Master's Thesis - Master Sustainable Development

Energy Justice in South Africa

Visions for a green hydrogen contribution in the Just Energy Transition

Utrecht University

June 23, 2023

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In collaboration with Impact Hydrogen

"The opposite of poverty is not wealth.
In too many places, the opposite of poverty is justice."

— Bryan Stevenson, US lawyer and justice activist

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June 23, 2023

GEO-2321 Master's Thesis (30 ECTS)
International Development Track
Master Sustainable Development
Faculty of Geosciences

Host organization
Impact Hydrogen
Groningen, the Netherlands
impacthydrogen.com

Cover illustration generated by Canva AI prompted "just energy transition in South Africa". Source: canva.com

ABSTRACT

The triple challenge of inequality, poverty, and unemployment in South Africa, together with the ever increasing threats from a changing climate, have led to the introduction of a Just Energy Transition (JET). Included in plans for this transition is the introduction of green hydrogen, an energy carrier stated to provide renewable energy, jobs, and justice, adding to an all-encompassing solution to the prevailing challenges. In similarity to the JET, this study applies an energy justice framework to evaluate various actors' perspectives on the emerging green hydrogen economy in South Africa. Consisting of distributive, recognition, and procedural elements, the framework allows for a holistic analysis of energy systems based on the environmental justice approach. By interviewing participants within the government, private sector, and civil society, the study found a variety of perspectives regarding socioeconomic aspects of the future energy system. From the findings a private and public energy approach were distinguished. The government is opting for privatization of the energy system in order to overcome the failing energy system and acquire national and international private funding for setting up the future energy system, including hydrogen. Simultaneously, a public pathway is presented as an alternative, aiming to bring back energy as a public good, for the betterment of the population, rather than transnational profits. Based on the findings, green hydrogen is generally regarded to be an inevitable future development, leaving little room for negotiating by concerned parties, let alone informing uninvolved actors. Politicizing hydrogen discourse can help inform and include actors, by alerting of the imminent transition they are faced with. This study advises fairer distributing, specifically of international benefits and burdens, while recognizing local requirements through multiscalar governance procedures. Only in such a way can the South African energy system contribute to the global effort of fighting climate change and can governance at the international level contribute to local prosperity.

Key concepts

Energy justice; just transition; green hydrogen; inequality; energy governance

TABLE OF CONTENTS

LISTS OF TABLES & FIGURES

LIST OF ACRONYMS

AMD	Acid Mine Drainage
BBBEE	Broad-Based Black Economic Empowerment
DFI	Development Finance Institution
DSI	Department of Science and Innovation
ESG	Earth, Social, and Governance
HBS	Heinrich Böll Foundation
HySA	Hydrogen South Africa
IPP	Independent Power Producer
ISA	Infrastructure South Africa
JET	Just Energy Transition
JET-F	JET Framework
JET-IP	JET Investment Plan
JET-P	JET Partnership
MEC	Minerals-Energy Complex
PCC	Presidential Climate Commission
PGM	Platinum Group Metal
PPP	Public-private partnership
REIPPPP	Renewable Energy Independent Power Producer Procurement Program
TVET	Technical and Vocational Education and Training
ZAR	South African Rand

CHAPTER 1
INTRODUCTION

Facing climate change, a global push for structural transformation toward a sustainable future has been initiated. Energy transition strategies aim to reduce emissions by shifting to low-carbon and renewable energy sources, creating more sustainable energy systems (Vanegas Cantarero, 2020). However, aside from involving technological developments these transitions have significant societal impacts that need to be considered and are fundamental to achieving sustainability (McCauley et al., 2019). Originating from trade unions' intention to combine climate change mitigation with prospects for future employment, the concept of a 'just transition' was born and later expanded to provide a combined framework for energy, environment, and social fairness and equity (McCauley & Heffron, 2018).

By the end of 2021, South Africa took center stage on the global energy transition theater, as COP26 introduced a Just Energy Transition Partnership (JET-P) between South Africa and a consortium of Western countries, including the European Union. The JET-P aims to *"accelerate the decarbonisation of South Africa's economy, with a focus on the electricity system"* (European Commission, 2021). A prerequisite of this partnership and the supplemental grant and loan is a renewed urgency to move away from coal, which currently accounts for a vast majority of the country's electricity provision (Calitz & Wright, 2021). Simultaneously, the partnership is designed to *"ensure that the resources are available to support the workers, communities, and businesses whose livelihoods are negatively affected by the transition"* (The Presidency, 2022, p. 22). The partnership is part of an existing, decade-old plan for a Just Energy Transition (JET) in South Africa, that aims to combat both climate change and societal issues that the country has been struggling with for decades (Field, 2021; South African Government, 2010).

Any such structural changes to the electricity system could be welcomed in South Africa, as the country has been struggling to provide electrical power to its citizens for well over a decade. Due to a combination of lacking accountability, poor maintenance and innovative planning, and a shift toward privatization, South Africa's main electricity supplier Eskom, a state-owned enterprise, is unable to meet increasing daily demands at all times, causing nation-wide, rolling blackouts for certain parts of the day (Alternative Information & Development Centre, 2020; Lawrence, 2020b). Last September marked another low, with the state of rolling blackouts being upped to stage six – out of possible eight – meaning that during that period around 37 percent of the grid was without power (Business Tech, 2022; Eskom, 2019). The ongoing crisis has resulted in economic stagnation, as businesses are unable to consistently operate, culminating in further increasing unemployment, poverty and violent crime (Lawrence, 2020b).

1.1 A justice-infused energy transition introduces green hydrogen

Energy has been at the center of climate change debates for decades, but latest global reporting by the International Energy Agency shows that, while the share of energy produced from renewable sources is growing, total carbon emissions from fuel combustion are at an all-time high (International Energy Agency, 2022b). Surprisingly, this is caused predominantly by an increase in energy sourced from coal, which is generally considered to be the most polluting of all fossil energy sources used at industrial scales (International Energy Agency, 2022b).

Achieving sustainable transitions is not a straightforward process, as attempting to achieve global environmental sustainability by switching to renewable energy sources often leads to unsustainable practices in the local environment (Caprotti et al., 2020; Sovacool et al., 2019b). General distinctions can be found between energy transition strategies in the global north and south, with mutually exclusive challenges. The latter often incorporates socioeconomic developments as part of the energy transition, using the momentum of change to achieve ancillary targets (Swilling et al., 2016; Vanegas Cantarero, 2020).

The JET aims to integrate both a transition toward renewable energy sources and a way of reducing long-present structural inequalities by incorporating the concept of energy justice. Derived from the environmental justice concept, it seeks to analyze moral values dominant in energy systems and provide guidance in decision-making in order to ensure a fair distribution of the benefits and burdens of energy production and consumption (Heffron et al., 2018; Jenkins et al., 2016; McCauley et al., 2013). The concept is applied by the Presidential Climate Commission in the JET Framework (JET-F), providing a guideline for partners to follow in their participation in South Africa's energy transition (Presidential Climate Commission, 2022). Energy justice is a relatively new concept that has gained popularity among both researchers and policy-makers as energy transitions worldwide are being initiated (McCauley et al., 2019). Combining established justice concepts of distribution, procedure and recognition, the concept provides a holistic approach to the potential impacts of energy systems (Jenkins et al., 2016; McCauley et al., 2013). This framework helps both to inform decision-makers who are partaking in the JET, and provide an analytical tool to be used for verification of justice practices within the transition.

A significant portion of the JET involves the introduction of hydrogen as a renewable energy carrier and fuel. Hydrogen is introduced within the JET as a silver bullet, providing an answer to multiple issues that arise from a transition to renewable energy sources, for example, its ability to act as a storage medium for electricity and the use of hydrogen in applications where electrification is difficult or impossible (Ayodele & Munda, 2019; Imasiku et al., 2021; Rosen & Koohi-Fayegh, 2016). Hydrogen is regarded as a clean fuel when produced from water electrolysis using renewable electricity and is then usually referred to as 'green hydrogen' (Clark II & Rifkin, 2006). Other prominent color-coded variants include gray hydrogen, produced from fossil fuels and by far the most matured and widely applied method, and blue hydrogen, for which unavoidable carbon emissions are captured and stored (Ayodele & Munda, 2019). The plans for South Africa include setting out to establish a green hydrogen economy, which consists not only of production and consumption of hydrogen, but also includes education systems, manufacturing industries, and infrastructure (Department of Science and Innovation, 2021).

