global South

Hall (1989) suggests that culture is integral to every facet of human existence, influencing and shaping all aspects of life. This includes individual personalities, modes of expression (including emotional displays), thought processes, problem-solving methods, urban planning, the organisation and operation of transportation systems, as well as the structure and functioning of economic and governmental institutions. There is no part of human activity that remains untouched by culture. Hayden (1988) states that culture serves as a link between technology, interaction, and cooperation. When taking into account how communities in the Global South manage the challenges of energy transitions, culture is an essential component. According to OIE, individuals participate in a variety of activities in society and the economy in order to maintain and enhance their quality of life. Developing and mastering ever-more-effective technology is frequently a part of these efforts.

To use these technologies within their sociopolitical and economic frameworks, communities in the Global South must collaborate and organise culturally, representing what OIE calls '*going concerns'*. Businesses, social groups, and governmental institutions are then examples of these ongoing issues that are essential for setting up the governance and energy service delivery systems. According to this concept, both official and unofficial institutions, as well as individual habits and cultural norms, have an impact on how people behave, respond, and make decisions inside these institutions. The distribution and use of energy resources are shaped by these factors. This in turn has implications for the general efficiency and equity of energy systems. For energy justice to be achieved in the Global South, it is important to understand the behaviour of these individual and collective actors within their institutional settings. This also requires analysing the values that underpin their actions and decisions, as well as how these values evolve and drive institutional change. By examining the cultural and institutional contexts in which energy decisions are made, the barriers to equitable energy access could be better understood and strategies to overcome them could be developed so that energy transitions are both just and inclusive. As highlighted in Chapter 4, integrating diverse ethical frameworks, both Western and non-Western, could enrich the understanding of justice, fairness, and responsibility in energy systems. By reflecting on shared and divergent perspectives, this analysis could ensure that energy transitions are not only inclusive but also responsive to community needs and environmental sustainability.

Habits, Evaluation and Behaviour in the Context of Energy Justice in the Global South

Habits have their roots in an individual's cultural background and previous interactions (Correljé et al., 2022). These behaviours affect how individuals engage with energy systems, whether it is through their engagement in energy-related decision-making processes, their adoption of new technology, or their everyday energy usage. These habits are not set in stone, though; people are capable of thinking back on their actions and making decisions based on their perceptions of what is and what should be. In the Global South, where energy access and justice are frequently contentious concerns affected by social, economic, and environmental considerations, this reflectivity is essential.

Communities in the Global South could employ both conventional wisdom and contemporary technologies to evaluate their circumstances as they face new energy-related possibilities and challenges. For example, individuals might identify injustices and inequities in the existing system by measuring and comparing energy availability across various groups or areas. This knowledge could spark discussion among all parties regarding the need for change, particularly when it is believed that current customs and institutions are insufficient or unfair. There may be a drive to review and change present energy practices when their detrimental effects become apparent, such as environmental damage or ongoing energy poverty. This approach entails challenging accepted conventions and looking for new benchmarks for evaluation that are more in line with the community's changing ideals and objectives. For instance, a community might first identify issues through evaluating past and current energy practices and their impacts. Realising that existing patterns contribute to injustices or environmental harm, the community can then aspire to change by seeking and advocating for more sustainable behaviours and institutional reforms that support renewable energy initiatives.

Societal developments and technological breakthroughs typically prompt rethinking of values and habits. This can lead to the need for new energy regulations, the reorganisation of energy-related organisations, and the advancement of more sustainable and equitable technologies. Ultimately, achieving energy justice requires a dynamic process that continuously reassesses beliefs and methods in response to evolving conditions. By doing this, energy systems can move towards a way that is

equitable, inclusive, and sensitive to the needs of everyone, especially the most disadvantaged groups in the Global South.

Values in the Context of Energy Justice in the Global South

As discussed in Chapter 4, the key values of energy justice are elaborated, with restorative justice emphasised as an essential tenet alongside distributive justice, procedural justice, and recognition justice. Within the OIE approach, a fundamental re-evaluation of the values and habits that have traditionally guided energy use is needed. In the Global South, this transition represents not only a technical shift but also an institutional and cultural transformation that touches upon several forms of justice.

Distributive justice is central to the energy transition in the Global South. The value of fairness in distribution requires that the benefits of new energy technologies, such as solar and wind power, be shared equitably so that marginalised communities who have often been deprived of reliable energy gain access to these resources. For example, rural communities in sub-Saharan Africa, where electrification rates are low, should receive targeted investments in decentralised solar power systems to improve energy access, thereby addressing long-standing inequities (Bernard, 2010).

Recognition justice is also crucial, as it involves acknowledging and respecting the diverse identities, needs, and experiences of different communities within the Global South. Marginalised groups, including indigenous peoples have often been excluded from energy decision-making processes that affect their lands and livelihoods. For instance, in countries like Brazil, the construction of large hydropower dams has often disregarded the rights and needs of indigenous peoples (Jaichand & Sampaio, 2013). Moving forward, it is essential to involve these communities in the planning and implementation of renewable energy projects to ensure that their voices are heard and their specific challenges are addressed.

Next, procedural justice in energy values inclusivity and transparency in decision-making processes. This means that all stakeholders, particularly those from marginalised communities, should have a meaningful role in shaping the transition. For example, in India, the implementation of decentralised renewable energy projects in rural areas has been more successful when local communities are actively involved in decision-making processes (Harish et al., 2022). This inclusion helps ensure that the benefits of the energy transition are distributed fairly and that the projects are designed to meet the specific needs of those communities.

Moreover, restorative justice plays a substantial role in the Global South by addressing both past and ongoing harms associated with energy practices. This approach involves more than just correcting historical injustices as it also focuses on making reparative efforts to heal and restore communities and ecosystems that have been damaged. For example, reforesting areas that were previously cleared for plantations or extractive industries not only helps to restore local ecosystems but also creates renewable energy resources like biomass. By undertaking these restorative actions, this approach aims to repair both environmental damage and social inequities, so that the negative impacts of past energy practices are addressed and mitigated.

Traditional energy systems, largely centralised and driven by large-scale fossil fuel production, will be replaced by more decentralised and renewable-based models. This shift is important for the Global South, as these new energy systems have the potential to either improve or exacerbate existing imbalances, depending on how they are implemented. Institutions play an important role in shaping the direction of this transition, as they influence the choices of individuals and communities about energy systems. For example, as communities begin to produce their own energy through local solar or wind installations, they might need to navigate new regulatory frameworks and property rights. These institutional changes will not only affect how energy is managed but also how values related to energy, such as fairness, sustainability, and community empowerment, are upheld or redefined. As these decentralised energy systems are developed, they challenge existing power structures and offer opportunities for communities to gain greater control over their energy sources. This aligns with values of self-reliance and sustainability, which are important for achieving a just energy transition. However, it also requires continuous reflection on how these new energy systems are governed and whether they truly serve the interests of all stakeholders, particularly the most vulnerable.

In conclusion, the energy transition in the Global South is a complex process that involves both technical and value-based changes. By foregrounding the principles of distributive, recognition, procedural, and restorative justice, the transition leads to a more equitable and inclusive future. The Original Institutional Economics approach highlights that achieving this transition is not solely about technological innovation, as it also requires critical shifts in institutional structures and cultural norms. Institutions are essential in guiding and implementing these changes so that they align with the evolving needs and aspirations of communities in the Global South. It also sets out the importance of collective decision-making within institutions to build a more just and sustainable energy system for all. In light of this, Section 5.2 will explore how Williamson's Institutional Economics adds to the understanding of institutional roles in achieving energy justice.

5.2. Integrating Williamson Institutional Economics with Energy Justice

Building on the OIE insights from Section 5.1, which emphasised the role of values in the socio-cultural and economic contexts of the Global South, it is evident that institutions play an important role in shaping energy justice. OIE provided the foundation for analysing how cultural norms and values affect energy distribution and access. However, to fully understand the complexities of institutional change and its impact on energy justice, it is essential to consider transaction costs and governance structures, central to Williamson's Institutional Economics. This section applies Williamson's four-layer scheme from transaction cost economics to energy justice, examining how each layer affects energy justice. By integrating this framework, the aim is to better understand the gaps in energy access, affordability, and environmental impacts. It builds on the insights from the OIE approach with an analysis of the economic and governance factors in the Global South. The Williamson framework also sets the stage for the next section, which will analyse universal human rights as a crucial layer within this framework.

5.2.1 Williamson's Four Layer Model

A schematic representation of the institutional model is provided in Figure 8. This scheme links the formal institutions, such as legislation and rules, to the informal institutions, which are based on customs, traditions, norms and beliefs, as seen in the upper portion (Williamson, 1998). Agreements and other public-private agreements that control the activities and relations of the parties directly involved, as shown in the scheme's lower section, are based on these rules and regulations. The main takeaway from this schematic is that all strategies for integrating sustainable energy technologies into energy management need to consider these four institutional levels. Depending on the size and scope of the project, which will involve various players, the focus will change, and the institutional framework will essentially become established. In smaller towns, for instance, self-organisation is more important and central and local governments have less influence.

However, this approach can be somewhat abstract, and before making any decisions, certain informal and formal institutions and procedures will need to be investigated and recognised, depending on the location and circumstances. In fact, the scheme's arrows in both directions imply that interactions between the various layers are anticipated. However, changing official laws and rules is typically a long and complicated process, while changing unofficial practices, beliefs and/or religions takes far longer, if it can be done at all. But throughout time, these practices and attitudes might alter due to factors like shifting philosophies, new discoveries about environmental issues, and socio-economic development. The impact of learning is a significant additional force for changes to the institutional structure. Experiences with certain technology, organisational structures, and governance models will influence decisions made later on these fronts. Failures will be avoided if they are known at all, and successes will be emulated. The players' own individual tastes and choices are important, but only to the extent that they are within the existing contracts and arrangements, the legal framework, and the policy framework. Thus, the framework has to be scrutinised and understood as a simple structure.

5.2.2 Williamson's Four Layer Model in the Context of Energy Justice in the Global South

When applied to the context of the Global South, several important parties could be involved in the efforts to achieve energy justice. The private sector, governments, educational institutions, research centres, commerce and industry associations, non-governmental organisations (NGOs), bi- or multilateral aid agencies, social development organisations, and advocacy groups are some of them. These stakeholders often drive innovative concepts, methods, and tools for sustainable energy projects. Their broad viewpoints enable them to understand what is occurring in many places, which helps with the learning and transformation procedures that are essential for achieving energy justice. Engaging these stakeholders throughout the development process is essential for integrating multiple viewpoints and resources, thereby improving the effectiveness and durability of energy justice campaigns. In Williamson's model, these stakeholders interact across the four layers, each layer representing a different level of governance and transaction costs that influence the energy transition. Through collaboration, the transition to sustainable energy sources can be made fair and inclusive, which would benefit all communities in the Global South.

Figure 8. Williamson Institutional Economics, Four-Levels of Social Analysis (2000)

1. Social Embeddedness

Social embeddedness involves the informal institutions, cultural norms, and traditions that influence how societies perceive and interact with energy resources (Williamson, 2000). In the Global South, communities' value systems, including beliefs about energy use, caring for the environment, and communal decision-making play an important role in shaping responses to energy projects. Each community or cultural group has particular values that guide their involvement in energy-related decisions, such as forming energy communities, choosing energy sources, and participating in local energy projects. Energy democracy makes sure that these decisions reflect the collective values of the community so local control and equitable distribution of energy resources can be promoted. For instance, recognition justice is important for acknowledging and valuing the diverse cultural identities and the knowledge systems of different communities, especially those that have been historically marginalised. This means that energy planning respects Indigenous activities and community values and integrates them into decision-making processes.

Examples of practices where social embeddedness is seen:

- With community-based energy cooperatives, local groups form cooperatives to manage and control energy resources, so that decisions align with community values and needs.
- By incorporating Indigenous knowledge and practices into energy projects, such as using traditional methods of sustainable land management or renewable energy solutions, respect for community values and heritages could be guaranteed.
- By designing energy projects that respect and reflect local cultural practices, such as ensuring that new infrastructure does not disrupt sacred sites or traditional activities, cultural sensitivity in energy planning could be realised.

Link with Restorative Justice

Social embeddedness influences how communities engage with energy projects by incorporating cultural norms and traditions into decision-making processes. Heffron (2021) discusses the use of a Social Licence to Operate (SLO) as a means to apply restorative justice, examining the relationship between businesses and communities. Originally emerging in the mining industry, the concept has expanded to the current efforts on energy transition (Minadakis & Vega-Araújo, 2024). The contemporary use is meant to suggest that communities can have as much authority as governments in granting permissions or licences (Heffron, 2021). Although, at first glance, the community might be seen as powerless, this is not entirely accurate. In many cases where the community perceives a project or any industrial activity as harmful to themselves, the community and the environment, they can resist through various means, which can lead to increased costs for businesses (Heffron, 2021; Minadakis & Vega-Araújo, 2024). SLO highlights how well a project aligns with community values and expectations and shows the importance of addressing community concerns. This approach recognises that business activities occur within a complex web of social institutions, norms, and expectations. An SLO represents the informal approval and acceptance granted by local communities and stakeholders for a project or business activity. Unlike formal regulatory licenses, SLOs are based on legitimacy, trust, and consent from the community. This concept is situated within the social embeddedness layer, as it pertains to the informal social norms and community relationships that impact the acceptance and legitimacy of business activities. Applying SLO principles can improve restorative justice by ensuring that energy projects address community concerns and contribute positively to community well-being.

2. Institutional Environment

The institutional environment includes the formal laws, regulations, and policies that govern energy systems and climate actions (Williamson, 2000). These formal structures set the rules for how energy resources are managed, who has access to them, and how they are distributed. In the Global South, this layer plays a role in shaping how energy justice is implemented, particularly in terms of ensuring that energy is affordable and accessible to everyone, not just the privileged few. This includes making sure that marginalised communities, who have historically had less access to energy, are prioritised in policies that aim to improve energy access and affordability and ensure that all communities have access to sustainable and reliable energy. Energy affordability is a significant concern, as it is important that energy prices are kept within reach for all, especially low-income households.

National laws and regulations play a critical role in this context, as they shape how international agreements and funding mechanisms are integrated into local practices. For instance, national policies must align with international commitments such as the Paris Agreement and Sustainable Development Goal 7 to effectively address energy disparities. These laws dictate how resources are allocated, how energy prices are regulated, and how energy infrastructure is developed to support equitable access.

Examples of (international) agreements that touch on this layer are:

- The Paris Agreement (UN, 2016): This global climate accord emphasizes the need for developed countries to take the lead in reducing emissions while providing financial and technical support to developing countries. This support is crucial for helping the Global South transition to sustainable energy systems, so that energy resources are distributed more equitably.
- Green Climate Fund (GCF): Established under the UNFCCC, the GCF supports projects that aim to improve energy access and affordability in developing countries, so that the benefits of clean energy reach those who need it most.

- Sustainable Development Goal 7 (SDG 7): SDG 7 focuses on ensuring universal access to affordable, reliable, and sustainable energy by 2030, directly addressing energy disparities in the Global South.

By aligning national laws with these international frameworks, the institutional environment can more effectively address energy justice and support the development of inclusive and sustainable energy systems.

3. Governance Structures

Governance structures refer to the organisations and processes that manage energy projects and implement climate policies (Williamson, 2000). This includes how decisions are made, who is involved in making those decisions, and how these decisions are enforced. Effective governance is important so that energy systems are managed fairly and inclusively. Procedural justice is important at this layer, making sure that decision-making processes are fair and that all stakeholders, especially marginalised communities, have a meaningful role in decision-making processes related to energy and climate policies.

Examples of practices where governance structure could be seen:

- Involving local communities in the planning and decision-making processes for energy projects, such as establishing community energy cooperatives or local energy committees, so that energy solutions are tailored to the specific needs and priorities of the communities they serve.
- Managing climate adaptation and mitigation funds with transparency and equity, so resources reach vulnerable populations and address local energy and climate challenges.
- Setting up robust systems for monitoring the implementation of energy projects and policies, including grievance mechanisms that allow affected communities to report issues and seek redress. This would support the implementation of projects fairly and the addressing of any negative impacts.