It is important to note that green hydrogen developments are still in their infancy globally and there is not a place in South Africa where either green or blue hydrogen is being produced or consumed at industrial levels (Boretti, 2021; Noussan et al., 2021). In this premature state of developments, small scale pilot projects require tremendous upfront investments, and the South African government hopes to acquire necessary capital from the private sector and international financing (The Presidency, 2022). It is in these early development stages where initial plans are made that various actors – eager to be involved in profitable opportunities – are looking to establish a foothold on the upcoming hydrogen market. The steps taken and decisions made during this phase are vital to future development of the renewed energy system and the inclusion of energy justice elements should start concurrently. Infrastructure South Africa and the Department of Science and Innovation of South Africa will inaugurate the process of developing a South African green hydrogen economy with two conferences that aim to bring together actors willing to partake in materializing these plans (Department of Science and Innovation, 2021; Infrastructure South Africa, 2022).

1.2 The unknown potential of green hydrogen

Plans for the development of a South African green hydrogen economy are presented in the middle of an energy crisis, due to an energy system that has been steadily deteriorating over time. Although the origin can be traced back to the era of apartheid, the deteriorated state of South Africa's energy system has become a more prominent issue in recent times of economic and political instability (Alternative Information & Development Centre, 2020; Lawrence, 2020b). Behind the somewhat stable apparel, the slowly decaying energy system had already been heavily affected by dominant party politics without sufficient opposition, accompanied by lacking accountability and a dragged-out dependency on mining to provide sufficient economic input for developments (Lawrence, 2020b; Mosala, 2022).

Exempting coal, the majority of extracted resources that account for export revenue include platinum group metals (PGMs) and iron ore (Lawrence, 2020b). South Africa is planning to reorganize the mining sector, rethink exports, and domestically manufacture the hardware required in renewable energy developments (Department of Science and Innovation, 2021). The strong connections between the mining and energy sectors mean actors are closely cooperating and are expected to continue to do so in the future. To achieve a just transition, recognizing the history and legacy of apartheid and the groups and individuals that are vulnerable or already negatively impacted by it is crucial. Trade unions and other civil society organizations remain skeptical of the proposed transition, worried about the prospects of the large workforce directly and indirectly associated with coal mining (Alternative Information & Development Centre, 2018; Hanto et al., 2022). Simultaneously, coal mining affected communities are collaborating with environmental justice organizations and are building more powerful social networks, calling for compensation schemes for when coal is phased out (Cock, 2019). Even without coal, the proposed new mining sector is expected to stay intertwined with the new energy system.

The problem this research set out to explore surrounds the fact that introduction of hydrogen as an energy commodity can bring both solutions and issues to South Africa. Literature on green hydrogen production often discusses technical feasibility and opportunity, while briefly mentioning socioeconomic benefits such as widespread electrification, increased wealth, and job security (Ayodele & Munda, 2019; Bhagwat & Olczak, 2020; Imasiku et al., 2021). South Africa is eager to establish international partnerships to decarbonize its own economy and create economic opportunities from exporting hydrogen to Western partners, who are further driven to transition to renewables and reduce dependency on Russian oil and gas (European Commission, 2022). However, these benefits of a hydrogen economy must be considered in the context of potential socioeconomic changes and accompanying challenges. The production of green hydrogen requires vast amounts of renewable energy and fresh water, raising issues in terms of land and water rights (Hanusch & Schad, 2021; F. Müller et al., 2021). This brings a risk of new forms of extractivism from the Global South, where valuable resources are exported without appropriate compensation (Voskoboynik & Andreucci, 2022). Therefore, a holistic approach is required when considering the implementation of green hydrogen in South Africa and to carefully evaluate the potential benefits and drawbacks. The energy justice framework can be applied in decision-making to help prevent social conflicts, environmental degradation and ensure inclusion of marginalized communities (Kalt & Tunn, 2022; F. Müller et al., 2022). Facing these uncertainties in progression of the JET, this research set out to answer the following research question: *How can energy justice be realized during the initial planning of South African green hydrogen developments from an actor's perspective?*

1.3 Research questions

The aim of this research is to provide an evaluative account of energy justice practices related to green hydrogen developments, as they are envisioned by actors who are involved in the planning process. By using the South African energy transition as a case study The study examines how actors approach the implications of introducing green hydrogen as an energy commodity. To achieve this objective, the aforementioned research question is devised to guide this research:

> *How can energy justice be realized during the initial planning of South African green hydrogen developments from an actor's perspective?*

In support of this main research question, the following sub-questions have been set up to guide and structure this research and provide a more in-depth look at the application of the energy justice concept in decision-making, using the three justice elements of distribution, recognition, and procedure, respectively:

SQ-1. How are the benefits and burdens of introducing green hydrogen distributed?
SQ-2. Whose interests are recognized in visions for development of the green hydrogen economy?
SQ-3. To what extent does energy justice influence procedures of green hydrogen decision-making?

1.4 Academic and societal relevance

This study builds on previous research by applying the framework of energy justice to the ambiguity of introducing green hydrogen to the renewable energy mix and to explore what actors are willing and able to contribute in order to realize energy justice. The research question presented above guided this research toward achieving this goal. Energy justice has been applied to research on fossil fuels (Cock, 2019; Mirzania et al., 2023) and renewable energy (Monyei et al., 2018; F. Müller et al., 2021; Sovacool et al., 2019b). Even though questions of justice are often left out of hydrogen research (Ayodele & Munda, 2019; Bhagwat & Olczak, 2020; Noussan et al., 2021) the concept has been applied to hydrogen on a theoretical level (Gevaert et al., 2022; Kalt & Tunn, 2022; F. Müller et al., 2022). The academic relevance of this study comes from the addition of a qualitative research approach with in-depth analysis of actor visions and interest, at the forefront of the hydrogen and justice nexus. Furthermore, this research contributes to the green hydrogen discussion simply by conducting qualitative research. Hydrogen research up to this point is techno-fix-focused at worst and fragmented at best and there is a need for a holistic overview of the implications of green hydrogen as part of energy transitions (Hanusch & Schad, 2021). The energy justice concept that this research applies, provides the holistic approach that is required to contribute to achieving a more comprehensive view of green hydrogen developments and how they might affect just transitions.

This study uses the South African case study, not only to extrapolate to other cases, but also provide insights into the future energy system of the country. Already facing energy and inequality crises it is far from certain what cost and benefits a new energy commodity, accompanied by technological and financial investments, might bring and how their distribution will materialize. Especially with a wide variety of (inter)national actors, from mining, energy, infrastructure, education and supporting trade unions (Alternative Information & Development Centre, 2018; Climate Investment Funds, 2020; Hanto et al., 2022), all with varying interest,

involved in planning the hydrogen economy. Introduction of hasty and neglectful climate adaptation and mitigation measures are foreseen to intensify existing inequalities (Markkanen & Anger-Kraavi, 2019). Due to the interconnectedness of energy with other aspects of society, energy inequality is said to exacerbate inequalities at the political, economic, and social levels (Sovacool et al., 2013). The South African government aims to bring justice along with the energy transition, therefore definition and management of those interests is required. Since justice can have different definitions and interpretations depending on who is asked and what is at stake, it is advised to transparently address these issues in order to find solutions that do not disproportionately benefit or burden specific people (Sovacool et al., 2016).

1.5 Research outline

This research follows the common research report structure with the first chapter having introduced the purpose of this research, and given a general context. Chapter 2 presents the theoretical framework this research is based upon, providing further details to the concepts of energy justice and the adjacent concepts of hydrogen commodification, inequality, and energy governance through which the energy justice concept is applied. Chapter 3 provides a regional contextualization for this research, building on the general contextual subjects of the first chapter. Chapter 4 outlines the research design and methodologies that are applied to gather findings that contribute to answering the research questions and showcasing how the research was conducted. The results section of this research is divided into three different chapters, each providing an overview of the analyzed data associated with one of the three sub-questions, answering each in the process. The individual chapters are linked to a specific segment of the theory and one of the three core elements of energy justice. Chapter 5 presents the findings linked to distribution justice, touching upon the subjects of hydrogen value, privatization, and climate change. Chapter 6 presents the findings pertaining to recognition justice, detailing fossil fuel continuation, the future energy workforce, and international interests. Chapter 7 presents the final findings related to procedural justice and focuses on the future energy system and standardization. In Chapter 8 the findings are discussed based on my interpretation of the theoretical framework, specifically explaining the results and addressing contradictions. Finally, Chapter 9 concludes this research, summarizing the research outcomes, and providing a concise answer to the main research question.

CHAPTER 2
THEORETICAL FRAMEWORK

This chapter addresses the three main concepts present in the research question: energy justice, green hydrogen, and energy governance, all of which are essential elements that guide this research. First, a brief definition of two essential justice concepts of equality and equity is provided. Thereafter, the concept of energy justice will be formulated, specifically addressing the three tenet framework. This will be followed by a detailed account of the technological and economic prospects of green hydrogen. The last concept to be discussed is energy governance, providing theory on implementation of energy transitions. In this chapter, the concepts of South African inequalities, hydrogen commodity and energy governance resemble the justice concepts of recognition, distribution, and procedure, respectively. This is clarified in the concluding conceptual framework.

2.1 Equality and equity

Frequently discussed aspects of justice theory are the concepts of equality and equity. These two concepts are often closely linked to environmental issues and are considered essential in reaching sustainable outcomes (Agyeman, 2008). In literature related to environmental and energy justice principles, equality refers to the equal distribution of resources, opportunities, or privileges among individuals or groups within a society, whereas inequality describes a lack thereof (Marshall, 1998). This is the definition used in this research when discussing (in)equalities. Within sustainable transition theory equality is considered to be a positive and desired outcome, although it is recognized that equality is relative and can therefore never be fully achieved (Heffron, 2021; McCauley, 2018; McCauley & Heffron, 2018). Specifically, in the context of climate change, existing inequalities are found to be exacerbated by global warming effects if not properly addressed (Markkanen & Anger-Kraavi, 2019). Likewise, insufficient energy access exacerbates existing inequalities, as poorer households, distanced from stable electricity provision, resort to alternative energy sources such as firewood to cook food and keep warm, which brings additional health problems from increased exposure to carbon toxics (Monyei et al., 2018).

Environmental justice originated from civil rights movements that strive for fairness and justice, making these goals also strongly tied to it (Agyeman, 2008). Within justice concepts, the terms ‘just’ and ‘fair’ are often used to prescribe distribution, which will come to light when discussing the concept of energy justice hereafter. Equity is regarded as a “*normative criterion for judging this distribution*” (Reckien et al., 2018, p. 176). The definition of equity used in this research is to provide a fair distribution according to the specific needs of individuals or groups and is therefore not necessarily equal in a quantitative manner (Markkanen & Anger-Kraavi, 2019). This outcome-based equity, which is also referred to as substantive equality, is therefore able to account for unequal starting points and actively improve distribution in favor of marginalized groups (Pellegrini-Masini et al., 2020). This ties into recognition justice, as disadvantaged actors need recognition to ensure equitable distribution.

Tying into both these concepts is the notion of the marginalized, which entails those specific groups or individuals that are often underrepresented and neglected by default in societal developments (Lacey-Barnacle et al., 2020). Many marginalized or disadvantaged groups, such as low-income households or ethnic minorities, have little participation in decision-making processes, despite being the most vulnerable to the harmful effects of poorly planned or executed policies (Brugnach et al., 2017; Markkanen & Anger-Kraavi, 2019).

2.2 Energy justice

When deliberately transitioning toward environmentally and socially sustainable systems, there will be consequences that contribute to or help resolve existing inequalities (Bennett et al., 2019). In this realization, the energy justice concept has been gaining momentum in recent years, as the urgency of climate change and the need to shift to renewable energy sources have become more pressing. The concept promotes energy to be more than simply technology and hardware and seeks to address structural inequalities that have often led to marginalized social groups bearing a disproportionate burden of energy costs, environmental degradation, pollution and lack of access to affordable energy (McCauley et al., 2013; Sovacool et al., 2017). The concept of energy justice is closely tied to often used terms of energy security and energy poverty. Glotrau and Sovacool (2012, p. 235) define energy security as the degree of access to *"affordable, reliable, efficient, environmentally benign, proactively governed, and socially acceptable energy"*. Whereas energy poverty is a result of continuous exposure to energy insecurities, specifying the lack of sufficiently available or distributed energy for a group or individual (McCauley, 2018). These concepts are generally human centered, thus taking an anthropocentric approach, whereas energy justice can also be applied with whole ecosystems as primary responsibility, resulting in an ecocentric justice approach (Pellegrini-Masini et al., 2020). One approach does not necessarily rule out the other and both can be combined when human wellbeing is sustainably accommodated without compromising the global ecosystem (Pellegrini-Masini et al., 2020).

Energy justice emerged as an area of focus within environmental justice debates, as the interconnectedness of energy production and consumption with broader social, economic, and political systems was established (McCauley & Heffron, 2018). Energy justice can function in its application as a conceptual, analytical, and decision-making tool (Sovacool & Dworkin, 2015). Applying the concept to energy transitions can unite two often opposing sustainability goals related to social and environmental justice and bring just transitions that benefit both people and the environment (McCauley & Heffron, 2018).

Two popular frameworks exist for applying the energy justice concept. Firstly, Sovacool et al. (2016) propose a conceptualization of energy justice, consisting of eight core principles: affordability, availability, affordability, due process, transparency and accountability, sustainability, intra-generational equity, intergenerational equity, and responsibility. This approach provides a universal outlook on energy justice and is criticized for being a justice checklist that discards more exceptional experiences (LaBelle, 2017). Due to the significantly unequal conditions in South Africa, this research focuses instead on applying a practical justice approach, which better accommodates for specific requirements of disadvantaged or underrepresented groups and individuals (LaBelle, 2017). Such an approach can be found in the second, and more widely applied framework, based directly on environmental justice principles of distribution, procedure, and recognition, to be used for conceptualizing, analyzing, and decision-making in energy-related matters (McCauley et al., 2013).

2.2.1 Three tenet framework

Energy justice refers to the fair distribution of the benefits and burdens of energy production and consumption. The three tenet framework, proposed by McCauley et al. (2013), encompasses three main elements: distributional justice, recognition justice, and procedural justice. The elements are interconnected and overlap one another, but remain distinct elements of the energy justice concept, each being attributed their specific justice requirements (LaBelle, 2017; McCauley et al., 2013).

Distributional justice refers to the fair distribution of the benefits and burdens of energy production and consumption among different individuals and communities. This includes ensuring that all individuals have access to affordable and reliable energy, and that the negative impacts of energy production, such as pollution and environmental degradation, are not disproportionately borne by marginalized communities (Jenkins et al., 2016; McCauley et al., 2013). This justice element is also commonly applied to spatial distribution, meaning that siting of energy projects should be inherently just decisions (Jenkins et al., 2016; McCauley et al., 2013). On top of that, fair distribution over time also needs to be considered, especially issues spanning multiple generations, such as structural inequalities or climate change (Bennett et al., 2019). Distribution justice is in line with the similar concepts of universal justice and equality, meaning that every actor deserves an equal share of benefits and burdens in a given situation (LaBelle, 2017).