Link with Restorative Justice

In this context, the integration of restorative justice principles into governance structures can enhance fairness and accountability. Heffron (2021) outlines initiatives for applying restorative justice within the framework of organisations and processes involved in managing energy projects and implementing policies. Restorative justice principles can be applied through:

- Prior-Harm Application: Restorative justice is used to ensure that all potential harms and injustices are identified and addressed during decision-making processes. This approach helps integrate prevention, mitigation, and restoration plans into governance practices. By applying restorative justice, policymakers can ensure that stakeholder concerns are addressed and that adequate measures are in place to prevent and rectify potential harms.
- Environmental and Social Impact Assessments (EIAs & SIAs): EIAs and SIAs, which are an example of prior-harm applications, are important in identifying and mitigating potential environmental and social impacts before projects are implemented. Restorative justice principles guide the development of EIAs and SIAs to ensure that they thoroughly address possible harms and include provisions for remediation and restoration.
- Financial Guarantees and Restoration Programs: Restorative justice also involves ensuring that financial guarantees are provided to restore any potential harms, such as those covered by Environmental and Financial Restoration Obligations (EFRO). EFROs are financial commitments required from entities to ensure that they have sufficient funds to restore any environmental or social damage caused by their activities. These obligations are designed to guarantee that, if harm occurs, resources are available to repair or compensate for the damage, which ensures accountability and adherence to restorative justice principles.

This connection illustrates how integrating restorative justice principles into governance structures can improve values such as fairness and accountability so that decision-making processes are more inclusive and responsive to stakeholder concerns.

4. Resource Allocation and Employment

The resource allocation and employment layer focuses on how energy resources are allocated and how the economic benefits of energy and climate policies are shared (Williamson, 2000). It looks at who gets access to energy, who benefits from energy projects, and how jobs and other economic opportunities are distributed, particularly in the context of transitioning to renewable energy. The terms energy affordability and energy equity play important roles here as it is important that energy is affordable for all households and that the economic benefits of the energy transition, such as job creation, are shared fairly. Restorative justice is also key, as it addresses the harms caused by past energy practices and ensures that new energy initiatives provide benefits to communities that have been negatively impacted. It also means that new energy projects do not repeat these mistakes and instead provide equitable benefits, particularly to those who have been most affected by past injustices.

Examples of resource allocation and employment:

- Implementing energy subsidies so that low-income households receive support will make energy more affordable for all segments of the population, especially those who have historically had less access.
- Developing training programmes and job opportunities in renewable energy sectors, such as solar and wind power, aimed at providing employment/economic benefits to communities that were previously marginalised or negatively impacted by past energy practices.
- Allocating funds to build and upgrade local energy infrastructure in underserved areas, think of rural communities in the Global South, to improve energy access and ensure that the benefits of energy projects are distributed equitably among different regions.

Through the application of Williamson's four-layer approach, this model for energy justice in the Global South illustrates how each layer interacts with important international agreements and practical actions. Within these four layers, it is set out how a fair and inclusive energy future is achievable by the energy transition, which resolves historical injustices, by including the concepts of distributive, acknowledgement, procedural, and restorative justice.

In conclusion, the Williamson framework provides a comprehensive lens for analysing institutional structures in energy governance, highlighting the importance of different layers, such as governance structures and contractual relationships. An important aspect of this analysis includes the role of universal human rights law as a layer within the Williamson framework. Recognised by international and national courts, human rights law offers a robust juridical foundation for evaluating how institutional structures can uphold principles of justice. This includes integrating restorative justice so that governance mechanisms in the Global South not only address energy justice but also consider human rights dimensions, leading to a more equitable and legally grounded approach to energy governance. Transitioning to human rights law, it is essential to explore how these legal principles intersect with and improve the framework's layers to ensure a thorough understanding of justice in energy transitions.

5.3. From Theory to Practice: Energy Justice in Human Rights Law

About 20 years ago, the first scholarly attempts were undertaken to disentangle the relationship between energy and human rights law (HRL) (Tully, 2006a; Bradbrook et al., 2008). The initial assessments concentrated on participation, framed accessibility to energy as a human right (HR) concern, and connected energy accessibility to poverty challenges within the framework of HR (Tully, 2006b). These limited early publications were subsequently supplemented by HR perspectives on crucial focused subjects, including fuel scarcity (Christman & Russell, 2016), national responses to the energy transition (Demski et al., 2019), and, in recent years, HR from a global warming viewpoint (Wewerinke-Singh, 2021).

There are notable parallels between the discourses on energy justice and human rights within the energy sector. As discussed in Chapter 3, the 1987 Brundtland Report was among the first to directly link HR with sustainable development and social justice with energy challenges (Brundtland, 1987). Regardless of these core similarities, research on energy justice, both inside and outside of the legal field, has not addressed HRL or the other way around. Scholarly research has demonstrated that the arena of HR has not given adequate attention to guarantee that everyone has access to modern, cheap, dependable, and sustainable energy and that the literature on energy justice still understudied the issue

of HR (Heffron, 2021b; Wewerinke-Singh, 2021). The majority of the research conducted on energy justice so far has, while not exclusively, been focused on understanding the consequences of energy practices for justice (a descriptive aim) or advocating for a fairer energy system (a normative purpose) (Jenkins, 2018).

Energy justice is mostly an academic endeavour with little practical legal applicability. In contrast, HRL is a well-established field of law and a subset of international law that is operationalised via a variety of procedures, including national and international laws as well as court cases (Huhta, 2023). Based on this, Huhta (2023) goes on to argue and illustrate how HR legislation, as opposed to solely academic or policy-focused frameworks, might give energy justice a legal foundation for its operationalisation. Thus, the same substantive concerns that are raised by energy justice can also be raised by human rights legislation. Nonetheless, since energy law is academic and policy-oriented, concepts of energy justice cannot be directly implemented or enforced (Huhta, 2023). A legal basis for incorporating energy justice into the law might be provided by human rights legislation. Specifically, human rights legislation in the energy industry is strongly related to the normative goal of energy justice. The latest report from the UN Intergovernmental Panel on Climate Change exemplifies this relationship. It defines the just transition as a collection of values, procedures, and practices meant to guarantee that no individuals, communities, businesses, sectors, nations, or areas are left behind in the shift to a low-carbon economy. These aspects include social security, respect and dignity for marginalised groups, social dialogue, and democratic interaction with all relevant parties (IPCC, 2023).

According to Huhta (2023), HR in the energy sector can, therefore, be employed in two distinct manners: either as a reference to energy as an HR in and of itself, or more generally, as a reference to the integration of HR legislation into the energy sector and its consequences in that domain. All human endeavours require energy in some form. The availability of reasonably priced energy is a prerequisite for meeting all basic human necessities, including food preparation, safe drinking water, communication, farming, current medical services, and mobility. Irrespective of the essential role of energy in meeting fundamental human needs, international HRL do not address energy-related issues (Tully, 2008). Similar to the right to water, which is also not expressly recognised as an HR in international HRL, some have claimed that access to energy is an HR and ought to be recognised as such, but energy as an HR has no institutional or legal support in international law (Walker, 2016; Löfquist, 2019).

Only the 1979 Convention on the Elimination of All Forms of Discrimination Against Women recognises energy accessibility as an HR. It requires the signatory nations to take all reasonable steps to end discrimination against women in rural areas and to guarantee their right to a satisfactory standard of living, including housing, sanitary conditions, and access to power and water (UN, 1979). This Convention only covers a small portion of the variety of concerns pertaining to energy as a human right because of its narrow application range and energy's marginal place within it. In other words, whereas energy is essential for the fulfilment of several HR, the international HRL is still in its infant shoes.

The SDG’s of the UN provide further background for understanding the relationship between energy and human rights (UN, 2015). The 17 goals specifically aim to achieve everyone's HRs, even if they are not legally enforceable, they carry several relations to HRL. It has been noted that a number of the 2030 Agenda's objectives line up with specific HR requirements that are now in place (Kaltenborn et al., 2020). Ensuring that everyone has access to modern, cheap, trustworthy, and sustainable energy is the seventh goal. This objective can be used to understand and defend access to energy in a human rights framework, even if it lacks objectives or criteria based on HR. In addition, the UN General Assembly proclaimed a healthy environment to be an HR (UN, 2022). Even if it is not legally enforceable, this strengthens the HR implications of the harmful environmental effects of energy production and use.

The majority of scholarly works concerning the intersection of energy and HRL concentrate on energy accessibility. Access to energy is therefore not an HR in and of itself, but rather a derived human right that can be defended on the basis of other rights. This body of literature generally agrees that having access to energy is a prerequisite for the fulfilment of other treaty-based HR. Put another way, even while energy access is not specifically included in HRL, it may be necessary in order to exercise other rights (Wewerinke-Singh, 2021). Institutions as well as human rights scholarship have endorsed this line of thinking (Salvi & EU Commission, 2013; Löfquist, 2019). In addition, it is common to characterise the lack of access to energy as a problem with poverty, which is a human rights issue (Wewerinke-

Singh, 2021). Energy poverty has always been viewed as a concern of socio-economic rights. Additionally, it has been claimed that the right to energy access is a prerequisite for substantive equality and the prohibition of discrimination under HR (Wewerinke-Singh, 2021). Energy is not seen as an HR unto itself, even in light of the close relationship that exists between the fulfilment of some HR and access to energy. It is a derived HR that depends only on how it relates to the current duties under international HRL.

There are three main groups into which the activities in the energy sector fall in terms of the consequences for HR. The first group deals with how energy-related activities affect HR since they affect fundamental human necessities when there is insufficient or no energy. The issues of energy poverty and accessibility are important in this area (Belaïd, 2022). The second category includes operations in the energy supply chain that have negative effects on HR. This is frequently described as having “an excess of energy” in the literature (Wilkinson et al., 2007). In other words, the enjoyment of HR can and frequently does suffer because of energy-related activities, which include exploration, mining, production, and eventually consumption. One instructive example is how the effects of global warming affect people's ability to exercise their HR (Boyd & UN, 2019).

The first and second groups demonstrate the influence that energy-related activities can have on HR. The third group focuses on the contrary: it clarifies how HRL affects the actions that are required, unable to be conducted, or permitted in the energy industry (Huhta, 2023). The government's decision to stop producing electricity using fossil fuels, for instance, raises concerns about the right to property. HRL may have a limiting effect on the development and application of energy policy and legislation, while it can also encourage and even demand more ambitious initiatives in the shift to cleaner energy, such as those set forth in the Urgenda and Shell examples (Urgenda Foundation v. State of the Netherlands, 2019; Milieudefensie et al. v. Royal Dutch Shell plc, 2021). In systems which are shifting to renewables, each of these features may also be present. For example, building wind parks may have an influence on offshore and onshore farming and fisheries, therefore affecting people's freedom to determine their own business opportunities and fields of employment. Likewise, the shift in mobility concerning biofuels may result in a reduction of crops available for food, risking the supply of food and, by extension, the fundamental right to life (Naylor et al., 2007). Once again, each of the three groups is relevant to discussions in scholarly work on environmental law and climate.

All in all, there are fundamental similarities between energy justice and HR as normative frameworks when applied to the energy sector; HR could offer energy justice a legal framework for operationalisation, as opposed to one that is solely academic background. Concerning the negative impacts on marginalised groups, energy justice and HR in the energy industry both place a strong emphasis on morals and ethics. Inequalities and power discrepancies can be addressed structurally within the context of HR. In order to guarantee an equitable energy transition, energy justice seeks to address inequities within the industry. Though HR apply more broadly and can occasionally obstruct steps necessary for energy justice, energy justice is sector-specific.

In the energy industry, both energy justice and HR are relative and may need striking a compromise between conflicting goals and ideals. There are no obvious winners or losers in the complex field of energy justice. Despite having a positive overall impact on society, even “pro-justice” actions could have the potential to increase inequality (Sovacool et al., 2017). Considered a normative framework and objective, energy justice has a substantial connection with the literature on HR in the energy industry. Redefining international law is not necessary to acknowledge the shared foundation between social justice and HR. The normative suggestions of energy justice have little impact if they stay in academia. The legally binding character of HR legislation can provide energy justice arguments with credibility and legitimacy. This addresses criticisms of energy justice's scholarly origins and its lack of real-world applicability. HR in the energy industry may be understood as applying HRL to energy challenges, so addressing the absence of a legally mandated framework for energy justice. A more comprehensive and legally obligatory foundation for energy justice is provided by the general notion that energy is a derived HR, required to fulfil other HRs based on treaties.

5.4. Main Conclusion

This chapter explores the research question of phase 2: *"How do institutional frameworks and governance structures in the Global South impact the implementation of energy justice, particularly with respect to restorative justice?"*

The analysis highlights that achieving energy justice involves more than technological advancements; it requires significant changes in institutional structures and societal norms. By applying the Original Institutional Economics (OIE) framework and Williamson's Institutional Economics, this chapter underscores the importance of transforming institutions to support equitable and inclusive energy transitions. Key insights include the critical role of institutions in shaping energy justice outcomes and the necessity of addressing cultural and value-based dimensions within these structures. An important aspect of this analysis includes the role of universal human rights law as a layer within Williamson's framework. Recognised by international and national courts, human rights law provides a robust juridical foundation for assessing how institutional structures can uphold principles of justice. This includes integrating restorative justice so that governance mechanisms in the Global South address energy justice and consider human rights dimensions, leading to a more equitable and legally grounded approach to energy governance.

The chapter also highlights the significance of the Social Licence to Operate (SLO) in applying restorative justice. SLO represents the informal approval granted by communities and stakeholders, emphasising legitimacy, trust, and consent. Originally from the mining industry, the concept has expanded to energy transitions, reflecting the alignment of projects with community values and expectations. Heffron (2021) discusses how SLO, situated within the social embeddedness layer, underscores the importance of addressing community concerns through restorative justice principles. Additionally, the chapter outlines practical applications of restorative justice in energy governance, including prior-harm application, Environmental and Social Impact Assessments (EIAs & SIAs), and Financial Guarantees and Restoration Programs. These initiatives ensure that potential harms are identified, mitigated, and addressed through comprehensive governance practices.

In preparation for the subsequent chapter, which focuses on methodology, the insights from this analysis provide a foundation for developing an Energy Justice Index. This scorecard, built on the theoretical and institutional insights explored, will quantify energy justice, including restorative justice. This methodology aims to offer a practical tool for measuring energy justice outcomes and supporting informed policy-making in the Global South.

6

Methodology: An Energy Justice Index for the Global South

"The goal is to turn data into information, and information into insight."

Carly Fiorina

In the previous chapters, this thesis reviewed the context of energy justice in the Global South and analysed the ethical and institutional dimensions. Building on this foundation, this chapter introduces a scorecard specifically designed to assess energy justice in the Global South and serve as a basis for creating an index, drawing on the theoretical and institutional insights gained so far. The focus now shifts to developing a methodology for quantifying energy justice, including restorative justice alongside distributional, recognition and procedural justice as key tenets. This scorecard aims to provide a practical tool for measuring energy justice outcomes across these four tenets, which can support informed policy-making for energy justice issues in the Global South.

6.1. The Rationale for Developing an Energy Justice Index

Quantifying energy justice is essential for several reasons. First and foremost, it provides a systematic way to evaluate and measure the effectiveness of energy policies and practices. In regions where energy access is often uneven and inequities are pronounced, having a quantifiable measure allows stakeholders to assess how well energy justice principles are being implemented and where gaps still exist. This empirical basis is crucial for identifying disparities, tracking progress over time, and making informed decisions to improve energy systems.

Quantification helps translate complex concepts such as distributive, procedural, recognition, and restorative justice into actionable data. By doing so, it offers a clearer understanding of how these principles are operationalised within specific contexts. This understanding is not only valuable for policy-makers but also for practitioners and researchers who seek to evaluate the impact of energy interventions and identify best practices. The index can serve as a benchmark against which different policies and projects can be assessed, thereby providing a comparative perspective on energy justice across different regions and initiatives.

An energy justice index comprises several key components. It includes indicators related to the accessibility and affordability of energy (distributive justice), the inclusiveness and fairness of decision-making processes (procedural justice), the recognition and respect for the needs and rights of marginalised communities (recognition justice), and the rectification of past harms and injustices

(restorative justice). Each of these components is measured using specific metrics that reflect the extent to which these justice principles are upheld in practice. What the index does not include is a focus solely on technological or economic aspects of energy systems without considering the social dimensions. It does not measure technological efficiency or economic performance in isolation but rather evaluates how these socio-technical aspects intersect with justice principles. This approach ensures that the index remains relevant to the broader goals of achieving equitable and inclusive energy transitions.

The insights gained from such quantification can be profound. By integrating restorative justice into the index, the methodology ensures that historical injustices are acknowledged and addressed, thereby supporting a more inclusive and fair energy transition, for human and non-human entities. This is important in the Global South, where ongoing disparities must be confronted to ensure that energy developments benefit all communities equitably. The inclusion of restorative justice also encourages the development of policies and practices that not only remedy past or ongoing injustices but also actively work to prevent future harm to people and the environment.

Overall, the energy justice index helps stakeholders make evidence-based decisions by providing a holistic view of how energy justice principles are being realised. It enables the identification of areas where improvements are needed and supports the development of targeted interventions. The index also facilitates cross-regional comparisons that can help to share knowledge and best practices between different contexts. By emphasising restorative justice, the index underscores the importance of addressing historical and ongoing injustices, thereby contributing to a more holistic and equitable energy transition.