Recognition justice refers to the fair and respectful treatment of under-represented individuals and communities in energy-related decision-making processes. This includes specific emphasis on the knowledge, perspectives, and contributions of marginalized communities and ensuring that their voices are heard in decision-making processes (Jenkins et al., 2016, 2021). This form of justice is the basis for energy justice as without it some groups will be excluded from other forms of justice (Bennett et al., 2019). This misrecognition is often connected to preconditions of communities or individuals such as race, gender or religion and can in turn lead to injustices in distribution or procedure (Svarstad & Benjaminsen, 2020; van Uffelen, 2022). Furthermore, recognition and understanding of diverse traditions, knowledge systems and worldviews is necessary in order to meaningfully engage with involved actors and provide fair planning and management of energy projects (Bennett et al., 2019). This justice element is also referred to as particular justice, which – contrary to universal justice – recognizes local experiences, leaving more room for case-by-case evaluation of injustices, and providing a baseline for equal outcomes (LaBelle, 2017).

Finally, procedural justice refers to the fair and transparent processes used to make decisions about energy production and consumption. This includes ensuring that all stakeholders, including marginalized communities, have a meaningful and equitable opportunity to participate in decision-making processes and that decisions are made using transparent and unbiased criteria (Jenkins et al., 2021; McCauley et al., 2013). Included in this form of justice is local capacity building and skills development that allows people to more actively participate in these processes (Bennett et al., 2019). In order to make sure that marginalized groups are truly and adequately heard, governance structures should have sufficient representation of all involved actors, an aspect that will be further discussed in the 'energy governance' concept (Bennett et al., 2019; Caprotti et al., 2020). Governments and state institutions will often focus on universal energy solutions that apply to everyone, but procedural justice further dictates the need for empowering the public, giving agency to decide for themselves the particularities of justice, rather than be subject to inclusive policies (LaBelle, 2017)

Note here the distinction between recognition and procedure. The former focuses specifically on marginalized and vulnerable individuals and groups, or equitable processes, whereas for the latter everyone is presented as equal. Together, these three tenets of energy justice help to ensure that the benefits and burdens of energy production and consumption are shared fairly and that decision-making processes are inclusive, transparent, and respectful of all actors.

2.2.2 The just energy transition

Energy transitions are often focused on technical and economic aspects and rarely incorporate social justice concerns, even when those can inform decision-making related to equally distributing the accompanying benefits and risks (Sovacool et al., 2016). When the energy transition is planned without taking the justice element into account, it can easily lead to new and additional inequalities. An often brought up issue is employees in fossil fuel or other carbon intensive industries being laid off without arrangements for reinstatement or compensation (Alternative Information & Development Centre, 2018; Healy & Barry, 2017; Lawrence, 2020b).

The concept of the 'just transition' in South Africa originated around 2011, from an unprecedented cooperation between environmentalists and trade unions, who understood that many jobs in fossil-related sectors would be lost in a low-carbon future and some preemptive measures needed to be taken (Cock, 2019). Over time, it was determined that this approach, built on social dialogue as 'change-maker', was not up for the task and a more all-encompassing approach was needed (Sweeney & Treat, 2018). Leading to them adopting a more elaborate form, which would focus on transformative change, away from a capitalist, extractivist energy system to a new clean system build on social equity and justice (Cock, 2019). The South African government has chosen an integrated approach by framing their energy transition as 'just', labeling the development as a sociotechnical transition (The Presidency, 2022), constituting an approach somewhere in between the two aforementioned union proposals. This facilitates rethinking of a failing energy system while simultaneously aiming for resolutions to ongoing social crises.

2.3 Hydrogen: an old technology and new commodity

The concept of hydrogen as part of a hydrogen economy serves multiple applications**,** two of which are utilized in this research. Firstly, hydrogen as a technological development, which serves a more natural-science-based perspective. Secondly, hydrogen as a commodity, which serves an economic and social science perspective. Both perspectives are often used interchangeably, even though they are equally important to consider in efforts to use green hydrogen to mitigate and combat ongoing crises in South Africa.

2.3.1 Hydrogen technology

Hydrogen technology refers to the technology required for the use of hydrogen as a fuel source, either through combustion or through the use of fuel cells that convert hydrogen into electricity. As hydrogen is a flammable gas, it can be used in similar applications as natural gas, either for heating or in internal combustion engines (Rosen & Koohi-Fayegh, 2016). However, most future applications of hydrogen center around its potential to carry electrical energy which can be extracted using fuel cell technologies, in this process the discharged hydrogen molecules react with oxygen to form water molecules (Boretti, 2021; Rosen & Koohi-Fayegh, 2016). Firstly, it can act as electricity storage for surplus wind or solar energy, to be extracted when the weather does not allow for direct use of these sources (Imasiku et al., 2021; Kovač et al., 2021; Rosen & Koohi-Fayegh, 2016). Another advantage of hydrogen is application in so-called 'hard-to-abate' sectors, which include chemical industries, air and maritime transportation and agriculture, that can exploit the higher energy density of hydrogen (Ayodele & Munda, 2019; Noussan et al., 2021).

Although hydrogen is a colorless gas, color attributes are given to the final product to distinguish different production methods. When hydrogen is produced using water electrolysis, powered by renewable energy sources, the product is regarded as green hydrogen, which among the different production methods has the best potential for decarbonization (Ayodele & Munda, 2019; Noussan et al., 2021). Hydrogen thus has the potential to be a very clean energy carrier, depending on the production method. Since renewable energy currently only consists of a small percentage of global energy use and other technologies needed for green hydrogen production are also still in early stages of development, the initiation of a green hydrogen economy will require significant investments in infrastructure, as well as further development of new technologies and policies to support it (Ayodele & Munda, 2019; Imasiku et al., 2021; Noussan et al., 2021).

2.3.2 Hydrogen commodity

While technologically sound, the perspective of hydrogen as a commodity is more volatile. It is often stated that hydrogen can help accelerate decarbonization of their energy systems and countries in the Global South are deemed valuable allies with abundant renewable energy resources, in scarcely populated and sun-drenched, empty wastelands, apparently up for grasp (AbouSeada & Hatem, 2022; Hamouchene, 2022; Imasiku et al., 2021). However, it is important to note that the benefits of a hydrogen economy must be considered in the context of potential socioeconomic changes and the challenges that come with it. The production of green hydrogen requires vast amounts of renewable energy, which is currently not readily available in South Africa, as well as fresh water for electrolysis, raising issues in terms of land and water rights (Hanusch & Schad, 2021; F. Müller et al., 2021). This brings a risk of new forms of extractivism, meaning valuable resources being exported without appropriate compensation (Voskoboynik & Andreucci, 2022).

Specific equipment needed for hydrogen production will put additional stress on other commodity markets, for example platinum and other 'high-tech' materials needed to produce electrolyzing equipment and fuel cells (Voskoboynik & Andreucci, 2022). Kalt and Tunn (2022) state there is an emerging global hydrogen market, which makes for easy manifestation of existing patterns of extractivism and neocolonialism if not managed with special care to such tendencies. Often, land is classified in various degrees of potential for hydrogen or other renewable applications, based solely on technical or 'objective' characteristics, whereas subjective and political characteristics of the same pieces of land are not or barely taken into account, putting additional stress on existing inequalities (Hanusch & Schad, 2021; Kalt & Tunn, 2022). Not to say that resources cannot be redistributed, but it does mean that one should engage with more precaution and take necessary steps to establish just acquisition and ownership of land and water. Application of energy justice frameworks in governance and decision-making is essential when the goal is to dwindle inequalities and bring inclusion of the marginalized (Kalt & Tunn, 2022; F. Müller et al., 2022).

2.4 Energy governance

Having established that the introduction of hydrogen can put additional stress on ongoing natural resources debates, governing the claims to these resources will become even more challenging. The concept of energy governance adheres mostly to the procedural justice element, providing guidelines for resources and risk management. This research follows Thondhlana et al. (2015) in their use of the governance concept, defining it according to Graham et al. (2003, p. 122) as "*the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other*

stakeholders have their say." This definition of governance is applied to management of natural resources, mainly those needed in a hydrogen economy. Due to the diversity of resources needed in a hydrogen economy – land, water, minerals, human and non-human capital (Hanusch & Schad, 2021; Sadik-Zada, 2021) – sustainable resource management vital with new and additional notions of scarcity surfacing (Lockwood et al., 2010). To further regulate these new dynamics, some countries are found to have deployed the governance concept of the developmental state to facilitate energy transitions (Kuzemko et al., 2019; Swilling et al., 2016). To this extent, a nation in which the state has a firm grip on the private sector through macroeconomic regulations and planning is considered a developmental state, with examples found in both China and the United states in their endeavors to transition to a low-carbon energy system (Kuzemko et al., 2019). It is specifically designated to take care of socioeconomic challenges within developments (Tshishonga & De Vries, 2011).