6.2. Quantification of Energy Justice

Building on the insights and gaps identified in existing frameworks, this section outlines a novel approach to quantifying energy justice in the Global South. Some studies have attempted to quantify aspects of energy justice, often focusing on energy security and related metrics such as affordability and environmental sustainability (Ang et al., 2015; Von Hippel et al., 2011). While these studies include important elements of energy justice, specific quantitative assessments of energy justice itself are limited. Existing indices, such as those from the World Economic Forum, World Energy Council and IEA, primarily address energy transitions, security, and sustainability but fall short of fully capturing the principles of energy justice (Singh et al., 2019; WEC, 2021; IEA, 2020). Notably, only Heffron et al. have developed a formal index for energy justice, which is limited to certain technologies and countries in the Global North (Heffron et al., 2018).

Apergi et al. (2024) have made significant progress in creating an index for assessing energy justice. However, a need for this new methodology arises from the recognition that while Apergi et al. (2024) index provides a foundational quantitative tool for assessing energy justice, it does not capture the historical, existing and future injustices important for a just transition in the Global South. Specifically, it overlooks the critical dimension of restorative justice, which addresses the need to repair past harms so that current energy policies contribute to long-term equity and healing. To address these gaps, this thesis proposes an expanded framework for quantifying energy justice that includes the fourth tenet: restorative justice**.** Building on the theoretical framework in Chapter 3, restorative justice is essential for ensuring that energy transitions not only avoid repeating past injustices but also actively work to repair the damage done by energy practices. This is important so that current and future energy policies can contribute to repairing and restoring (past) injustices.

By incorporating restorative justice into the assessment framework, this thesis aims to provide a more comprehensive tool for evaluating energy justice in the Global South. This expanded framework will be used to develop a new scorecard that not only measures the integration of procedural, recognition, and distributive justice but also evaluates the extent to which energy transitions contribute to the restoration of justice for historically marginalised communities. The following section will detail the methodology used to develop this new scorecard, including the specific metrics and indicators employed to assess each of the four tenets of energy justice. Additionally, it will explain how the metrics were derived from the analytical framework and how these previous chapters are connected to the empirical framework.

6.3. An Improved Energy Justice Index

6.3.1 Conceptual Choices

This methodology will use the definition found in Chapter 3.2, using the four-tenet framework and the ten core principles of energy justice. The framework based on the four tenets forms the broad theoretical foundation for the index, while the ten principles enable the incorporation of specific, measurable elements into this theoretical structure. For example, for the tenet of procedural justice, the decision-making framework based on ten principles guides the integration of elements that assess due process, transparency, and accountability. For distributional justice, the framework incorporates metrics related to the availability and affordability of energy resources. For recognition justice, intersectionality, and restorative justice, the concepts of responsibility, sustainability, resilience, as well as intergenerational equity are interconnected. Clearly, these elements are multifaceted and may overlap across these four tenets. As a result, some components may assess aspects of more than one tenet and therefore assigning them to a single tenet is a necessary design choice.

For each core tenet, particular elements are specified, as seen in Figure 9, leading to a total of 10 components. For procedural justice, recognition justice and distributional justice, these are the same as Apergi et al. (2024).

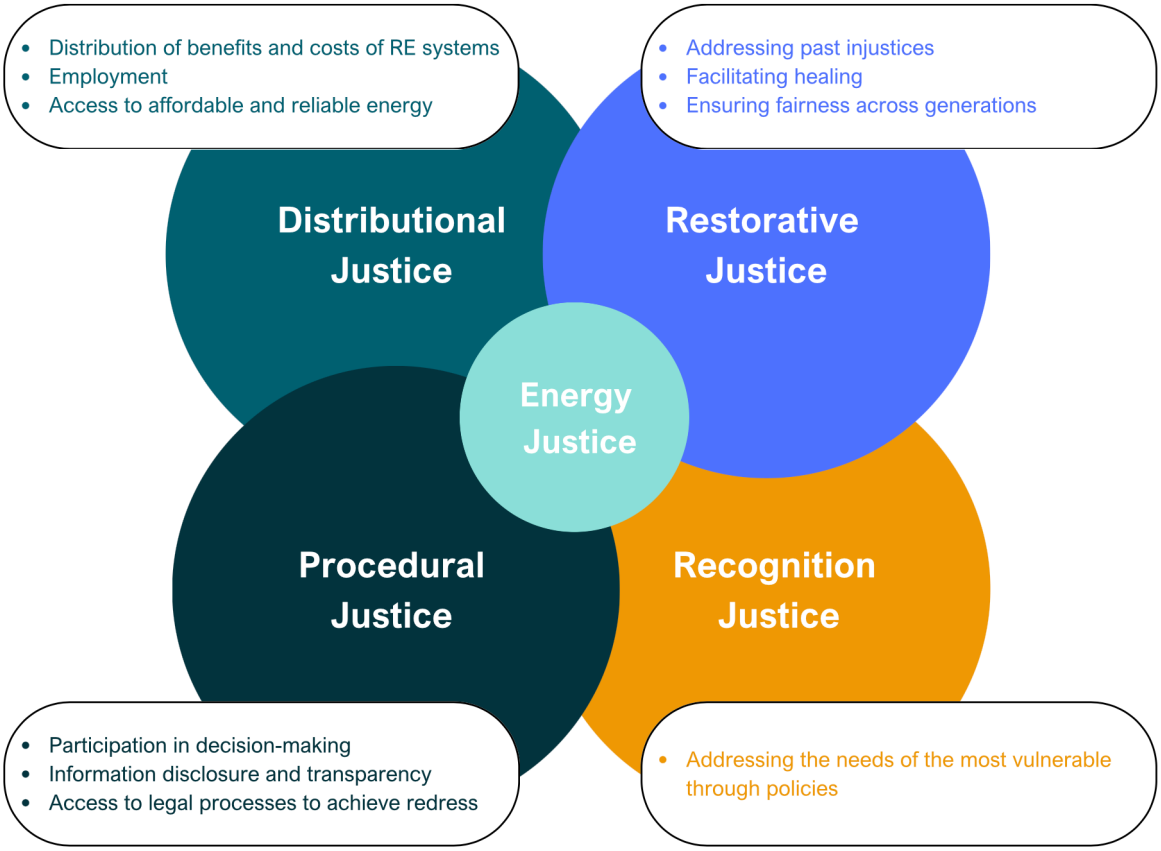

Figure 9. The Four Tenets of Energy Justice and the Related Components

Conceptual Choices: Restorative Justice Components

In the development of the Energy Justice Index, the components selected for restorative justice that are 'addressing past injustices', 'facilitating healing', and 'ensuring fairness across generations' are rooted in the analytical framework outlined in Chapter 3.2.5.

Addressing Past Injustices: This component reflects the necessity of acknowledging historical wrongs that energy projects have inflicted on marginalised communities and the environment. As discussed in Chapter 3.2.5, Heffron (2021) highlights the importance of restorative justice in dealing with historical injustices. This component ensures that energy policies and projects do not merely perpetuate existing

inequities but actively seek to address past harms. It incorporates the idea that restorative justice is not just about compensation but about proactively responding to historical grievances, which aligns with the normative goal of making the world more equitable.

Facilitating Healing: This focuses on the processes that support reconciliation and recovery among affected communities. As also noted in Chapter 3.2.5, next to addressing past injustices, restorative justice is aimed at repairing harm and fostering healing rather than simply punishing wrongdoers. This component is important for promoting community well-being and trust, reflecting Heffron's (2021) emphasis on restorative practices as a means to address and prevent future harm. Facilitating healing integrates with the broader energy justice framework by ensuring that the impacts of energy projects are addressed in ways that support the recovery and resilience of communities.

Ensuring Fairness Across Generations: This addresses the ethical imperative of intergenerational equity, making sure that current energy policies do not unfairly burden future generations. Chapter 3.2.5 highlights that restorative justice principles advocate for considering the long-term impacts of energy projects on both current and future generations. This component shows the need for sustainable practices that not only rectify past harms but also prevent future injustices, aligning with the principles of restorative justice that focus on long-term fairness and sustainability.

All in all, the choice of these three components ensures that the Energy Justice Index evaluates current practices and also incorporates measures for rectifying past injustices, facilitating community healing, and promoting intergenerational fairness. The index provides a holistic tool for assessing how energy transitions contribute to restorative justice and overall energy equity by integrating these elements. The subsequent sections will detail the methodology used to develop this new scorecard, including the specific metrics and indicators for assessing each of these components. This approach builds on the analytical framework developed in previous chapters and integrates it with the empirical framework, providing a solid basis for assessing energy justice outcomes in the Global South.

6.3.2 Metrics to Measure Components

Data Sources

To assess the various components, this study incorporates both policy information and outcome data. By integrating these two types of data, the analysis captures both the planned intentions (*policies*) and the actual status of energy justice within a country (*outcomes*). Given that the index is designed to reflect changes over time, incorporating policy data helps to monitor the ongoing developments in the energy transition, while outcome metrics provide an up-to-date view of the transition's progress. Therefore, the optimal approach involves assessing each component through a mix of policy metrics and outcome data. However, this combined method is not feasible for every component, as illustrated in Table 2. Additionally, the metric for renewable energy electricity output has been categorised under the component of 'access to affordable and reliable energy', as this classification better aligns with their relevance to this aspect. Ensuring fairness across generations is placed under restorative justice, as it addresses the need to rectify inequities across generations and promote long-term equity for future generations.

The sources of data include a mix of secondary data and data gathered through a primary collection method. Each type of data has its own constraints. Secondary data includes sources that have established reputations in data provision, such as data from IRENA, World Bank, IMF, IEA, and WEF. To ensure the index is broadly applicable, it is ideal to assess the components using secondary data. However, this is not always feasible because data on certain components may either not exist or be inaccessible. When this type of data is unavailable, it becomes necessary to gather country-specific data, referred to in Table 2 as 'in-country research'. This process involves consulting national databases, policy documents, and interviews with government officials, policymakers, and project implementers.

To maintain uniformity in the data collected across stakeholders, a standardised set of interview questions is applied, as can be seen in Appendix B. The interviews will follow a semi-structured format, which is commonly used in qualitative research (Qu & Dumay, 2011). This method features a set of questions that can be asked in a flexible order, combining both open and closed questions. This

adaptable approach encourages participation from the stakeholders and is especially useful for investigating complex topics (Johannesson & Perjons, 2014).

This method seeks to balance practicality and precision by prioritising the use of secondary data as much as possible while avoiding the need to depend on potentially unreliable sources. The necessity for collecting primary data adds difficulty to applying the index but also offers a chance to gain a deeper and more thorough insight into the EJ aspects. The method also uses binary metrics to evaluate each component to simplify data collection and facilitate comparisons. Although this approach may miss some country-specific nuances, it improves the index's applicability to other states in the Global South.

Measuring Procedural Justice

To evaluate procedural justice in RE projects, this study adopts metrics from Apergi et al. (2024). To assess participation in decision-making within a specific country, this study employs a binary metric to determine whether community consultations for RE projects are legally required. Additionally, the outcome metric is evaluated by the percentage of RE projects that have undergone community consultations. This information must be gathered separately for each country being evaluated.

To evaluate information disclosure and transparency, this method examines whether countries mandate the public release of details regarding RE projects and whether such information is made available (yes or no). This data also must be collected for each country individually, as it is not pre-existing.

Additionally, the research includes a measure of the extent to which information on all relevant aspects of renewable energy projects is accessible to help build the index. An additional metric used to evaluate this component is an index (0–7) that scores the transparency of government policy-making (WEF, 2022). To further evaluate the legal options for obtaining redress, this study employs an index (0–7) to assess judicial independence (WEF, 2022).

Measuring Distributional Justice

The distributional justice tenet has three distinct components, each of which is evaluated through multiple metrics, adopted from Apergi et al. (2024). The assessment of how benefits and costs are allocated within renewable energy systems involves multiple factors. These include the existence of agreements for sharing benefits with local communities for renewable energy projects, as well as any additional advantages not covered by official agreements, examples might include community projects, infrastructure improvements like new roads, job creation, and new electricity connections. Other metrics are the percentage of renewable energy projects with benefit-sharing agreements or extra benefits, the proportion of projects in areas without vulnerable groups that offer no benefits, and the share of projects in such areas that face conflicts with local communities.

A frequently discussed element of the transition to renewable energy sources is employment. 'Green jobs' are considered crucial for fairly distributing the benefits of the energy shift and compensating for job losses in traditional fossil industries. In terms of outcomes, this method incorporates data on the number of local individuals working in the RE sector. Additional metrics are the amount of registered patents for solar and wind technologies in the specified year.

The third component is the availability of affordable and reliable energy and this is assessed using the proportion of the population with electricity access and the adjusted electricity prices for purchasing power parity. Additionally, the analysis includes metrics on the quality of electricity supply, rated on a scale from 0 to 7. Subsequently, various dimensions of policies and regulations that promote renewable energy are evaluated. The analysis includes outcome indicators such as the proportion of renewable energy compared to the total (including fossil fuels) in electricity generation.

Table 2: Tenets, Components and Metrics Used for the EJ Index

Tenet	Component	Metric	Source
Procedural Justice	**Participation in decision-making**	Requirement for community consultations for RE projects (*P*)(+)	In-country research
		Proportion of RE projects with community consultations (*O*)(+)	In-country research
	Information disclosure and transparency	Requirement to make RE project information available beforehand to local communities (*P*)(+)	In-country research
		Information provision per RE project (*O*)(+)	In-country research
		Transparency of government policy making (Index, 0-7) (*O*)(+)	WEF
		Availability of information across all relevant characteristics of RE projects inquired (*O*)(+)	In-country research
	Access to legal processes for achieving redress	Judicial independence (Index, 0-7) (*O*)(+)	WEF
Distributional Justice	**Distribution of benefits and cost of RE systems**	Requirement to have a benefit sharing agreement and other benefits in place with local communities for RE projects (*P*)(+)	In-country research
		Proportion of RE projects with benefit sharing agreements and other benefits (*O*)(+)	In-country research
		Proportion of RE projects in areas where there were no vulnerable groups that did not receive any benefits (*O*)(+)	In-country research
		Proportion of RE projects in areas where there were no vulnerable groups and conflict due to disagreements of the local communities (*O*)(+)	In-country research
	Employment	Employment of local personnel in renewables (green jobs) (Number of jobs per capita) (*O*)(+)	IRENA
		RE patents (Wind and Solar) (Number of filed patents) (*O*)(+)	IRENA
	Access to affordable and reliable energy	Electricity access (%) (*O*)(+)	World Bank
		Quality of electricity supply (Index, 0-7) (*O*)(+)	WEF
		Electricity prices (US cents/kWh adjusted for purchase power parity) (*O*)(-)	WBG - Doing Business/IMF
		RE electricity output (% of total electricity output) (*O*)(+)	IEA
Recognition Justice	**Addressing the needs of the most vulnerable through policies**	Existence of an approved national electrification plan (*P*)(+)	RISE
		Electrification plan includes off-grid solutions (either/or both mini-grids and standalone systems) (*P*)(+)	RISE
		Inclusion and gender sensitivity in electrification planning (Score: 0-100) (*P*)(+)	RISE
		Existence of cross-subsidies to support low-income consumers of electricity (*P*)(+)	In-country research
Restorative Justice	**Addressing past injustices**	Requirement for environmental and social impact assessments for RE projects (*P*)(+)	In-country research
		Proportion of energy projects addressing historically disadvantaged communities (*P*)(+)	In-country research
	Facilitating healing	Requirement to set aside funds for future compensation for environmental damage or social inequities in RE projects (*P*)(+)	In-country research
	Ensuring fairness across generations	Requirement for Social Licence to Operate (SLO) or comparable agreements for energy projects (*P*)(+)	In-country research
		Requirement for Energy Financial Reserve Obligation (EFRO) or comparable financial provisions (*P*)(+)	In-country research

Measuring Recognition Justice

Examining the presence of relevant policies determines the degree to which policies cater to the needs of the most vulnerable groups, including those related to gender or the effects on people experiencing poverty and marginalised communities (Apergi et al., 2024). The method here incorporates binary indicators to determine the existence of national electrification programmes, off-grid energy access targets, and whether inclusivity and gender sensitivity are considered in electrification planning. These policy indicators are all incorporated into the RISE (World Bank Group, 2020). Additionally, this method incorporates a yes/no metric to determine if financial support mechanisms are in place to help low-income electricity users.

Measuring Restorative Justice

The fourth tenet added to the quantification in this thesis is restorative justice, which comprises three specific components. These components are derived from the analytical framework discussed in previous chapters and were explained in Chapter 6.3.1.

The first component, “addressing past injustices”, involves evaluating how renewable energy projects address historical harms and inequities. As outlined in Chapter 5.2.1, Heffron (2021) emphasises the importance of environmental and social impact assessments (EIAs & SIAs) in identifying and mitigating potential harms before projects start. This proactive approach reflects the principles of restorative justice by ensuring that past injustices are recognised and rectified. This component is operationalised by assessing how well projects target historically disadvantaged communities and address past inequalities, ensuring that the process of evaluating and implementing projects incorporates measures to rectify historical wrongs.

The second component, “facilitating healing”, focuses on the metric of requiring financial resources specifically designated for addressing and correcting immediate and ongoing impacts of renewable energy projects. This metric aims to ensure that as negative effects emerge during or after the implementation of renewable energy projects, financial resources are readily available to address these issues promptly. It emphasises proactive measures to remedy harms as they occur, providing affected communities and environments with timely compensation and support throughout the project’s duration. This approach supports immediate healing by making sure funds are specifically allocated for addressing current issues, rather than just planning for future cleanup.

The third component, “ensuring fairness across generations”, includes metrics such as the requirement for a Social Licence to Operate (SLO) or comparable agreements and Energy Financial Reserve Obligations (EFRO). The SLO metric evaluates whether energy projects are required to engage with local communities and address their concerns throughout the project's lifecycle, including decommissioning. As noted also in Chapter 5.2.1, the concept of SLO reflects the informal social norms and community relationships that impact project legitimacy. By ensuring that energy projects obtain a social license, this metric reinforces restorative justice principles by managing long-term impacts and preventing future generations from bearing the consequences of poor environmental management or unmet commitments. The second metric in this component, “ensuring fairness across generations”, focuses on the requirement for an Energy Financial Reserve Obligation (EFRO) or a similar financial provision. EFROs are designed to ensure that sufficient funds are set aside to cover future compensation and remediation needs. As discussed in Chapter 5.2.1, this metric assesses whether companies are required to allocate funds specifically for decommissioning and environmental restoration. This long-term financial provision supports restorative justice by ensuring that resources are available to address potential future harms, thus protecting future generations from the financial and environmental burdens of poorly managed projects. The emphasis here is on proactively preparing for future impacts, so that financial responsibilities are met over the long term to maintain accountability and fairness across generations.

In summary, these metrics for restorative justice are rooted in the analytical framework discussed in previous chapters and designed to ensure that past injustices are addressed, financial mechanisms for compensation are in place, and future generations are protected from potential negative impacts.

6.3.3 Constructing the EJ Index

The calculation for the EJ Index follows the method outlined by Apergi et al. (2024). However, including restorative justice introduces 10 components instead of 8, which is the difference in the equation. Due to the imbalance in the number of components assigned to each tenet, the index was structured based on the components. Consequently, an equal weight is applied to each component. Due to this, some tenets appear more prominently in the index than others. However, given that the tenets constitute the theoretical framework and the components address the fundamental parts of EJ, this variation in representation is justifiable.

The EJ index is computed using the formula below:

$$\mathbf{EJ} = \frac{\mathbf{1}}{\mathbf{10}} \sum_{x=1}^{10} \mathbf{C_x} \qquad \text{Eq. 1}$$

In this formula, $\mathbf{C_x}$ denotes the ten components that are averaged to evaluate EJ. Each component $\mathbf{C_x}$ is made up of various metrics $\mathbf{M_j}$, which reflects different facets of the component. It is crucial to recognise that equal weighting has its drawbacks. This method, while being broadly used in science due to its simplicity, might not accurately capture the nuances present in all countries Apergi et al. (2024). However, to enhance the index's general applicability, the research approach prioritised overall applicability, accepting some loss of country-specific details as a trade-off.
Additionally, to verify the reliability of the approach, the average energy justice score was calculated using equal weighting across each tenet. Each metric is scaled relative to the highest value recorded for that year, creating a range from 0 to 1. All metrics are given equal importance and then summed to evaluate each component:

$$\mathbf{C_x} = \sum_{j=1}^{N} \mathbf{M_j} \qquad \text{Eq. 2}$$

The number of metrics differs by component, so each component is adjusted to a scale of 0 to 4 for comparison consistency. As a result, the overall energy justice score is also scaled from 0 to 4.

In summary, the revised Energy Justice Index integrates ten key components, including elements of restorative justice, to provide a holistic and practical framework for evaluating energy justice. This approach now improves the index's ability to address diverse aspects of energy justice and supports a more nuanced assessment of energy transition initiatives.

6.4. Main Conclusion

This chapter addressed the sub-question: *"How can an energy justice index in the Global South, with restorative justice as a tenet, be quantified?"*
The need for an Energy Justice Index stems from the requirement to evaluate and measure energy justice across diverse contexts systematically. In regions where energy access is inequitable, and inequalities are common, quantifying energy justice provides a tool for assessing how effectively justice principles are implemented. By translating complex energy justice concepts, such as distributive, procedural, recognition, and restorative justice, into actionable data, the index enables stakeholders to identify gaps, track progress, and make informed decisions to improve energy systems.

The rationale for developing this index, as outlined in Chapter 6.1, is multifaceted. It offers a structured approach to understanding how energy justice principles are operationalised within specific contexts. This is important for policy-makers, practitioners, and researchers seeking to evaluate energy interventions' impact and identify best practices. The index can serve as a benchmark, allowing for comparative analysis across different regions and initiatives. By including restorative justice in the index, the methodology secures that historical injustices are acknowledged and addressed and thereby supports a more inclusive and fair energy transition.

Insights from earlier chapters were built upon in developing the Energy Justice Index. Chapters 3 and 4 provided the theoretical and conceptual frameworks that shaped the index, while Chapter 5 contributed insights into institutional frameworks and practical metrics relevant to energy justice. Building upon these insights, this chapter introduced a scorecard that integrates restorative justice alongside other key tenets. This approach integrated components for rectifying past injustices, facilitating healing, and promoting fairness across generations. The revised Energy Justice Index now offers a more inclusive and practical framework for assessing energy justice. By offering a holistic assessment, the index supports evidence-based decision-making and facilitates cross-regional comparisons, which can help develop targeted interventions and share best practices.

The next chapter will transition from this methodological overview to a practical application, presenting a case study on South Africa. This case study will apply the Energy Justice Index to explore the specific dynamics and challenges of energy justice within the South African context, focusing how the index functions on a real-world scenario and identifying areas for potential improvement.

7

Case Study: South Africa

"It is in your hands to create a better world for all who live in it."

Nelson Mandela

In Chapter 6, the methodology for evaluating energy justice was outlined, including the development of an index including restorative justice and tailored to capture various dimensions of restorative justice. This approach provides a method for analysing energy justice across different regions in the Global South. Building on this methodological foundation, this chapter transitions to a practical application of the index through a detailed case study of South Africa. This case study is chosen to illustrate how the index operates in a real-world context, shedding light on the challenges and opportunities present in South Africa's energy landscape.

7.1. Motivation for South Africa

South Africa presents a compelling context for exploring energy justice in the Global South due to its unique socio-economic landscape, historical context, and ongoing energy challenges. After years of apartheid, South Africa shows significant social and economic inequalities. These gaps also affect access to basic services, such as energy (Smith, 2021). Economic deprivation leads numerous inhabitants to rely on unauthorised electricity connections and dangerous energy sources. connections and risky energy sources (Monyai et al., 2023). The socioeconomic gaps and social divisions in South African cities are among the most severe globally (Marcus & Marcus, 2022). The ongoing inequalities have led to widespread frustration due to inadequate access to essential services. Issues surrounding energy access remain contentious and have posed numerous challenges for successive South African governments since the end of apartheid.

Energy is vital for households to satisfy fundamental needs. In South Africa, despite electricity being the primary energy source for households, around 43% of the population is estimated to be energy poor (Monyai et al., 2023). To address energy poverty, people often use a combination of traditional energy sources like firewood and cow dung, along with intermediate options such as paraffin. Also modern energy sources are used, including electricity, liquefied petroleum gas (LPG), and biogas. Although energy prices are steep and many people struggle to afford it, there is still a strong demand for energy to support essential needs like lighting and powering appliances as cooking appliances, TVs, and cooling units. Residents face financial hardships due to this inadequate energy supply, which affects their ability to engage in income-generating activities and meet essential needs like education and healthcare. This clearly shows the strong link between financial poverty and energy poverty (Monyai et al., 2023).

Also, South Africa is facing a significant energy crisis characterised by frequent power outages, known locally as “load shedding”, and a heavy reliance on coal for electricity generation (Wiese & Van Der Westhuizen, 2024). This crisis underscores the urgent need for an energy transition towards more sustainable and reliable sources. However, this transition must also be just so that the benefits of new energy systems are equitably shared and vulnerable communities are not further disadvantaged. The country’s energy landscape is diverse, with a mix of traditional coal-based power and newly existing RE projects. South Africa is one of the signers of the international climate agreement, the Paris Agreement, so it intends to reduce its carbon emissions drastically in the coming years.

As one of Africa’s largest economies and a significant emitter of GHGs, South Africa’s approach to energy justice has implications that extend beyond its borders. The country’s experiences can provide lessons for other countries in the Global South that are facing similar challenges. By focusing on South Africa, this case study aims to offer deeper insights into how energy justice can be operationalised in a context marked by deep inequalities, environmental challenges, and a great need for sustainable development.

7.2. Application of the EJ Index to South Africa

The application of the EJ Index to South Africa involves a detailed analysis of the country's energy landscape, including its energy access, distribution, and justice issues. This analysis will be guided by the components and metrics outlined in the methodology chapter, which include evaluating procedural, distributional, recognition, and restorative justice aspects.

Specifically, the evaluation will address:

- **Procedural Justice:** The extent to which South Africa's energy policies incorporate community participation and ensure transparency.
- **Distributional Justice:** The fairness of energy resource allocation, including the availability of affordable and reliable energy and the distribution of benefits and costs related to energy systems.
- **Recognition Justice:** The effectiveness of South Africa’s energy policies in addressing the needs of vulnerable and marginalised groups.
- **Restorative Justice:** The actions taken to address and rectify past injustices concerning energy access and ensure that current practices promote long-term equity.

Data Collection

The primary data for this research was collected through interviews with key stakeholders, as identified in Table 1, together with their role, institute and reference code, as set out in Chapter 2. These stakeholders were selected based on their involvement and influence in South Africa’s energy sector. The interviews were designed around a set of questions aimed at gaining insights into the four justice aspects outlined above. The target was to conduct a minimum of ten interviews, balancing the need for diverse perspectives with the practical considerations of time and resource constraints. Although a larger number of interviews might have provided an even broader spectrum of insights, the decision to focus on ten was made to ensure that each interview could be thoroughly analysed. This approach, while modest in scale, allowed for an in-depth exploration of the issues and ensured that the data collected was of better quality.

In addition to stakeholder interviews, policy documents were also consulted. These documents, either publicly available or provided by the stakeholders themselves, offered more context and additional perspectives on the current energy policies and practices in South Africa. By triangulating data from interviews and policy documents, a robust and well-rounded analysis was ensured, contributing to the depth and credibility of the research findings.

7.2.1 Procedural Justice

To score procedural justice in South Africa, mainly in-country research has been done. This consisted of stakeholder interviews set out in Table 1 and consultation on policy documents. The outcomes of the different elements are set out in Table 3.1.

Participation in decision-making

This component involves assessing the requirement for community consultations in renewable energy (RE) projects. According to South Africa's latest 'Presidential Climate Commission Report' on a Just Transition in South Africa, a series of in-person consultations must be conducted to gain a better understanding of the needs of communities affected by the shift from fossil fuel-based energy systems. This initiative aimed to tailor the transition framework to the needs of those most impacted by the upcoming changes (PCC, 2022). The consultations involved substantial interaction with local municipalities and leaders in the affected regions, so that their perspectives were included (PCC, 2022). These consultations led to a significant multi-stakeholder conference in Johannesburg in May 2022, where attendees emphasised the need for a fair and equitable transition. The conference saw considerable support for the just transition framework (PCC 2022b). Additionally, the policy encourages the involvement of workers and community organisations, such as unions and advocacy groups, in the policy-making process. This engagement ensures that decisions reflect their interests and help them capitalise on new opportunities. All interviewees confirmed that this requirement for community consultation was actively implemented, so this requirement is in effect.

To assess the metric proportion of RE projects with community consultations, each of the ten interviewees was asked to provide their estimate of the proportion of renewable energy projects that included community consultations. An equal-weighted average was calculated from their responses to ensure accuracy and account for varying perspectives. After applying this formula to the responses from all ten interviewees, the weighted average proportion of RE projects with community consultations was found to be 0.7. This result indicates that, according to the interviewees, 70% of renewable energy projects include community consultations. This high proportion reflects strong compliance with the policy requirement and demonstrates effective engagement with local communities in the decision-making process. Interviewee IND1 said that, overall, community consultations are held, but 100% compliance is always difficult. Smaller renewable energy projects, especially those with limited budgets or in early development stages, could lack the resources required for extensive community engagement. For example, projects with tight financial constraints may prioritise essential project components over consultation processes. In line with this, EIAI1 suggested that renewable energy projects, especially amidst recent energy crises and the push for urgent solutions, often face trade-offs that impact community consultations. EIAI1 indicated that due to the urgency to increase energy supply, some project requirements, such as community consultations, might be compromised. Furthermore, TIC1 highlighted that the impact of different energy technologies on the environment and communities varies. For instance, wind and solar projects generally have less opposing reactions compared to technologies like nuclear power.

Information disclosure and transparency

The metric for information disclosure and transparency evaluates how effectively RE projects and policies ensure clear and open communication regarding their operations and financial aspects. According to the Presidential Climate Commission Report on a Just Transition, the approach firstly mandates that communities be well-informed about what the just transition entails. This involves assisting communities in understanding the transition's specifics and facilitating open discussions about areas of agreement and disagreement. Such transparency is crucial for cultivating trust and ensuring that stakeholders have a clear understanding of the processes affecting them. The policy many times emphasises on the importance of engagement characterised by transparency, openness, impartiality, and consensus. It advocates for decision-making processes that are effective, relevant, and coherent, so that all stakeholders have access to necessary information and can participate meaningfully. Furthermore, the policy requires the adoption of a standardised approach for tracking financial flows related to the just transition, i.e. using the National Treasury's Green Finance Taxonomy, which helps in disclosing financial data in a manner that promotes transparency and supports informed policy and economic decisions. Consequently, this requirement is actively implemented.

In practice, interviewees partly confirmed that efforts are being made to implement these transparency practices. However, the weighted average score for the metric on information disclosure and

transparency is 0.5, which shows there is still room for improvement. Interviewee ACF1 and TIC1 pointed out that while some information is being provided, it is not always at the level expected. For instance, information is often only posted on government buildings or official websites, which may not reach all relevant stakeholders effectively. Interviewee IND1 highlighted that South Africa has 12 official languages, and not all information is translated into all these languages. This lack of linguistic inclusivity, according to her, could block broader community engagement. Additionally, IND1 suggested that there should be increased use of social media platforms, WhatsApp groups, and other digital communication tools to improve information dissemination. These methods could help bridge gaps and ensure that information reaches a wider audience, leading to greater inclusivity and engagement in the just transition process.

The metric for transparency in government policymaking was sourced from the World Economic Forum (WEF, 2017). The most recent data available, from 2017, was used for this analysis. The WEF's index ranges from 1 to 7, with 7 representing the highest level of transparency. In 2017, South Africa's score was 3.95 (WEF, 2017). For the purposes of this study, the score was rescaled to a 0-1 index, resulting in a value of 0.6. Additionally, a slight downward trend in transparency is observed over the years, with South Africa scoring 4.5 in both 2015 and 2016, and then dropping to 3.95 in 2017.

When evaluating the availability of information across all relevant characteristics of RE projects, the weighted average outcome from the interviews was 0.4, which means that there is considerable room for improvement in this area. For instance, one interviewee, TNS1, said that while basic project details are often made available on official government websites, they are not always updated regularly. SAIIA1 mentioned here that important information, such as environmental impact assessments or detailed financial reports, are often lengthy documents that are not easily accessible or understandable for the average community member. IND1 again pointed out that the information is not provided in all 12 official languages of South Africa, which limits again its accessibility to non-English speaking people.