In the context of climate change, it is often mentioned that localized mitigation plans can only bring so much and international collaboration at an unprecedented scale is necessary to bring genuine progress (Dunlap, 2021; European Commission, 2021; F. Müller et al., 2022). However, local and global sustainability are often found to contradict one another in less industrialized contexts (Caprotti et al., 2020). For example, renewable energy projects might be regarded as sustainable at a global scale, whereas in localized context they often interfere with the balance of local resource distribution (Caprotti et al., 2020; Kalt & Tunn, 2022). International bilateral energy partnerships can offer valuable funding for innovative value chains, but risks of such partnerships being asymmetrical remains and more research is needed on designing international hydrogen partnerships in a way that brings local ownership and justice (Kalt & Tunn, 2022). To achieve a just transition, identification of desired outcomes of both transition and partnerships, defined by different actors, is necessary (Tyler & Mgoduso, 2022).

Caprotti et al. (2020) in turn suggest that multiscalar governance is required in just energy transitions as the lowest scales of communities and households are often underrepresented and hardly considered, leading to energy inequalities. The multiscalar approach is necessary as justice approaches are prone to fixate on a global perspective, and by doing so can strengthen the energy justice framework (Lacey-Barnacle & Bird, 2018). Absence of multiscalar governance is said to be strongly integrated with inequalities in different contexts in South Africa and integrating different levels of governance can aid in resolving some of the inequalities (Caprotti et al., 2020). Müller et al. (2022) stress that for green hydrogen to even remotely provide its seemingly all-encompassing benefits it needs to include principles of energy justice at all levels of society.

The ideas of multiscalar governance are also apparent in a specific mode of energy governance, termed energy democracy. The concept originates from grassroots social movements and aims to enable the public voice in energy related decision-making in order to make an equitable energy transition possible (Sweeney, 2014). On top of that, the concept promotes reestablishing energy as a public good and restructuring the energy sector to provide social justice and inclusion (Vanegas Cantarero, 2020). The South African JET offers a new governance playing field in which the various levels of governance could be integrated and collaborate to bring energy justice together. But conscious aspiration to achieve these goals is necessary as the approach is complex, bringing additional risk of failure.

2.5 Conceptual framework

To research how actors are envisioning the potential role of green hydrogen in a just energy transition, with the goal of energy justice in mind, a framework was set up which helped answer the research questions. Operationalizing the applied concepts and sub concepts in a conceptual framework displays how the three different justice concepts are used to establish an overview of energy justice definitions from different actors and how these are meant to be implemented with specific regards to developing a green hydrogen value chain. Conceptualization of the energy justice framework is based on the central theory from McCauley et al. (2013), splitting the research into the three sub-questions linked to each of the three justice elements. Figure 2.1 displays the conceptual framework that ties the aforementioned concepts to the research objective and specific research sub-questions. It ties the elements of distribution, recognition and procedure to the concepts of hydrogen (H2) commodity, South African inequalities and energy governance, respectively.

Distributional justice addresses acknowledgments of *opportunities and risks* that introduction of green hydrogen will bring and how these are managed. This concept is represented in sub-question 1. Recognition justice addresses *envisioned interests* of involved actors, the degrees to which people are fairly represented in these hydrogen plans and which possible misassumptions are made, evaluated by likely changes in equality. This concept is represented in sub-question 2. Procedural justice addresses *fair governance*, defining how actors are influenced by concepts related to energy justice in setting up policy and implementation strategies. This concept is represented in sub-question 3.

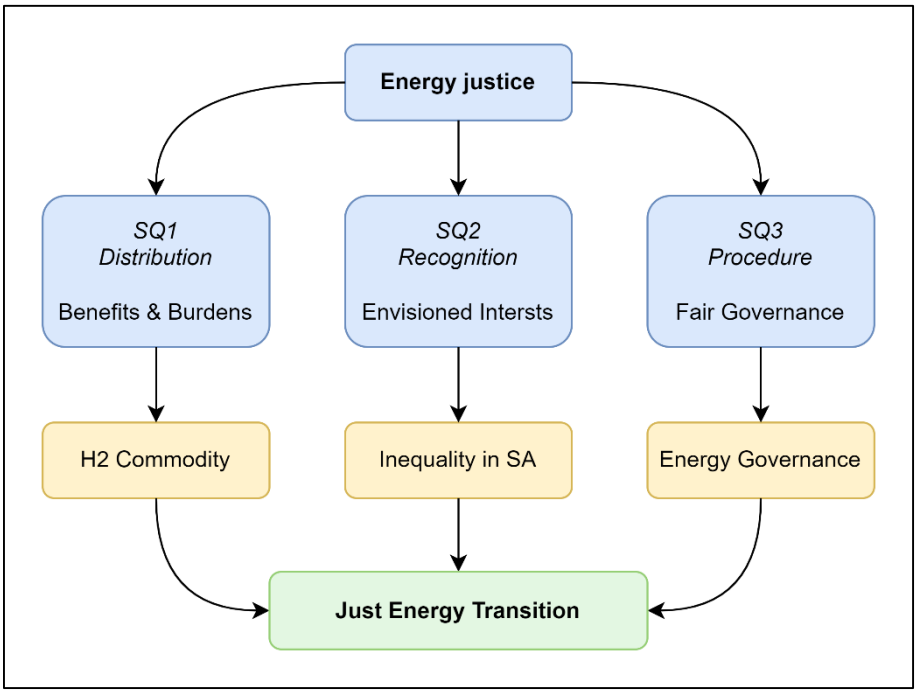

Figure 2.1 - Conceptual framework

CHAPTER 3
JUST TRANSITION IN SOUTH AFRICA

In this chapter the key themes presented in Chapters 1 and 2 are further explored and placed in the context of South Africa and the Just Energy Transition, describing the setting in which the research has been carried out. The need for this contextualization becomes apparent from Young (1990, p. 75), who states that a *"critical theoretical approach to justice begins with the insight that any normative or social theory is and should be conditioned by the particular historical and social context in which it speaks."* As justice practices are embedded in historical, political, and economic systems (LaBelle, 2017), the following topics will be examined. First, an overview of the country is given, followed by a look at the history of inequalities. This is followed by a more in-depth look at current practices in the energy system and, thirdly, relevant justice policies related to the scope of this research are mentioned. Finally, a brief history of South African hydrogen developments is provided.

3.1 South Africa

The Republic of South Africa, abbreviated to South Africa in this study, is located in the southernmost part of Africa. This area in Sub-Saharan Africa has been inhabited for over 2,000 years by Khoekhoen pastoralists along the coast, with Zulu and San tribes traversing the countryside (Tibane, 2021). The country is well-positioned between the Atlantic and Indian oceans (Figure 3.1), providing excellent sea access to Asia, Europe and the east coast of the Americas, and a former safe-haven on international voyages originating from Western Europe. This position is what led to colonization by the Dutch in 1652, later taken over by the British, starting in the Western Cape and spreading across the country in the following centuries (Tibane, 2021). While initially these outposts were only designated for resupplying ships, further expansion of the Cape Colony led to escalated conflict with established tribes and was maintained when the British took over around 1795, driving Dutch settlers further inland as conflict expansion similarly progressed eastwards.

Figure 3.1 - Map of South Africa. Source: SA Places (n.d.)

The expansion was followed by establishment of two white-ruled Boer republics in the contemporary Free State (Orange Free State) and combined North West, Limpopo, Gauteng, and Mpumalanga (South African Republic) provinces (Davenport & Saunders, 2000). After diamonds and gold reserves were uncovered in the South African Republic, British interests were pulled further east and the republics were brought down in the early 1900's, all while the native populations were oppressed, enslaved, or caught in or between conflict (Tibane, 2021). Further exploitation of these resources, and inclusion of coal mining established the basis for the South African economic development and still provides the foundation of South Africa's economic system (Cronjé & Chenga, 2009; Lawrence, 2020b). While the unnatural imbalances of former Western colonists and local native populations provided a basis for persisting inequality and later apartheid regime (Mphambukeli, 2019). Presently, the country is built up of a mixed economy, with a well-established financial sector and globally accredited research instituted in a wide range of fields (Ashman et al., 2011; Tibane, 2021). Although still faced with similar issues of heritage and oppression that it has been plagued by over the last few centuries (Lawrence, 2020b).

3.2 Inequality

South Africa is widely regarded as one of the most unequal countries in the world, the most unequal when measured by its income-based Gini coefficient (Francis & Webster, 2019; Ngwane & Bond, 2020). This statistic becomes evident from the country's societal division, being partly developed into a post-industrial state with a strong tertiary sector, while simultaneously having significant portions of its population living in extreme poverty and lacking access to basic needs like food, shelter and sufficient, stable income (Ashman et al., 2011; Francis & Webster, 2019; Mosala, 2022). Consequently, the most prominent issues the country is faced with – known as the triple challenges – are poverty, inequality, and unemployment, being interconnected, as well as the cause of many other challenges within the country (Mzangwa, 2016). These inequalities are shaped by the country's history of colonialism and apartheid, as well as more recent economic and political developments (Francis & Webster, 2019; Mosala, 2022). Currently, inequalities in South Africa persist, partly due to structural barriers left over from the apartheid era, appearing in racially dominated segregation of classes (Mphambukeli, 2019). This 'economic apartheid' is substantiated by the existence and continuous expansion of informal settlements and neglect of rural communities, both often lacking access to basic services (Cock, 2019; Mphambukeli, 2019).

The South African mining industry is considered to be the major instigator of historical and persisting inequalities in South Africa when at economic, social, and well-being factors (Cock, 2019; Francis & Webster, 2019; Markkanen & Anger-Kraavi, 2019). Mining corporations have a long history of exploiting cheap labor specifically involving marginalized groups, amongst which are the, mostly rural, mining communities (Cronjé & Chenga, 2009; Lawrence, 2020b). A steady decline in South Africa's primary mining industry and the failure to commit to secondary manufacturing industries have led to increased unemployment, specifically among the rural communities in the northeastern provinces, that surround the many operational and abandoned mining pits (Cock, 2019; Francis & Webster, 2019). While progress has been made in increasing black ownership and management in the industry, significant disparities in terms of employment and community impacts continue to exist, and so the legacy of apartheid continues to this day (Cronjé & Chenga, 2009; Francis & Webster, 2019; Mphambukeli, 2019). The mining sector and its impact on the energy sector remain obstacles to solving inequalities due to their power to influence national and local policy, as shown in the following section.

3.3 The Minerals-Energy Complex

Currently, the South African energy system is under suffocating pressure, pulled on the one side to provide sufficient electricity using outdated power stations, and pushed on the other to reduce emissions and transition to renewable sources. The ongoing energy crisis has resulted in major economic deficits, as a result of businesses being unable to consistently operate, culminating in further increasing unemployment, poverty and violent crime (Lawrence, 2020b). It has increased energy insecurity and requires an energy justice approach to identify and accommodate those with the most urgent needs.

Figure 3.2 - Installed energy capacity per source in percentages. Source: Calitz and Wright (2021)

While the economy has been further diversified in the last decades, the mining industry still significantly impacts South Africa's economy, both from the raw materials it provides to the manufacturing industry, and being a source of state revenue from exporting locally extracted resources (Lawrence, 2020b). As displayed in Figure 3.1, the main source of energy in South Africa is coal, making up 38 GW of the country's 51.6 GW of installed energy capacity as of 2021 (Calitz & Wright, 2021). The mining and energy centered economy has been found lacking in its ability to fully industrialize the country in a way that would allow for increased diversification of its manufacturing industry, as had been the case in South Korea for example (Bell & Farrell, 1997). Additionally, maintaining the strong position of the coal – and by extension mining – industry is found favorable by a multitude of vested actors with strong political influence (Hanto et al., 2022). This dynamic is often referred to as the Minerals-Energy Complex (MEC) and shows itself in preservation of the sector through a favorable economic and policy climate (Fine & Rustomjee, 1996; Hanto et al., 2022). Mining is fundamental to capitalist, extractivist endeavors in South Africa, strongly influences development of other sectors, even up to the tertiary economy financial sector, and is still a leading cause of institutionalized racism in South Africa, with the accumulated mining capital still predominantly white-owned (Ashman et al., 2011; Lawrence, 2020b). The MEC enhances and fortifies the powerful position of the private sector in the South African energy and mining sectors, which is likely to endure the just energy transition as alternatives extractable resources are to become more prominent.

The need for other valuable minerals is gradually increasing with ongoing global energy transitions, and South Africa has access to 95% of global reserves in Platinum Group Metals (PGMs), which are largely unexploited (Minerals Council South Africa, 2019). Most of the currently extracted precious metals – including gold – are directly exported, wasting local added value potential (Lawrence, 2020b; Ngwane & Bond, 2020). The South African PGM sector is mostly focused within a specific domain of the country, stretching from Limpopo province, through Gauteng and Mpumalanga, to the port of Durban KwaZulu-Natal (Minerals Council South Africa, 2019). Due to its economic potential, the area is a focal point of development and consequently dubbed the 'Platinum Valley' in contemporary documentation (Bowden, 2021). Due to its applications in hydrogen production methods and electric vehicle technology, the demand for PGMs is expected to surge in the near future and anticipated to bring additional economic activity and prosperity to the country (Bowden, 2021).

3.4 Post-apartheid justice policies

At the end of apartheid in the early 1990's, a new government came to power, formed by the African National Congress, and plotting a new neoliberal course to help re-industrialize South Africa and combat the country's segregation with affirmative action policies (Ashman et al., 2011). This neoliberal approach had been set in motion by the previous government under international pressure, to reduce state power and influence over the free market, and pave the way for increased privatization (Mosala, 2022). In the following years, international control over local policy making would both aggravate economic inequalities and create a new governing elite, having displaced the previous one (Koelble, 2004). International influences and privatization would later emerge in climate change response measures, as well as related socioeconomic developments.

The radical change of governing party, brought with it a focus to combat the racial segregation that – while it had been discarded at an institutional level – persisted through socioeconomic inequality (Mphambukeli, 2019). The new government attempted a reversal of this apartheid legacy through the Broad-Based Black Economic Empowerment (BBBEE) legislation, including policies to increase Black economic ownership and control (Shai et al., 2019; Webster & Francis, 2019). Enacted in 2003, the initial focus was on redistributing ownership of larger corporations (Webster & Francis, 2019). Over time results fell short, and it became apparent that inequalities were only shifting, from interracial inequality to inequalities among people with similar ethnicity (Francis & Webster, 2019). Economic inequality among the Black population remained the highest, and it is stated that the BBBEE legislation only helped establish a new 'Black bourgeoisie', helping to improve positions of individuals rather than groups (Francis & Webster, 2019; Webster & Francis, 2019). Sixteen years after implementation, the goals of the legislation have changed, focusing on empowerment rather than ownership, but results are hard to quantify due to inconsistent monitoring and reporting (Shai et al., 2019). The latest BBBEE-enactment determines to what degree a corporation can compete in government procurement programs (Shai et al., 2019).