Access to legal processes to achieve redress

To assess access to legal processes for redress, the metric of judicial independence was examined using data from the World Economic Forum's Global Competitiveness Index, which rates countries on a scale from 1 to 7, with 7 being the best (WEF, 2017). The latest available source was again for the year 2017. This year, South Africa received a score of 4.91, which, when rescaled to a 0-1 index for this method, results in a score of 0.7 (WEF, 2017). This score indicates a decline in judicial independence, as earlier data show scores of 5.82 in 2015 and 5.44 in 2016. The downward trend raises concerns about the accessibility and effectiveness of legal processes, particularly in cases involving energy justice and environmental protection, where strong judicial independence is very important for ensuring fair outcomes.

Table 3: Procedural Justice Tenet Outcomes for South Africa

Component	Metric	Unit	Calculation	Source	Outcome
Participation in decision-making	Requirement for community consultations for RE projects	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	1
	Proportion of RE projects with community consultations	Proportion (0-1)	= # RE projects with community consultations / total RE projects	In-country research	0.7
Information disclosure and transparency	Requirement to make RE project information available beforehand to local communities	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	1
	Information provision per RE project	Proportion (0-1)	= # RE projects where information provided to local communities/total number of RE projects	In-country research	0.5
	Transparency of government policy making	Index (0-7) (rescaled to 0-1)	N/A	World Economic Forum	0.6 (=3.95/7)

	Availability of information across all relevant characteristics of RE projects inquired	Proportion (0-1)	= # of available items on requested information in in-country research for RE projects / total requested RE projects	In-country research	0.4
Access to legal processes to achieve redress	Judicial independence	Index (0-7) (rescaled to 0-1)	N/A	World Economic Forum	0.7 (=4.95/7)

As can be deduced from equation 2, which was set out in Chapter 5.2.3 Constructing the EJ Index, the components are first calculated:

$$\mathbf{C_{procedural}} = \sum_{j=1}^{N} \mathbf{M_j}$$

$$\mathbf{C_{participation\ in\ decision-making}} = \mathbf{1 + 0.7 = 1.7}$$

$$\mathbf{C_{information\ disclosure\ and\ transparency}} = \mathbf{1 + 0.5 + 0.6 + 0.4 = 2.5}$$

$$\mathbf{C_{access\ to\ legal\ processes\ to\ achieve\ redress}} = \mathbf{0.7}$$

Now that the components of procedural justice are calculated, the energy justice index for procedural justice could be calculated using equation 1, as introduced in Chapter 5.2.3 Constructing the EJ Index:

$$\mathbf{Procedural\ EJ} = \frac{1}{3}\sum_{x=1}^{3} \mathbf{C_{procedural}}$$

$$\mathbf{Procedural\ EJ} = \frac{1}{3}(\mathbf{1.7 + 2.5 + 0.7}) = \mathbf{1.63}$$

This means that the calculation of the Procedural Energy Justice Index (EJ) yields a value of 1.63, which represents the overall procedural justice in South Africa's energy transition. This result shows both the strengths and weaknesses in the procedural aspects of energy justice. While policies for participation in decision-making, information transparency, and access to legal processes exist, the actual outcomes in practice need significant improvement. Although efforts are being made, the real impact of these policies is not as strong as it could be. This value gives policymakers an important benchmark and shows that more needs to be done to improve the procedural aspect in the country's energy sector.

7.2.2 Distributional Justice

To score distributional justice, in-country research has been executed for the first component, distribution of benefits and cost of RE systems, and secondary data is used for the second and third components, respectively, employment and access to affordable and reliable energy. The findings for the different components are presented in Table 4.

Distribution of benefits and cost of RE systems

In South Africa, the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) mandates benefit-sharing agreements with host communities so that the local groups impacted by renewable energy projects receive tangible benefits (South African Department of Energy, 2024). THE REIPPPP, which invites bids from independent energy producers to determine which projects will proceed. Bids are evaluated primarily on the proposed tariffs, from bidding windows 1 to bidding windows 4 (which account for 70% of the evaluation) and on contributions to economic development (which account for 30%). This requirement, confirmed through both policy documents and stakeholder interviews, shows that there is a commitment to this metric and, therefore, the outcome with a score of 1. The REIPPPP facilitates the creation of community trusts to manage and distribute these benefits, aiming to address local socioeconomic needs. These initiatives are financed through a

portion of the revenue generated by each renewable energy project from electricity sales to Eskom, the national electricity provider. Additionally, a community trust representing residents within a 50-kilometre radius of the renewable energy project is required to hold between 2% and 5% of the project's shares.

The REIPPPP requires that a significant proportion of RE projects have benefit-sharing agreements with local communities, which is also seen in practice. This requirement is confirmed by both policy documents and interviews with stakeholders, who have emphasised the programmes' focus on guaranteeing that local groups receive tangible benefits from RE projects. According to interviewees, this widespread implementation of benefit-sharing agreements supports the outcome with a proportion score of 1.

In the REIPPPP, benefit-sharing agreements are required to make sure that all communities that are impacted by RE projects, including areas with vulnerable groups, receive benefits from these projects. The weighted outcome for this metric was 0.7; according to feedback from interviewees CDO1 and RNW1, there is concern that while the REIPPPP is well-intentioned, in practice, it could result in weaker enforcement. Ms IND1 stated that the programme includes benefit-sharing, but in practice, projects in areas with vulnerable groups sometimes fall short as these areas often face less attention.

The weighted average that comes from the interviewees for the proportion of renewable energy (RE) projects in areas without vulnerable groups that experienced conflicts due to disagreements with local communities is 0.8. This means that 20% of these projects faced such conflicts. This score indicates that while a substantial portion of projects in non-vulnerable areas encountered local disputes, it is a notable area for improvement. Some interviewees emphasised that, despite the REIPPPP's initiatives to improve positive community relations, these persistent conflicts reveal a need for stronger conflict management strategies and more effective stakeholder engagement.

Employment

In evaluating the employment of local personnel in the renewable energy sector, data from the International Renewable Energy Agency (IRENA) is used. According to IRENA (2022), there were 24,559 renewable energy jobs available in South Africa. The number of jobs was 10,442 for CSP, 7,900 for solar photovoltaic, 3,200 for wind energy, 1,610 for solar heating and cooling, 812 for hydropower and 595 for liquid biofuels (IRENA & ILO, 2023). To determine the job availability per capita, this figure is calculated relative to the total population of approximately 60 million. This results in a per capita job availability of 0.000409. Thus, there are approximately 0.000409 renewable energy jobs for each person in South Africa.

The total number of patents for renewable energy in South Africa is 784 for wind, 937 for solar thermal, 703 solar photovoltaic, 211 PV-thermal hybrid, 216 marine energy, 145 hydropower, 24 geothermal energy, and 1,211 biofuels (IRENA, 2022). This leads to a total patent number of 4,231. Given this substantial number, the index score reflects a high level of innovation and activity in the renewable energy sector.

Access to affordable and reliable energy

The World Bank Group provides detailed data on electricity access in South Africa (World Bank Group, 2022). As of the most recent year available, 2022, 86.5% of the South African population had access to electricity, translating to an index outcome of 0.865.

The quality of the electricity supply is assessed by the World Economic Forum's Global Competitiveness Index (WEF, 2017). This index ranges from 1 to 7, with 7 representing the highest quality. In 2017, South Africa's index score was 3.92. When normalised on a scale from 0 to 1, this score translates to an outcome of 0.56.

The affordability of electricity prices is detailed in the World Bank Group's Doing Business database (World Bank Group, 2019). According to this data, the electricity price is 16.1 US cents per kWh. This corresponds to an index outcome of 0.839.

Data and statistics from the International Energy Agency (IEA) show the proportion of renewable energy in South Africa's total power generation. In 2021, South Africa's share of renewable energy in power generation was 7.3% (IEA, 2021). Thus, the outcome for this metric is 0.073.

Table 4: Distributional Justice Tenet Outcomes for South Africa

Component	Metric	Unit	Calculation	Source	Outcome
Distribution of benefits and cost of RE systems	Requirement to have a benefit sharing agreement and other benefits in place with local communities for RE projects	(0, 0.5, 1)	1 = both requirements in effect 0.5 = only one of requirements in effect 0 = none in effect	In-country research	1
	Proportion of RE projects with benefit sharing agreements and other benefits	Proportion (0-1)	= (# RE projects with a benefits sharing agreement with local communities/total number of RE projects)*0.5 +(# of RE projects with other benefits for local communities/total number of RE projects)*0.5	In-country research	1
	Proportion of RE projects in areas where there were no vulnerable groups that did not receive any benefits	Proportion (0-1)	1-((# of RE projects done in areas with vulnerable groups/total of projects)* (proportion of projects without benefit sharing agreements and other benefits))	In-country research	0.7
	Proportion of RE projects in areas where there were no vulnerable groups and conflict due to disagreements of the local communities	Proportion (0-1)	1-((number of RE projects done in areas with vulnerable groups/total number of projects)* (number of RE projects where there was conflict due to disagreements of the local communities/total number of projects))	In-country research	0.8
Employment	Employment of local personnel in renewables (green jobs)	Number of jobs per capita	N/A	IRENA	0.000409
	RE patents (Wind and Solar)	Number of filed patents	N/A	IRENA	1
Access to affordable and reliable energy	Electricity access	% of population with access to electricity	N/A	World Bank	0.865
	Quality of electricity supply	Index (0-7) (rescaled to 0-1)	N/A	World Economic Forum	0.56
	Affordability of electricity prices	US cents per kWh (adjusted for purchase power parity)	1-Electricity prices (after normalisation)	WBG – Doing business/IMF	0.839
	RE electricity output	RE electricity output as % of total electricity output	N/A	IEA	0.073

The components can again be calculated as follows:

$$\mathbf{C_{distributional}} = \sum_{j=1}^{N} \mathbf{M_j}$$

$$\mathbf{C_{distribution\ of\ benefits}} = \mathbf{1 + 1 + 0.7 + 0.8 = 3.5}$$

$$\mathbf{C_{employment}} = \mathbf{0.000409 + 1 = 1.000409}$$

$$\mathbf{C_{access\ to\ affordable\ and\ reliable\ energy}} = \mathbf{0.865 + 0.560 + 0.839 + 0.073 = 2.337}$$

Now that the components of distributional justice are calculated, the energy justice index for distributional justice could be calculated using equation 1:

$$\mathbf{Distributional\ EJ} = \frac{1}{3}\sum_{x=1}^{3} \mathbf{C_{distributional}}$$

$$\mathbf{Distributional\ EJ} = \frac{1}{3}(\mathbf{3.5 + 1.000409 + 2.337}) = \mathbf{2.279}$$

The Distributional Energy Justice Index (EJ) is calculated at 2.279, indicating South Africa's current performance in distributing energy benefits. This score shows both progress and areas needing improvement. South Africa excels in implementing benefit-sharing agreements and maintaining a strong patent portfolio. However, challenges exist, such as a low renewable energy output share of 7.3%, ongoing conflicts in some regions, and modest employment levels in the renewable sector. This index shows the need for further efforts to improve the distribution of energy benefits and job creation within the sector. It provides again a benchmark for policymakers to address these issues and improve equity in South Africa's energy transition.

7.2.3 Recognition Justice

Only one component is assessed to score recognition justice in South Africa, and mainly secondary data is used, except for the last metric on cross-subsidies. Table 5 provides an overview of the outcomes from these metrics.

Addressing the needs of the most vulnerable through policies

Recognition justice focuses solely on addressing the needs of the most vulnerable through targeted policies. The existence of an approved national electrification plan is a key metric for this component and can be found in the World Bank's RISE documents, where it is confirmed that such a plan exists (RISE, 2020). However, the same document indicates that the electrification plan lacks policies related to mini-grids and off-grid solutions. Regarding the inclusion and gender sensitivity in electrification planning, this scores 100 in RISE (RISE, 2022). Additionally, South Africa implements the Free Basic Electricity (FBE) policy, which provides cross-subsidies to support low-income consumers. Under this system, higher tariffs paid by industrial and wealthier residential consumers help subsidise electricity costs for low-income households (National Treasury South Africa, 2021).

Table 5: Recognition Justice Tenet Outcomes for South Africa

Component	Metric	Unit	Calculation	Source	Outcome
Addressing the needs of the most vulnerable through policies	Existence of an approved national electrification plan	Binary (0,1)	1 = requirement in effect 0 = not in effect	RISE	1
	Electrification plan includes off-grid solutions	Binary (0,1)	1 = requirement in effect 0 = not in effect	RISE	0
	Inclusion and gender sensitivity in electrification planning	Binary (0,1)	1 = requirement in effect 0 = not in effect	RISE	1
	Existence of cross-subsidies to support low-income consumers of electricity	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	1

The components can again be calculated as follows:

$$\mathbf{C_{recognition}} = \sum_{j=1}^{N} \mathbf{M_j}$$

$$\mathbf{C_{addressing\ the\ needs}} = \mathbf{1 + 0 + 1 + 1 = 4}$$

Now that the components of recognition justice are calculated, the energy justice index for recognition justice could be calculated using equation 1:

$$\mathbf{Recognition\ EJ} = \sum_{x=1}^{1} \mathbf{C_{recognition}}$$

$$\mathbf{Recognition\ EJ = 4}$$

In summary, the metrics for recognition justice show that South Africa has made significant progress in supporting vulnerable communities. The existence of a national electrification plan, attention to gender sensitivity, and the Free Basic Electricity policy all demonstrate the country's way toward fair energy access. However, the absence of strong policies for mini-grids and off-grid solutions reveals a gap in reaching remote and underserved areas. This outcome highlights both the progress made and the need for further work to ensure recognition justice is achieved for everyone.

7.2.4 Restorative Justice

Three components are evaluated to assess restorative justice in South Africa, focusing on addressing past injustices, facilitating healing, and ensuring fairness across generations. This evaluation relies solely on in-country research, with Table 6 offering an overview of the outcomes from these metrics.

Addressing past injustices

The first metric, the requirement for environmental and social impact assessments (EIAs and SIAs) for renewable energy projects, is fully in effect as these requirements have been legally mandated since 1989, as outlined in the South African National Environmental Management Act (NEMA) of 1998 and its subsequent amendments. This metric received a score of 1. All interviewees confirmed that EIAs and SIAs are indeed conducted as per these legal requirements. Interviewee EIA1 also mentioned that there are specific departments within the Department of Environment, Forestry, and Fisheries responsible for conducting these assessments.

Another metric, the proportion of energy projects addressing historically disadvantaged communities, currently stands at 0.2. This low figure indicates that only a small portion of projects are specifically aimed at these communities. The outcome of 0.2 was derived from an analysis of the current implementation of the framework for a just transition in South Africa (PCC, 2022). Interviewee RNW1 noted that the framework outlines important principles and requirements for addressing historical disadvantages, but has not been fully applied in practice. According to RNW1, the framework serves mostly as a guiding document that sets out the goals and principles for a just transition but lacks binding enforcement mechanisms, which affects its practical application. This gap between the framework's intentions and its actual implementation contributes to the limited proportion of projects targeting historically disadvantaged communities according to the interviewees.

Facilitating healing

Regarding the facilitation of healing, there is no current requirement to allocate funds for future compensation related to environmental damage or social inequities caused by renewable energy projects. This absence of financial provisions results in a score of 0. Interviews with stakeholders revealed that they were unaware of any existing metrics or policies addressing this issue, and no relevant provisions were found in current policies or practices.

Ensuring fairness across generations
Similarly, the metric for ensuring fairness across generations also scored 0. There are no established requirements for a Social License to Operate (SLO) or similar agreements, nor for Environmental Financial Risk Obligations (EFRO) or comparable financial measures. Interviewees confirmed that they were not aware of any metrics or policies related to these aspects, and a thorough review of policy documents indicated that such provisions are currently absent in South Africa's regulatory framework.

Table 6: Restorative Justice Tenet Outcomes for South Africa

Component	Metric	Unit	Calculation	Source	Outcome
Addressing past injustices	Requirement for environmental and social impact assessments for RE projects	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	1
	Proportion of energy projects addressing historically disadvantaged communities	Proportion (0-1)	= # of energy projects addressing / total number of projects	In-country research	0.2
Facilitating healing	Requirement to set aside funds for future compensation for envrionmental damage or social inequities in RE projects	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	0
Ensuring fairness across generations	Requirement for SLO or comparable agreements for energy projects	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	0
	Requirement for EFRO or comparable financial provisions	Binary (0,1)	1 = requirement in effect 0 = not in effect	In-country research	0

The components can again be calculated as follows:

$$\mathbf{C_{restorative}} = \sum_{j=1}^{N} \mathbf{M_j}$$

$$\mathbf{C_{addressing\ past\ injustices}} = \mathbf{1 + 0.2 = 1.2}$$

$$\mathbf{C_{facilitating\ healing}} = \mathbf{0}$$

$$\mathbf{C_{ensuring\ fairness\ across\ generations}} = \mathbf{0 + 0 = 0}$$

Now that the components of restorative justice are calculated, the energy justice index for restorative justice could be calculated using equation 1:

$$\mathbf{Restorative\ EJ} = \frac{\mathbf{1}}{\mathbf{3}} \sum_{x=1}^{3} \mathbf{C_{restorative}}$$

$$\mathbf{Restorative\ EJ} = \frac{\mathbf{1}}{\mathbf{3}} (\mathbf{1.2 + 0 + 0}) = \mathbf{0.4}$$

All in all, South Africa's RE sector shows limited progress in restorative justice. While environmental and social impact assessments are legally mandated, leading to some accountability, the focus on historically disadvantaged communities remains small. The absence of requirements for future compensation funds, Social License to Operate agreements or comparable agreements, and Environmental Financial Risk Obligations or comparable financial provisions creates a gap in ensuring fairness and healing. The overall restorative energy justice index reflects these deficiencies, scoring a relatively low 0.4. This indicates substantial room for improvement in addressing past injustices and ensuring equitable outcomes across generations.