In 2011, the South African government published a Climate Change Response white paper, acknowledging the country's vulnerability to climate change and the need for a just transition to a climate-resilient and low-carbon future (Department of Environmental Affairs, 2011). Part of this strategy was to set up a Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) and in line with the justice aspect of the transition its aim included benefits for communities within a 50 kilometer radius to each project (Department of Environmental Affairs, 2011; Lawrence, 2020a). Consisting of consecutive bidding rounds, each setting a new target for installed renewable capacity, it was the most ambitious renewable energy program globally at the time of the first round (Papapetrou, 2014). The tenders were evaluated based on a weighted assessment of 70% for costs and 30% for socioeconomic impact, and contractors had to provide proof of financial stability (Matsuo & Schmidt, 2019). The program enjoyed further praise due to its clarity and transparency, providing initial investors with confidence to commit capital (Papapetrou, 2014). Despite this early praise, the South African regulatory framework surrounding the REIPPPP was later deemed inconsistent across bidding rounds, marking the projects as unattractive investment opportunities (Caprotti et al., 2020; Hanto et al., 2022). Overall this resulted in a favoring of larger, transnational corporations for the tenders, leading to further dependence on international actors to bring economic gains (F. Müller & Claar, 2021). While the results have been inconsistent at best, the program offers one of the most viable opportunities for green hydrogen developments to be integrated into the national regulatory framework in the short term, while ensuring a just implementation of such developments.

3.5 Hydrogen in South Africa

In 2008, the Department of Science and Technology – which later changed to Science and Innovation – initiated the fifteen-year program Hydrogen South Africa (HySA) as part of their research and development program to find innovative possibilities for PGM beneficiation (Whyte, 2021). With this program, the government sought to contribute to making the economy more knowledge-driven, by researching possible storage and utilization technologies for the transportation and power sectors (Pollet et al., 2014). Included was also the aim of creating jobs at different skill levels throughout the hydrogen value chain, from mining and manufacturing to education and research (Pollet et al., 2015). Although due to high costs of hydrogen and fuel cell technologies it was expected that consumers and smaller enterprises would be less involved in uptake of products, and focus would instead be on larger corporations and profits from export of end-products (Pollet et al., 2015). As this program was developed, hydrogen would mainly be produced from fossil sources, while a hydrogen economy would be set up, including infrastructure for production, distribution and consumption of hydrogen (Treat, 2022).

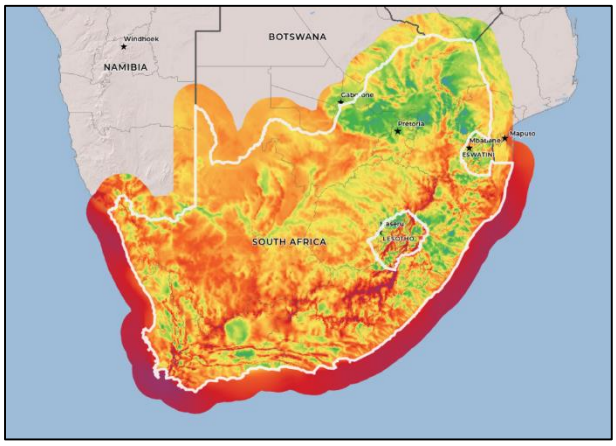

Figure 3.3 - Wind atlas displaying average wind speed in South Africa. Source: World Bank (2021).

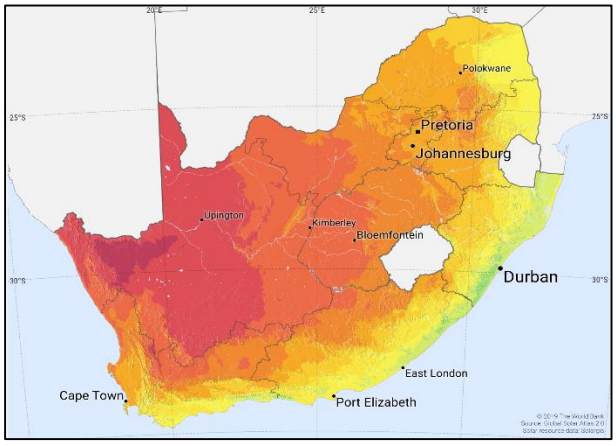

Figure 3.4 - Solar atlas displaying photovoltaic power potential in South Africa. Source: World Bank (2019).

Fast forward to 2021, nearing the end of the initial term of the HySA program, and the Department of Science and Innovation published the Hydrogen Society Road Map, presenting the near and long-term future prospects for hydrogen and a center stage position for green hydrogen (Department of Science and Innovation, 2021). From the abundance of coastal and inland winds, and affluent solar radiation – displayed in Figure 3.3 and 3.4 – there appears to be tremendous potential for South Africa to exploit these renewable energy resources and take on a competitive position in the global hydrogen export market (AbouSeada & Hatem, 2022). Due to its long-standing focus on hydrogen developments, South Africa is considered to have an advantage in knowledge, intellectual property, and infrastructure, appearing through its main hydrogen utilizer SASOL (Mathu, 2022). Initial focus would be on expanding the gray hydrogen value chain and integrating blue and green hydrogen when production costs become more competitive (Imasiku et al., 2021). Building on the momentum of a global green hydrogen economy, most technical, political, and financial constraints can be easily overcome, leaving socioeconomic barriers to be overthrown or neglected (AbouSeada & Hatem, 2022; Imasiku et al., 2021). As part of the JET, hydrogen is foreseen to take a secondary role to energy sources like wind, solar, and hydro power (The Presidency, 2022). Its transportation capabilities – independent from direct grid connection – increase its tradability, which South Africa seeks to exploit through various forms of export. Running the risk of conflicting with other developments, this additional factor specifically requires increased vigilance for injustice practices.

CHAPTER 4
RESEARCH METHODOLOGY

The following chapter describes in detail the research methodologies employed to collect, analyze and interpret the data, and will provide a justification for the methods and techniques used. It further includes a presentation of ethical concerns and considerations, a reflection on employing the research methods within this study, and a statement on my positionality.

The focus of this research is on the South African energy transition. The reasoning behind picking South Africa as the research area was to include interpretations of energy justice from a range of actors that are bound by one state, while not limiting it to a specific site, which would not have been feasible in the current phase of hydrogen developments. A case study approach was taken in this research that allowed for more thorough examination of localized efforts toward a single geographical location (Bryman, 2016). Case study research is regarded as a common approach to research on energy and just transitions, resulting in data with the potential to inform similar cases (Hanto et al., 2022; Sovacool, 2021; Sovacool et al., 2019a). Although the country of South Africa is regarded as a highly diversified area in a manner of aspects, as was clarified in the previous chapter, transition planning mostly occurs on the national level, making a more specific research area less relevant for this specific study.

Figure 4.1 displays the research framework measuring the scope of this research and a guide for the research process. It comprises four linked segments: initial desk research, data collection, data analysis, and the results. Using the integral elements of energy justice from McCauley et al. (2013) and others to answer each of the sub-questions culminates in a discussion and final answer to the main research questions.