7.2.5 Energy Justice Index Score

The individual components of energy justice calculated in the previous sections can now be used to determine the overall energy justice index score, as shown below:

$$\mathbf{EJ} = \frac{1}{10}\sum_{x=1}^{10} \mathbf{C_x} \qquad \text{Eq. 1}$$

$$\mathbf{C_{participation\ in\ decision-making}} = \mathbf{1.7}$$
$$\mathbf{C_{information\ disclosure\ and\ transparency}} = \mathbf{2.5}$$
$$\mathbf{C_{access\ to\ legal\ processes\ to\ achieve\ redress}} = \mathbf{0.7}$$
$$\mathbf{C_{distribution\ of\ benefits}} = \mathbf{3.5}$$
$$\mathbf{C_{employment}} = \mathbf{1.000409}$$
$$\mathbf{C_{access\ to\ affordable\ and\ reliable\ energy}} = \mathbf{2.337}$$
$$\mathbf{C_{addressing\ the\ needs}} = \mathbf{4}$$
$$\mathbf{C_{addressing\ past\ injustices}} = \mathbf{1.2}$$
$$\mathbf{C_{facilitating\ healing}} = \mathbf{0}$$
$$\mathbf{C_{ensuring\ fairness\ across\ generations}} = \mathbf{0}$$

$$\mathbf{EJ} = \frac{1}{10}(\mathbf{1.7 + 2.5 + 0.7 + 3.5 + 1.000409 + 2.337 + 4 + 1.2})$$

$$\mathbf{EJ} = \frac{1}{10}(\mathbf{16.93})$$
$$\mathbf{EJ = 1.693 = 1.7}$$

The overall energy justice index score, calculated at 1.7, represents a relatively modest outcome, particularly when compared with the findings of Apergi et al. (2024), who use the same method but with only the three tenets. They showed higher scores for countries Malaysia, Jordan, Chile, and Kenya in the Global South. Several factors could contribute to South Africa's lower score in this context.

First, while South Africa performs reasonably well in the distribution of benefits, it is seen that it scores relatively low in metrics related to information disclosure and transparency. This lack of transparency can lead to mistrust and hinder public engagement in renewable energy projects, in the end affecting the success and fairness of these initiatives. Additionally, while there is some level of participation in decision-making processes, South Africa falls short compared to the more inclusive and robust frameworks observed in Malaysia and Jordan, where transparency and legal frameworks for redress are stronger.

A significant factor in South Africa's lower score is the considerable weight of the restorative justice tenet, which is important for addressing past injustices and achieving a just energy transition. Despite introducing restorative justice into their just energy transition framework (PCC, 2022), South Africa lacks practical requirements such as Social License to Operate agreements, Environmental Financial Risk Obligations, or funds set aside for future compensation. The absence of these measures hinders efforts to mitigate the social and environmental impacts of RE projects and contributes to the lower score in this area. Moreover, the country's moderate progress in addressing the needs of historically disadvantaged communities, evident in the relatively low proportion of energy projects targeting these groups, further pulls down the overall score.

In sum, the overall energy justice index score of 1.7 highlights a range of strengths and weaknesses in South Africa's approach to energy justice. While the country shows reasonable performance in certain areas, such as the distribution of benefits, significant gaps remain, particularly in information disclosure, transparency, and restorative justice. These findings emphasise the need for targeted improvements to enhance energy justice outcomes. The insights gained from this analysis will be explored further in the next chapter, which will present the main observations from the empirical data and set the stage for developing comprehensive policy recommendations in later sections.

7.3. Main Observations

In the previous sub-chapter, the energy justice framework was applied to South Africa, focusing on calculating procedural, distributional, recognition, and restorative justice elements. This sub-chapter presents the main observations derived from the empirical analysis of these four justice elements. By examining the calculated scores for each component, this section aims to highlight key insights into South Africa's performance in these areas. The observations made here will form the basis for the policy recommendations and targeted interventions discussed in the chapter on policy recommendations.

7.3.1 Main Observations on Procedural Justice in South Africa

Participation in decision-making

Firstly, South Africa has achieved a 70% adherence rate to community consultation requirements for renewable energy (RE) projects. This statistic indicates a generally effective level of engagement with local stakeholders. However, this engagement can be inconsistent, particularly during times of energy crises when urgent solutions are prioritised over thorough community consultations. As one interviewee noted, such crises often lead to trade-offs that impact the quality and depth of these consultations. The importance of procedural justice, as discussed in Chapter 4, is supported by both Western and non-Western theories. These theories emphasise that energy systems should not only be efficient but also inclusive. Procedural justice entails community consultations as integral to decision-making processes, thereby supporting both collective well-being and individual rights. The principle of Ubuntu, which highlights that “a person is a person through other persons”, underscores the value of community and relationality. This principle aligns with the observed high engagement rate, and reflects a commitment to collective decision-making and respect for communal voices.

Information disclosure and transparency

The weighted average score of 0.5 for information provision indicates a gap between policy intentions and actual practice. Although transparency policies exist, their implementation is inconsistent, which impacts the accessibility of information. Interviewees expressed concerns about the limited detail and accessibility of information regarding energy projects. One interviewee suggested that improvements could include providing information in all twelve local languages and distributing it through multiple channels. Another interviewee suggested improving accessibility by using clear, easily understandable language instead of lengthy policy documents. According to Rawls’ Theory of Justice, transparency and fairness in resource distribution are important, and information is considered a resource. The current state of information disclosure falls short of this ideal, as it does not fully uphold the principle of making information accessible to all stakeholders. Non-Western frameworks, such as Buen Vivir, also emphasise transparency and co-responsibility as essential for community well-being. The current shortcomings in information provision conflict with these values, which address the importance of clear and accessible communication to build trust and address community needs.

Access to legal processes to achieve redress

There is a generally adequate score of 0.7 for access to legal processes, but the declining judicial independence could raise concerns about the effectiveness of legal redress in addressing grievances. Kantian ethics emphasises the importance of fairness and the protection of individual rights through impartial legal processes. The decline in judicial independence in South Africa could undermines this principle by potentially limiting the ability of individuals and communities to seek justice.

7.3.2 Main Observations on Distributional Justice in South Africa

Distribution of benefits and cost of RE systems

South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) mandates benefit-sharing agreements with host communities, so that local groups could receive benefits from RE projects. This initiative has resulted in a high score for benefit-sharing agreements, scoring a 1, which indicates effective implementation. However, there are also concerns about the enforcement of these agreements, particularly in areas with vulnerable groups, and ongoing conflicts in some regions, which highlight areas needing improvement. The ethical principle of interconnectedness and collective responsibility, explains the need for energy systems to balance individual benefits with community needs. While the REIPPPP aims to align with this principle by involving communities in benefit-sharing, the challenges in enforcement for vulnerable groups reflect a

need for greater emphasis on community relationality and collective well-being, as emphasised in both Ubuntu and Rawlsian perspectives.

Employment
Employment in the renewable energy sector shows a relatively modest per capita job availability, but South Africa exhibits a high level of innovation with a substantial number of patents. The relatively low share of renewable energy in power generation further indicates an area where potential progress may be needed.

Access to Affordable and reliable energy
Access to affordable and reliable energy is relatively strong, with a high percentage of the population having electricity access and reasonably good scores for electricity quality and affordability. However, the low proportion of renewable energy output indicates the need for greater emphasis on increasing the renewable share in the energy mix. This environmental sustainability aspect comes back within Western ethical frameworks that often view nature through the lens of its value to human well-being, whereas non-Western perspectives like Buen Vivir and Dharma advocate for living in harmony with nature. The current energy mix, with its limited renewable share, indicates that policies should more strongly reflect the integrative view of nature's intrinsic value and focus on sustainable practices.

7.3.3 Main Observations on Recognition Justice in South Africa

Addressing the needs of the most vulnerable through policies
South Africa has implemented a national electrification plan that is supported by the Free Basic Electricity (FBE) policy and uses cross-subsidies to aid low-income consumers. These measures show progress in addressing the needs of the most vulnerable. However, the electrification plan does not include mini-grids or off-grid solutions, which shows a gap in reaching remote and underserved areas. The FBE policy and national electrification plan align with Western ethical frameworks that emphasise individual rights and fair distribution, as well as non-Western perspectives like Ubuntu and Buen Vivir, which stress communal well-being and collective responsibility. However, the absence of mini-grid and off-grid solutions is a divergence from these ethical ideals. Integrating these solutions would align with the principle of interconnectedness and collective responsibility, which makes that energy policies are more equitable overall. The high scores for inclusion and gender sensitivity in electrification planning shows the positive efforts towards fair access to energy, which is further supported by the FBE policy that provides subsidies for low-income consumers.

7.3.4 Main Observations on Restorative Justice in South Africa

Addressing past injustices
South Africa's framework for addressing past injustices includes the legal requirement for EIAs and SIAs, which have been in place since 1989 under the National Environmental Management Act (NEMA). This metric received a score of 1, which indicates compliance with legal mandates. However, the proportion of energy projects specifically targeting historically disadvantaged communities stands at only 0.2, which reflects limited practical application of the principles outlined in the just transition framework. This gap is attributed to the framework's lack of binding enforcement mechanisms.
The low proportion of projects addressing historically disadvantaged communities suggests that while just transition policy frameworks exist, their application does not fully address historical wrongs. Ubuntu here highlight the importance of communal well-being and reparative measures, and focuses on the need for more effective implementation of principles aimed at rectifying past harms.

Facilitating healing
There are no current requirements for setting aside funds for future compensation related to environmental damage or social inequities caused by renewable energy projects. This absence of financial provisions results in a score of 0, and stakeholders reported a lack of relevant metrics or policies addressing future compensation. In terms of interconnectedness and collective responsibility, Buen Vivir and Dharma emphasise healing and reparative justice as part of communal and ecological harmony. The absence of future compensation mechanisms in South Africa can in this way be seen as a gap in facilitating healing. These perspectives emphasise the importance of integrating financial provisions to address long-term impacts and promote reconciliation.

Ensuring fairness across generations
The metrics for ensuring fairness across generations, including requirements for an SLO and EFRO, both scored 0. There are currently no established requirements for these measures, which reflects a significant gap in the regulatory framework. Environmental sustainability principles from both Western and non-Western perspectives highlights the need to consider the long-term impacts of energy projects on future generations. Western ethical frameworks, such as the capabilities approach, advocate for preserving resources to support future well-being, while non-Western perspectives like Buen Vivir stress living in harmony with nature for current and future generations. The absence of SLO and EFRO requirements in South Africa indicates a missed opportunity to align with these ethical principles, as they would help energy projects contributing to long-term sustainability and fairness.

7.4. Main Conclusion

This chapter addresses the first part of the research question: "*Given the renewed method including restorative justice, how does South Africa score on the energy justice index, and what policy recommendations emerge from these insights?"* It answers how South Africa performs on the Energy Justice Index. Policy recommendations based on these findings will be detailed in the final chapter (Chapter 9).

The case study of South Africa reveals several key insights:

1. Procedural Justice: South Africa generally meets community consultation requirements for renewable energy projects, which reflects a commitment to procedural justice. However, the effectiveness of these consultations differs, such as during energy crises where community consultations are not taken into account.
2. Distributional Justice: South Africa has the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) and, because of this, shows strong performance in benefit-sharing agreements. However, challenges remain in enforcing these agreements, especially in vulnerable regions. Employment opportunities in the renewable energy sector are modest, and the low share of renewable energy in power generation indicates a need for expanding renewable energy sources.
3. Recognition Justice: The national electrification plan and Free Basic Electricity (FBE) policy demonstrate progress in addressing the needs of vulnerable populations. However, currently, there is a lack of mini-grids and off-grid solutions, which falls short of reaching remote areas. Integrating these provisions could improve overall equity and align with the principles of recognition justice.
4. Restorative Justice: The legal framework for addressing past injustices through Environmental and Social Impact Assessments and Social Impact Assessments complies with legal mandates but lacks effective enforcement, particularly for historically disadvantaged communities. There are no current requirements for future compensation or mechanisms that ensure fairness across generations. This shows that there are significant gaps in facilitating long-term healing and sustainability.

Overall, this chapter provides a detailed evaluation of South Africa's performance on the Energy Justice Index. The insights gained will guide the policy recommendations presented in Chapter 9, which aim to achieve an inclusive energy transition. These recommendations may also apply to other regions in the Global South facing similar challenges.

8

Discussion

"We cannot solve problems with the kind of thinking we employed when we came up with them."

Albert Einstein

In the preceding chapters, the methodology for evaluating energy justice was thoroughly detailed, resulting in the development of an Energy Justice Index designed to incorporate restorative justice principles. Chapter 7 applied this index to a case study of South Africa, providing insights into the country's performance across various dimensions of energy justice, including procedural, distributional, recognition, and restorative justice. This chapter will delve deeply into the methodology, examining its theoretical foundations and practical applications. It will explore how the Energy Justice Index was constructed, focusing on its innovative approach to incorporating restorative justice principles. The discussion will cover the rationale behind the index's design, its strengths in capturing diverse aspects of energy justice, and the challenges encountered during its application. By synthesising the results from the previous chapters, this discussion will provide a better interpretation of how South Africa's energy justice practices align with theoretical and practical expectations. It will also address the potential for policy improvements and offer reflections on the broader implications for energy transition strategies in the Global South.

8.1. Reflection on the Methodology

The methodology presented in this study builds upon a theoretical framework with the introduction of a new tenet and integrates both qualitative and quantitative approaches to develop an improved Energy Justice Index (EJI). This methodology is designed to achieve a more holistic evaluation of energy justice by incorporating multiple components and metrics that reflect the complex nature of energy systems and their impacts on society.

At the heart of the methodology is the four-tenet framework of energy justice, which includes procedural justice, distributional justice, recognition justice, and restorative justice. Each tenet is integral to understanding different facets of energy justice, so a multifaceted assessment was made. I.e., procedural justice focuses on the fairness of decision-making processes and the transparency of energy governance. This is supported by both Western and non-Western ethical theories and emphasises that energy systems should not only be efficient but also inclusive. This tenet was operationalised through metrics that assess whether community consultations for RE projects are legally mandated and whether such consultations are carried out. The aim was to evaluate how inclusive and accountable the decision-making processes are. A notable observation was the discrepancy between policy metrics and outcome metrics. Frequently, policies were in place, yet the outcomes did not align with the intended objectives of these policies. This gap suggests that the existing policy measures may not be sufficiently effective and there is a need for either more robust policy formulations or additional policy support and implementation.

Another notable point is that South Africa's lower score is significantly influenced by the emphasis on restorative justice. This tenet is important for addressing past injustices and ensuring a just energy

transition. Despite South Africa incorporating just energy transition principles into its energy transition framework (PCC, 2022), it still lacks essential elements needed to address the needs of historically marginalised communities. This is reflected in the relatively small proportion of energy projects addressing these groups.

Reflecting on the quantification process, the development of the EJI was a critical aspect of this research. Creating a quantifiable measure has deepened the understanding of energy justice, by zooming in on the four tenets, and exploring the components and metrics of how energy justice principles can be operationalised. The EJI has met its objectives by serving as a robust tool that not only provides theoretical insights but can also offers practical applications. The index has proven valuable in several key areas. Firstly, it has highlighted disparities in energy justice by identifying gaps where current policies fall short. Secondly, it has enabled the tracking of progress over time, offering a clear view of how well energy policies are addressing justice principles. Thirdly, the EJI has guided policy development by pinpointing areas needing improvement and supporting the formulation of more effective policies. The incorporation of restorative justice into the EJI has been especially significant. It ensures that the index addresses injustices experienced by people and the environment, whether historical, current, or anticipated in the future. This aspect of the EJI has informed the creation of policies that not only rectify past wrongs but also work proactively to prevent future harm.

In summary, the quantification approach through the EJI has made substantial contributions to both theoretical and practical advancements in the field of energy justice. It has fulfilled the research's initial goals and provides a solid foundation for future work, reinforcing the importance of quantifiable measures in achieving equitable and inclusive energy transitions.

Limitations

As restorative justice is a newly emerging concept, a major challenge in calculating the EJI was finding relevant data. The data sources used for the index include a combination of secondary data and primary data collected specifically for this research. Secondary data were preferred due to the established reputations of sources (i.e. IRENA, IMF and WEF). Using secondary data helps ensure the index is broadly applicable and is generally preferred due to its consistency and ease of comparison across countries. However, it was not always possible to use secondary data for all components as some data either did not exist or were inaccessible. In cases where secondary data were unavailable, country-specific data had to be gathered. This involved consulting policy documents and conducting interviews with policymakers, and project implementers. Primary data collection is often more time-consuming and may introduce potential biases. Interviews with stakeholders, although valuable for gaining in-depth insights, can be affected by the subjectivity or bias of the respondents, which might impact the reliability of the collected data. Additionally, the extensive time required for primary data collection further complicated the research process, making it a less efficient option compared to secondary data for large-scale comparative studies.

With this, the study brought attention to how difficult it is to get secondary data, particularly for measuring restorative justice and certain aspects of procedural justice and distributional justice. The in-country study also showed that there is a dearth of information on the procedures used in the creation of renewable energy projects. This emphasises the necessity of achieving more data openness for renewable energy projects. The methods used for data collection and the assumptions made during this process significantly impact the quality of the measures used to quantify the index components. Consequently, using multiple sources for the same metric could potentially affect the findings. When more than one source was available for a given metric, the source with the most extensive data coverage over the years was selected. Additionally, data from sources used for other metrics were prioritised to minimise the number of sources. The accessibility of datasets to the general public was also considered in the selection process.

The selection of weighting is another design decision that affects the outcomes, as covered in Chapter 6. The results show that the choice of how to weigh the individual factors affects the average index scores in some way. This needs to be taken into account when selecting the weights as well as when presenting and interpreting the findings. Notwithstanding these drawbacks, equal weighting is commonly employed when creating composite indices when there is not any empirical or theoretical support for the relative significance of the various dimensions. Future data compilation efforts involving a large number of nations may benefit from the application of more advanced data reduction and weighting techniques.

8.2. Recommendations for Future Research

The goal of future research should be to thoroughly evaluate and expand the use of the Energy Justice Index (EJI) across diverse countries in the Global South. This includes not only testing its applicability in different regions but also refining and improving the index to better capture the nuances of energy justice in various settings. A key area of interest for future studies would be to explore how the index can be effectively implemented in additional Global South nations. This would involve understanding the various challenges faced by these countries, and specific socio-economic conditions, so that the index remains relevant and useful in these contexts. This would also lead to interesting comparisons. Most importantly, improving data accessibility, particularly for the underrepresented aspects of energy justice, is essential for making the index more robust and applicable to a wider range of countries.
Another possibility for future research involves expanding the scope of the index by incorporating new elements and metrics, especially within the restorative justice dimension. By doing so, the index could provide a more robust assessment of how energy policies and projects address historical injustices and contribute to a just transition. For instance, including more detailed indicators related to SLOs, environmental risk management, and compensation mechanisms could deepen the index's ability to evaluate the long-term social and environmental impacts of renewable energy projects.

Moreover, it will be important to explore ways to adapt the index better to reflect the specific circumstances of individual nations or regions. This could involve customising the weighting of different components or tailoring certain metrics to align with local priorities, while still maintaining the index's broader applicability and comparability across countries. This balance between customisation and standardisation is essential so that the index remains a valuable tool for both local policy analysis and international comparisons.

As the index evolves, there is also potential to integrate additional dimensions of energy justice, such as cosmopolitan justice, which considers the global impacts of energy policies and the responsibilities of nations to address cross-border issues like climate change and energy poverty. Including such elements could further improve the index's ability to provide a holistic evaluation of energy justice, including local and national considerations as well as global ethical obligations.

9

Conclusion and Policy Recommendations

"The best way to predict the future is to create it."

Abraham Lincoln

This final chapter synthesises the research findings and reflects on their contributions. Section 9.1 revisits the main research question and summarises key insights from the study, focusing on whether the research met its goals and how the methods and findings align with initial expectations. Section 9.2 discusses the contributions of this research to the field of energy justice, especially in integrating restorative justice, and considers its theoretical and practical impacts. Finally, Section 9.3 presents policy recommendations based on the research, aimed at guiding policymakers in improving energy justice practices in the Global South and enhancing the integration of restorative justice principles. This chapter provides a clear overview of the research outcomes, their implications, and practical guidance for future policy development.

9.1. Overview of the Main Research Findings

The central research question guiding this study was:

> *"How can energy justice, as part of the broader framework of climate and environmental justice, be achieved, particularly within the context of transitioning to sustainable energy sources in the Global South, with considering restorative justice as an essential tenet?"*

To address this question, the research was divided into three phases, each designed to explore specific aspects of energy justice, particularly focusing on the integration of restorative justice within this framework. The findings from each phase are summarised below, addressing the sub-questions that were posed to guide the investigation.

Sub-question 1: What are the key components of energy justice, and how is energy justice defined?

The study identified and defined the key components of energy justice as procedural justice, distributional justice, recognition justice, and restorative justice. Procedural justice involves fair and inclusive decision-making processes, ensuring transparency and the active participation of all stakeholders, especially marginalised communities. Distributional justice concerns the equitable

allocation of energy resources, benefits, and burdens. Recognition justice emphasises the need for acknowledging and respecting different identities. Restorative justice, newly integrated into the framework through this study, focuses on addressing historical and ongoing injustices by ensuring reparative measures are in place for human and non-human entities. This more holistic and 'updated' definition of energy justice serves as a robust foundation for assessing and implementing just energy transitions.

Sub-question 2: How can restorative justice be integrated within the energy justice framework, and how does it relate to different ethical theories?
Restorative justice was integrated into the energy justice framework to address the need for reparative actions in energy transitions, especially in contexts with historical injustices, such as those in many Global South countries. It builds upon the definitions found from sub-question 1, and these were explored through eight ethical theories, including Western and Non-Western theories, demonstrating that restorative justice aligns with broader moral principles of justice and equity, such as those found in theories of deontological ethics, liberal egalitarianism, Ubuntu and Dharma, for example. These eight ethical theories represented diverse ethical perspectives from different geographical origins, cultural contexts, and philosophical traditions, especially non-Western viewpoints, and provided a holistic understanding of energy justice. With this diverse integration, energy policies could be more globally inclusive and culturally sensitive, which, in the end, can lead to more equitable outcomes. This section set the stage for subsequent research phases to contribute to more robust policy analyses and recommendations for the evolving energy landscape.

Sub-question 3: How do institutional frameworks and governance structures in the Global South impact the implementation of energy justice, particularly with respect to restorative justice?
This part of the thesis revealed that institutional frameworks and governance structures in the Global South significantly influence the implementation of energy justice, including the restorative justice component. The interrelation between values, society, culture, and institutions plays an essential role in this dynamic, as synthesised from OIE. In many Global South contexts, deeply embedded societal values and cultural norms shape the functioning of institutions and governance structures, which in turn affect how energy justice is perceived and implemented. Moreover, the effectiveness of governance structures in addressing historical injustices depends on how well these institutions align with the cultural values and societal expectations of the communities they serve. An important aspect of this analysis included the role of universal human rights law as a layer within Williamson's framework. Recognised by international and national courts, human rights law can provide a robust juridical foundation for assessing how institutional structures can uphold principles of justice. There are fundamental similarities between energy justice and HR as normative frameworks when applied to the energy sector and HR could offer energy justice a legal framework for operationalisation, as opposed to one that is solely academic background. As energy justice aims to address inequities within the energy sector, HR can address inequalities and power discrepancies structurally within the context of HRL to guarantee an equitable energy transition.

Sub-question 4: How can an energy justice index in the Global South, with restorative justice as a tenet, be quantified?
In response to this sub-question, the study developed a method for quantifying energy justice in the Global South, incorporating restorative justice as a key tenet. This method involved creating an index that could be applied across different countries in the Global South that allows for a standardised measure of energy justice that accounts for the particular challenges and opportunities in these regions. The index was designed to be versatile and replicable. In this way, it could provide a tool for researchers and policymakers to assess and improve the fairness of energy transitions. The inclusion of restorative justice in the index ensures that the historical and ongoing impacts of energy systems on marginalised communities are accounted for in the evaluation process.

Sub-question 5: Given the renewed method including restorative justice, how does South Africa score on the energy justice index, and what policy recommendations emerge from these insights?
The application of the energy justice index to South Africa revealed that while the country has made progress in addressing energy justice, significant gaps remain, particularly in the area of restorative justice. South Africa's relatively low score on the index, especially on restorative justice, underscores the need for more targeted policies that address the specific needs of historically disadvantaged communities. The study's findings led to several policy recommendations, which will be presented in depth in Section 9.3.

9.2. Contributions of this Research

This thesis has made some important contributions to the field of energy justice, with a particular focus on the Global South. Firstly, this research has expanded the theoretical framework of energy justice by integrating restorative justice alongside procedural, distributive, and recognition justice. This integration provides a more comprehensive approach, addressing not only contemporary inequities but also historical injustices and focuses on non-human entities besides human entities. By integrating restorative justice it moves beyond the traditional three tenets and offers a richer understanding of how energy transitions can be made more equitable and inclusive.

Secondly, the study highlights the important role of institutional frameworks and governance structures in implementing energy justice. By examining how values, societal norms, cultural contexts, and institutional practices interact, the research underscores the need for energy policies that align with local realities. This insight is essential for formulating policies that are effective and equitable in the complex field of energy governance in the Global South. It shows that institutional frameworks play a critical role in shaping energy governance outcomes, and their analysis is crucial for understanding how to achieve fair and inclusive energy transitions.

A central contribution of this research is the development of an Energy Justice Index (EJI) that incorporates restorative justice. Quantification is essential for several reasons. First, EJI provides a systematic way to evaluate and measure the effectiveness of energy policies and practices. In regions with uneven energy access and pronounced inequities, a quantifiable measure allows stakeholders to assess how well energy justice principles are being implemented and where gaps remain. This empirical basis is important for identifying disparities, tracking progress, and making informed decisions to improve energy systems. Second, quantification translates complex concepts like distributive, procedural, recognition, and restorative justice into actionable data. This offers a clearer understanding of how these principles are applied in specific contexts, which is valuable for policymakers, practitioners, and researchers. The index serves as a benchmark for assessing policies and projects, providing a comparative perspective on energy justice across different regions and initiatives. Third, the EJI includes indicators related to accessibility and affordability for distributive justice, inclusiveness and fairness in decision-making for procedural justice, recognition of marginalised communities for recognition justice, and rectification of past harms for restorative justice. It does not focus solely on technological or economic aspects but evaluates how these intersect with justice principles. This approach ensures the index remains relevant to achieving equitable energy transitions. Fourth, the index provides insights by integrating restorative justice, ensuring historical injustices are acknowledged and addressed. It supports the development of policies that remedy past or ongoing injustices and prevent future harm to people and environment. The index facilitates evidence-based decision-making and cross-regional comparisons, in which knowledge and best practices can be shared.

Linking Contributions
Each contribution builds upon the previous sections of the thesis. The theoretical and conceptual framework lay the groundwork for understanding the importance of integrating restorative justice. The insights into institutional frameworks highlight the need for methodological tools like the EJI. The development of the EJI provides a practical means to apply the theoretical and institutional insights gained. Finally, policy recommendations can be made using the findings from the EJI to offer targeted guidance for improving energy justice practices.

9.3. Recommendations for Policymakers

Based on the research findings, several policy recommendations are proposed to improve the fairness and inclusivity of the energy transition. These recommendations aim to address the potential shortcomings related to the four tenets.

To strengthen restorative justice measures, policymakers could focus on several actions. First, they could develop and enforce policies prioritising restorative justice in energy transitions. This means addressing both historical and current injustices through socio-economic empowerment. Also, improving access to essential services like housing, sanitation, and transportation for disadvantaged communities is a key part of this effort. Second, energy companies should be required to obtain and maintain Social Licenses to Operate (SLO) or comparable agreements. This should be formalised through regulatory frameworks that mandate ongoing community consultations and engagement processes. Companies must demonstrate their commitment to fair practices and equitable benefit-sharing as part of these agreements. This ensures that local communities have a formal mechanism to voice their concerns and negotiate benefits throughout the lifecycle of energy projects. Third, establish Environmental Financial Risk Obligations (EFRO) or comparable financial mechanisms so that energy projects are prepared to handle future environmental or social damages. This approach helps align with restorative justice by holding projects accountable for their long-term impacts and aiding in the rectification of past harms. Additionally, set up compensation funds to provide monetary support to communities affected by energy projects. These funds should address past injustices and support historically marginalised groups.

To increase procedural justice, it is essential to establish transparent and inclusive decision-making processes within energy projects. This involves organising public forums, consultations, and stakeholder meetings to actively involve all affected parties. Long-term community fora could be developed and managed by experienced facilitators to ensure ongoing, meaningful engagement. These forums should be initiated early in the decision-making process and continue throughout the project's duration to build trust and support collaboration. Access to information must be improved by conducting workshops and sessions in all of the country's official languages, so that information is accessible to everyone. Special provisions should also be made to accommodate individuals in rural communities or areas without broadband access, such as providing alternative means for accessing information and participating in discussions. The process should include a system for reporting back to communities during the drafting stages and ensure that draft plans are released publicly for comments before finalising decisions. This approach allows for continuous public feedback and refinement of the plans based on community input. Additionally, the possibility of co-creation should be explored, especially if the energy project is located on or near community sites, to ensure that community members have an active role in shaping the project. Moreover, it is important to also see the potential risks limitations of civil society organisations in representing community voices, especially in politically polarised countries. While these organisations may advocate for community interests, they may not fully capture or reflect the diverse voices within communities. Finally, decisions should be grounded in concrete evidence rather than personal opinions to enhance the fairness and effectiveness of the process. All in all, addressing gaps in information access and ensuring community involvement are vital for preventing unfair negotiations and decision-making.

To enhance distributional justice, policies must be designed to ensure a fair distribution of the economic and social benefits of energy projects. This involves balancing broad societal benefits with targeted support for the most affected groups to address their immediate needs and promote long-term inclusivity. To improve the performance of green job opportunities, proactive labour market policies could be implemented. These policies should include income support during job transitions, retraining and reskilling programs, and effective job placement services. Additionally, it is important to support fair employment standards by establishing and enforcing minimum conditions for employment and worker benefits, including setting minimum wages. These measures aim to reduce poverty and income inequality, so that the benefits of energy projects are equitably shared.

For recognition justice, a main policy recommendation is to update the national electrification plan to include off-grid solutions such as solar home systems and mini-grids, as these technologies are crucial for extending energy access to remote and underserved communities where traditional grid expansion is not feasible. It is also important to ensure that all communities, particularly those in isolated areas, have reliable and equitable access to energy. Additionally, special attention should be given to

marginalised and vulnerable groups within these communities to enhance energy justice. For women, particularly housewives who may not have formal employment, community training programmes should be developed to provide them with skills relevant to the energy sector. These programmes can help empower women by creating opportunities for them to participate in and benefit from energy projects, thus addressing gender disparities in energy access and employment. Female trainers could lead these programmes to ensure cultural sensitivity and address the specific needs of women. For the elderly and people with disabilities, energy solutions must be designed with accessibility in mind. User-friendly features, such as large, easy-to-read controls on appliances and voice-activated systems, could help ensure these groups can manage their energy needs effectively. Support services tailored to their needs, such as dedicated assistance for installation and maintenance, are also crucial in promoting fair access and addressing potential barriers to energy use. By focusing on these aspects, energy justice can be better realised, in a way that all community members benefit equitably from energy resources.

By adopting these recommendations, countries in the Global South can make significant progress in achieving energy justice and creating a more fair and sustainable energy transition. These steps aim to address existing challenges, promote equity, and make sure that energy projects benefit all communities.

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Appendix A. Climate Change & Greenhouse Effect Explained

All societies are experiencing the effects of climate change, particularly those most at risk that lack the means to adjust to the changing conditions. The frequency and severity of extreme weather events have increased along with sea level rise, severe heat, drought, intense rainfall and global warming. The majority of what we are currently witnessing, since the Industrial Revolution, is attributable to human actions. As outlined in Paris in 2015, to attain carbon neutrality by 2040–2050 and curtail the rise in average global temperatures to less than 2°C above pre-industrial levels, it is imperative to substantially decrease GHG emissions by approximately 5-8% annually starting now. In this chapter, the proof of climate change is presented, the role of human activity in its onset is explored and the GHG emissions per capita across various nations and industries are examined.

The Greenhouse Effect (GE)

It is necessary to comprehend the greenhouse effect (GE), the primary GHG that create it, and its significance for the emergence of life on Earth in order to identify the changes in the world's climate that have occurred in the century that followed the dawn of the industrial era. Without the GE of the atmosphere, the world's thermal level would be approximately 30°C lower. The issue we are currently facing is that an excessively powerful GE has caused a previously unseen rate of temperature rise. As temperatures rise, we've noticed a surge in the occurrence and strength of extreme weather phenomena, alongside a rise in sea levels. These changes have adversely affected tens of millions of individuals, particularly those lacking adequate resources to cope with climate change.

Taking the Earth as a basic system in equilibrium is necessary for understanding the GE. The Earth operates as a system that absorbs sunlight as heat and emits it as a black body. When the first law of thermodynamics, which stipulates the preservation of energy, is employed in this model, it necessitates a state of balance between the absorbed and released energy. Like any physical entity with a degree above absolute zero (0 Kelvin, equivalent to -273.15°C), the Earth releases radiation with specific characteristics such as frequency, wavelength, and spectrum. The sun, with its substantially higher temperature compared to Earth, likewise radiates energy. The Stefan-Boltzmann law can be applied to compute the radiation emitted per unit area from a black body with a temperature denoted by T. In this context, the designation "black body" implies that we are postulating both the Earth and the sun to behave as theoretical, non-reflective entities. The Stefan-Boltzmann law establishes a connection between the radiation discharged per unit area and the thermal state of the black body:

(1) $E = \sigma \cdot T^4$
With $\sigma = 5.670373 \cdot 10^{-8} W m^{-2} K^{-4}$

For the sun, the energy output per square meter emitted is:

(2) $E_{sun} = \sigma \cdot T_{sun}^4$ with $T_{sun} = 5796\,°K$
$E_{sun} = 5.670373 \cdot 10^{-8} \cdot (5796)^4$
$E_{sun} = 6.399 \cdot 10^7\ W m^{-2}$

Using this number, we can determine the energy emitted by the solar body, referred to as its luminosity L_0. This luminosity is determined by multiplying E_{sun} by the total area of the sun. Considering that the radius of the sun is approximately 695,700 kilometers ($r_{sun} = 6.957 \cdot 10^8$), we obtain:

(3) $L_0 = E_{sun} \cdot A_{sun}$ with $A_{sun} = 4\pi r_{sun}^2$
$L_0 = E_{sun} \cdot 4\pi r_{sun}^2$
$L_0 = (6.399 \cdot 10^7) \cdot (4\,\pi\,(6.957 \cdot 10^8)^2)$
$L_0 = (6.399 \cdot 10^7) \cdot (4\,\pi\,(6.957 \cdot 10^8)^2)$
$L_0 = 3.892 \cdot 10^{26}\ W$

Formulas (2) and (3) can be utilized to calculate the quantity of energy transmitted per square meter at the mean distance of Earth from the sun, which is approximately 150 million kilometers (or $r_d = 1.496 \cdot 10^{11}\ m$):

(4) $E_d = \frac{L_0}{4\pi r_d^2} = \frac{3.892 \cdot 10^{26}}{4\,\pi\,(1.496 \cdot 10^{11})^2} = 1384\ Wm^{-2}$

The region of the Earth exposed to sunlight corresponds to the area of a circle with a radius equal to that of the Earth, $A = \pi r_e^2$. By multiplying this with the E_d , we can determine the total radiation absorbed by the Earth.

(5) $E_{absorbed} = \pi\, r_e^2\, E_d$

For increased accuracy, we must also acknowledge that a portion of solar radiation is bounced back by the Earth's surface. The extent of this reflection varies based on surface attributes, with higher reflection rates observed over areas where snow or ice is present. Typically, approximately 30% of the total incoming solar radiation is sent back. To adjust for this, we multiply the incoming solar radiation by $(1 - a_e)$, where $a_e = 0.3$ representing the albedo of the Earth. From here, we are able to calculate the Earth's degree under the assumption that it functions as a black body with a temperature denoted as T_e , and under the condition that the energy emitted equals the energy absorbed from solar radiation.

(6) $absorbed\ solar\ radiation = emitted\ black\ body\ radiation$

$E_{absorbed} = E_{emitted}$

$E_{absorbed} = \pi\, r_e^2 (1 - a_e)\, E_d$

$E_{emitted} = \sigma \cdot T_e^4 \cdot 4\,\pi\, r_e^2$

$\pi\, r_e^2 (1 - a_e)\, E_d = \sigma \cdot T_e^4 \cdot 4\,\pi\, r_e^2$

In this way, the Earth's balanced temperature can be determined:

(7) $T_e = \sqrt[4]{\frac{(1-a_e)E_d}{4\sigma}} = \sqrt[4]{\frac{(0.7) \cdot 1384}{4 \cdot 5.670373 \cdot 10^{-8}}} = 255.6\ ° K$

This outcome suggests that 255.6°K would represent the thermal condition in the scenario where the Earth acted as a black body without an atmosphere surrounding it.
Now, a basic atmosphere enveloping the Earth is introduced, marked by a temperature T_A that enables solar radiation to pass through it without absorption, while absorbing the radiation emitted by the Earth. Essentially, the assumption is that the atmosphere can produce a greenhouse effect. This straightforward atmospheric layer also operates as a black body, emitting radiation in both directions—towards outer space and towards the Earth's surface—as determined on the temperature T_A.

The atmosphere balance formula:

$(8a)$ $2\sigma \cdot T_A^4 = \sigma \cdot T_e^4$

The Earth's surface formula:

$(8b)$ $\frac{1}{4}(1 - a_e)E_d + \sigma \cdot T_A^4 = \sigma \cdot T_e^4$

Solving these two formulas yields the following result:

$(9a)$ $T_A = \sqrt[4]{\frac{(1-a_e)E_d}{4\sigma}} = 255.6\ ° K$

$(9b)$ $T_e = \sqrt[4]{2T_A} = 304.1\ ° K$

Hence, due to the existence of the atmosphere, which absorbs the majority of the long-wave radiation, the Earth maintains a mean temperature of 304°K, approximately corresponding to 31°C. This temperature exceeds by approximately 50°C the temperature Earth would experience in the absence of a greenhouse effect.
It's important to note that 31°C is significantly more than the observed mean surface temperature of approximately 15°C. This discrepancy arises from the simplified model of the Earth and its atmosphere, which does not account for the Earth's complex system. Nevertheless, this basic model emphasizes the significant influence of the atmosphere on the temperature. To improve accuracy, the model could include multiple atmospheric layers with different temperatures. Key greenhouse gases include H_2O (water), CO_2, CH_4, NO_x and other fluorinated gases, with varying atmospheric lifetimes.

Current Patterns in GHG levels and Climate
Over the last century, human activities have significantly raised the level of greenhouse gases. The levels of CO_2 and CH_4 in the atmosphere have elevated by over 50%, increasing from approximately 270 ppm at the end of the 1800s to around 415 ppm currently. It's important to emphasize that in the past 2.5 million years, the Earth has not experienced such a heightened level. The rise adheres to a roughly exponential trend, and the annual percentage rise has been consistently growing. Furthermore, CO_2 remains in the atmosphere for 300 to 1,000 years and CH_4 for about 10 years. This means greenhouse gases continue to impact the climate long after their release, persisting for many decades and centuries. With the rise in greenhouse gas concentrations, the atmosphere has absorbed more radiation from the Earth, causing an increase in atmospheric temperature. This elevated atmospheric temperature has consequently resulted in increased emission of radiation back to the Earth's surface, contributing to its increasing temperature as well.

The increase in temperature is not the sole indicator of climate alteration, as succinctly outlined in the report from the Intergovernmental Panel on Climate Change (IPCC). The report affirms that numerous climate changes are already underway and that certain changes already initiated will persist in impacting the climate for the coming centuries and millennia (IPCC, 2021). Nevertheless, the report also underscores that significant and continual cuts in CO2 and other greenhouse gas emissions could mitigate climate change. The IPCC provides assessments regarding the likelihood of exceeding 1.5°C and 2°C global warming thresholds established by the Paris Agreement in 2015. Without prompt and substantial cuts in greenhouse gas emissions, achieving a limit on 2°C temperature increase will be unattainable. Human-induced greenhouse gas emissions have already contributed around 1.1°C to the rise in temperatures since 1850-1900, and without swift and tangible emission curbs, global temperatures could rise between 2°C and 5°C.

It's important to emphasize significant impacts of climate change as highlighted in the IPCC. The Summary for Policy Makers (SPM) highlights the substantial implications of climate change, and it is crucial to stress these. The water cycle is being heightened by climate change, which is causing increased precipitation, floods, and severe droughts in different parts of the world. Recent examples include burning forests associated with worldwide excessive heat as well as floods in Australia, Bangladesh, and Central Europe. The pace of sea level rise has accelerated, with the last ten years seeing rates of roughly 3.4 mm/year. By the end of the century, extreme events that were previously uncommon may happen every year. Permafrost and glacier melting, (such as the latest occurrences in the Alps), and Arctic Sea ice loss—which is expected to be ice-free before the end of the century—are all made worse by climate-induced temperatures. Marine habitats are also impacted by ocean warming, acidification, and decreased oxygen concentrations. Cities now experience more severe effects of the environment, such as extreme temperatures, flooding, and rising sea levels in areas near the shore.

The SPM further highlights that if urgent and significant measures are not taken to cut greenhouse gas emissions, the average global temperature could rise by over 2.5°C by the close of this century. This would exceed the warming thresholds established by the 196 nations that signed the Paris Agreement.

Appendix B. Case Study & Interview Questions

Restorative Justice

Environmental and Social Impact Assessments

1. **Requirement for Environmental and Social Impact Assessment for Renewable Energy (RE) Projects**
    - **Question:** Are there environmental and social impact assessments for renewable energy projects?
    - **Follow-up Questions:**
        - In what ways could these assessments be improved to ensure they address both environmental and social concerns adequately?
        - How can these assessments better incorporate the principles of restorative justice?
2. **Proportion of RE Projects with Environmental and Social Impact Assessments**
    - **Question:** What proportion of renewable energy projects currently include environmental and social impact assessments?
    - **Follow-up Questions:**
        - What factors influence whether or not a project undergoes such assessments?
        - How can we increase the number of projects that integrate these assessments effectively?

3. **Addressing Historical injustices**
    - **Question:** Are currently energy projects addressing communities that have historically been disadvantaged by previous energy or environmental initiatives?
    - **Follow-up Questions:**
        - In your opinion, what would be a fair compensation or restitution process for communities that have suffered negative impacts?
        - How can energy projects be designed not only to prevent harm but also to actively contribute to the restoration of past inequalities?

4. **Stakeholder Engagement in Restoration**
    - **Question:** Are stakeholders being involved in restorative processes after the implementation of energy projects?
    - **Follow-up Questions:**
        - What role do you see for communities in monitoring and evaluating these projects post-completion?
        - How can mechanisms for restorative justice ensure that communities genuinely benefit from these projects?

5. **Monitoring and Evaluation of Restorative Justice**
    - **Question:** Are projects actively using indicators to measure the effectiveness of restorative justice in energy projects?
    - **Follow-up Questions:**
        - How can success be defined in terms of restoration and compensation for affected communities?
        - Are you aware of any successful examples of restorative justice being applied in similar sectors?

6. **Integration of Restorative Justice in Policy**
    - **Question:** Are policymakers currently integrating restorative justice into the energy policy framework?

- **Follow-up Questions:**
  - What barriers do you see to implementing restorative justice in energy policy?
  - What would be a feasible first step in making restorative justice an integral part of energy policy?

Additional Questions on EFRO and SLO

7. Energy Financial Reserve Obligation (EFRO)

- **Question:** Are there reserves, such as an Energy Financial Reserve Obligation (EFRO), where companies are required to set aside funds for future compensation for environmental damage or social inequities?
- **Follow-up Questions:**
  - Should such a reserve be mandatory for energy projects in South Africa?
  - How could EFRO contribute to promoting restorative justice in the energy sector?

8. Social Licence to Operate (SLO)

- **Question:** To what extent do you think companies in the energy industry earn or maintain their Social Licence to Operate (SLO)?
- **Follow-up Questions:**
  - How important is SLO for the success of sustainable energy projects?
  - What role can restorative justice play in obtaining or maintaining an SLO?

Other tenets

Community Consultations and Engagement

1. **Requirement for Community Consultations for RE Projects**
   - **Question:** To what extent are community consultations mandatory for renewable energy projects?
   - **Follow-up Questions:**
     - What are the most effective ways to conduct these consultations to ensure meaningful community participation?
     - How do these consultations contribute to achieving energy justice, particularly in the context of restorative justice?

2. **Proportion of RE Projects with Community Consultations**
   - **Question:** What proportion of renewable energy projects currently involve community consultations during their planning and implementation?
   - **Follow-up Questions:**
     - How do these consultations impact the acceptance and success of the projects?
     - What can be done to ensure that more projects include community consultations as a standard practice?

3. **Requirement to Make RE Project Information Available to Local Communities**
   - **Question:** How important is it to require that renewable energy project information be made available to local communities beforehand?
   - **Follow-up Questions:**
     - What types of information should be provided to ensure transparency and community trust?
     - How can this requirement be enforced to ensure that communities are well-informed?

4. **Information Provision per RE Project**
   - **Question:** How effectively is information about renewable energy projects currently being provided to local communities?
   - **Follow-up Questions:**
     - What challenges exist in disseminating this information?
     - How can we improve the accessibility and understanding of project information for community members?

Benefit Sharing and Local Community Support

1. **Requirement for Benefit Sharing Agreements in RE Projects**
    - **Question:** Are benefit-sharing agreements a mandatory requirement for all renewable energy projects?
    - **Follow-up Questions:**
        - What should these agreements include to ensure fair and equitable distribution of benefits?
        - How can benefit-sharing agreements support restorative justice in the energy sector?

2. **Proportion of RE Projects with Benefit Sharing Agreements**
    a. **Question:** What proportion of renewable energy projects currently have benefit-sharing agreements in place with local communities?
    b. **Follow-up Questions:**
        i. How do these agreements impact the local communities involved?
        ii. What steps can be taken to increase the number of projects that implement benefit-sharing agreements?

3. **Proportion of RE Projects in Areas Where Vulnerable Groups Did Not Receive Benefits**
    a. **Question:** How often do renewable energy projects fail to provide benefits to vulnerable groups in the local communities?
    b. **Follow-up Questions:**
        i. What are the reasons behind this gap, and how can it be addressed?
        ii. How can policies ensure that vulnerable groups are prioritized in benefit-sharing arrangements?

Support for Low-Income Consumers

Existence of Cross-Subsidies to Support Low-Income Consumers of Electricity

- **Question:** How effective are cross-subsidies in supporting low-income consumers of electricity?
- **Follow-up Questions:**
    - What challenges exist in implementing cross-subsidies for low-income consumers?
    - How can cross-subsidies be structured to ensure that they contribute to energy justice and the broader goals of restorative justice?

Appendix C. Case Study: Consent Form Participation

Consent Form for Participation in Research Interview

Title of the Study: A Just Energy Transition in South Africa
Researcher: Elif Sibel Gökbekir
Institution: Delft University of Technology, Faculty of Technology, Policy And Management

Introduction:
You are being invited to participate in a research study conducted by Elif Sibel Gökbekir, a master's student at Delft University of Technology. The purpose of this study is to explore the concept of a just energy transition in South Africa. Your participation will involve an interview where your insights and perspectives will be gathered. The purpose of this interview is to gain insights into the energy landscape of South Africa, with a focus on issues related to energy access, distribution, and justice. The information you provide will be used to inform the analysis and findings of my master's thesis.

Confidentiality & Use of Data:
Your participation in this interview is voluntary and the information you provide will be treated with confidentiality. Your name and any other identifying information will be anonymised in the final thesis uploaded. This means that your identity will not be disclosed in any publications or presentations resulting from this research, such as in the Research Repository of TU Delft.
The insights gained from this interview will be used solely for the purpose of my master's thesis. The data may be included in the thesis report, presentations, or academic publications, but your name and personal details will remain anonymous.

Duration:
The interview is expected to last approximately 45 minutes to 1 hour. However, please note that the duration may extend beyond this time, depending on the depth of our discussion.

Consent:
By signing this form, you agree to participate in this research interview. You acknowledge that you have read and understood the information provided above, and you consent to the use of your anonymised data in the research as described.

Participant's Signature: _____

Participant's Name (Printed): _____

Date: _____

Researcher's Signature: _____

Date: _____