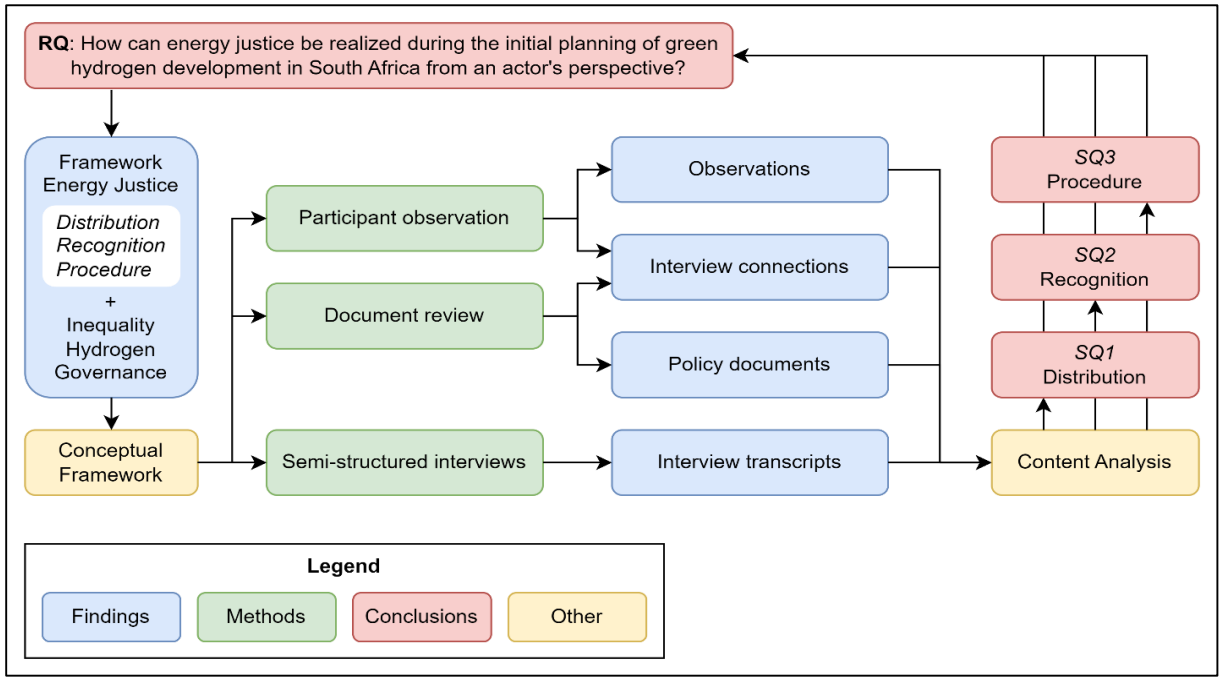

Figure 4.1 - Research framework

4.1 Research methods

To achieve sufficient validity for this empirical research process, data has been collected using a variety of sources, including both primary and secondary data sources. Through data triangulation these results can be compared, providing additional internal validity, possibility to verify observations through interviews, and help create a holistic depiction of the research subject (Bryman, 2016). The research data has been acquired using a combination of qualitative research methods, including participant observations, semi-structured interviews, and document review. An overview of all consulted data sources can be found in Appendix I.

4.1.1 Participant observations

The initial method used to gather data was that of participant observations, which were concluded during the three aforementioned events. Observation of the dynamics and interactions between different actors will allow for data to be collected relevant to the context that behavior is exhibited in (Bryman, 2016). During these events, I witnessed the participation of different actors in the initial planning phases of green hydrogen development. Data was collected during the conferences by taking notes of observations, speaker presentations, and attendee comments, with specific regards to their background and sentiment toward hydrogen or renewable energy. The observations were used to assess the dynamics between parties involved, gauge peoples' reactions to proposed plans, and help create a more complete picture from documented indirect verbal and non-verbal communication. Although such observations are regarded as impartial and prone to bias, due to the method relying on a researcher's own reflection and interpretation, they remain a valuable source of data to compare to other findings (Bryman, 2016). Furthermore, observations and interaction with participants helped establish direct contact with possible interview participants, as beforehand it remained unclear who would be participating. Deducting that those attending actors specifically want their interests weighed in on planning of the South African green hydrogen economy, they were regarded as worthwhile for the approach of this study.

Since no implemented plans for a South African green hydrogen economy exist as of yet, the case study was initially set to comprise two events that are set to accelerate the coordination and initiation of the South African green hydrogen economy. However, after finding that parties with more critical views toward hydrogen developments were underrepresented here, further additions to the research area were considered to compensate for the lack in research subject diversity. From the initial desk research, a similar third event was found to be happening around the same timeframe, allowing for streamlined inclusion of this perspective.

South Africa Green Hydrogen Summit

In late November 2022, Infrastructure South Africa organized the South Africa Green Hydrogen Summit in Cape Town. This conference was the inauguration of green hydrogen developments in South Africa and offered a showcasing of South African hydrogen opportunities and presented the country as an upcoming participant in global green hydrogen developments (Infrastructure South Africa, 2022). The conference was co-organized with the German agency for international development, who were a major sponsor of the event as well. Other than that, the Netherlands and Japan were the most dominantly represented countries. Apart from a significant contingent of South African government officials, prominent corporations from the national and international industrial sector were present, such as SASOL (energy and chemical), Anglo American (mining), ArcelorMittal (steelmaking), and financial institutions, such as the European Investment Bank and the Rand Merchant Bank.

Science Diplomacy for Economic Development through Hydrogen

Also in Cape Town, and a week after the previously mentioned event, the national Department of Science and Innovation (DSI) co-hosted the conference Science Diplomacy for Economic Development through Hydrogen. Although this designation does not directly reveal it, the event was focused specifically on using hydrogen as a lever for social justice (Department of Science and Innovation, n.d.). Similar organizations as the previous event were present, albeit that the South African government was less well represented here.

Taking Back the Just Transition

Although not specifically focused on hydrogen, but very strongly tied to the Just Energy Transition and energy justice concepts, the third event encompassed a smaller conference in Johannesburg that permitted online access. The forum, centered around regaining public power in the South African JET, was hosted by the Alternative Information and Development Centre and the Friedrich-Ebert Foundation. There was a presence of local and international union representatives from the mining sector specifically, as well as general workers' representatives. They were joined by representatives from critical think tanks and research institutes, making the audience mostly correspond to civil society organizations.

4.1.2 Semi-structured, in-depth interviews

The main body of acquired data for this study originates from a series of 8 semi-structured, in-depth interviews, conducted with actors knowledgeable of hydrogen developments or the South African energy system in general. This type of interview allows for flexibility during the interview and leaves a possibility for follow-up questions, while still keeping to a thematic structure, aiding in adjusting to different perspectives offered (Adams, 2015; Bryman, 2016). During these interviews, the main principles of energy justice served as a guideline for conversing with the interviewees and an interview guide was set up, containing question and general focus points, as can be examined in Appendix II. The interviews were all conducted in English, either because this was the native language of the participant or the language that both the participant and I were most fluent in. Snowball sampling was used to reach possible candidates for interviews, resulting from the observations and interaction with conference participants. All participants have direct affiliation to the South African JET, and work for government, private, or civil society organizations. All participants were contacted directly through these events, and even though many more respondents were reached out for, only those approached in person agreed to be interviewed. Although, according to Bryman (2016), average qualitative research shows a sample size of 30, numbers vary greatly and small sample sizes are common and sometimes even preferred (Crouch & McKenzie, 2006). Nevertheless, exempting the private sector perspective, saturation was not fully reached and therefore additional data was gathered from relevant policy and gray literature documents.

4.1.3 Document reviews

In addition to the two previous data sources, relevant documents were reviewed to complement acquired data and attempt to provide a more exhaustive picture of perspectives. Both policy documents from relevant government actors, as well as gray literature from civil society actors were considered for review. While government actors were sometimes found to be reluctant to share in-depth information, and sometimes directly referred me to published government documents, these were included in the overall data analysis. Most of these documents helped saturate the government perspective and held additional information on how different ideas of justice are applied by the administrative and executive organizations. As interview participants from the civil society perspective were limited to union representatives, the choice was made to additionally review gray

literature on green hydrogen and the JET from other sources relevant to this case study. Two of the documents – D7 and D8, as per Appendix I – originate from the Heinrich Böll Foundation (HBS), an organization working on community development in the South African hydrogen sphere, who unfortunately were unavailable for interviews within the given timeframe. The final document D9 extensively covered some of the topics discussed during the third conference, containing in-depth details that could not have been retrieved within the limited time available for both the conference and interviews, but was of additional value to capture the broader view.

4.1.4 Data analysis

All methods of data collection produced information regarding ongoing practices of energy (in)justices and how planning for a green hydrogen value chain can result in changing dynamics within the ongoing energy security debate in South Africa. All acquired data – consisting of notes, interview transcripts, and documents – was filtered, analyzed, and organized using a selection of themes. A content analysis of the collected data was undertaken using the method of inductive coding, based on Linneberg and Korsgaard (2019), as applied in the research of Hanto et al. (2022), and expressed in figure 4.2. This research followed the analytical capabilities of the energy justice concept to assess how decision-makers apply the concept (Sovacool & Dworkin, 2014).

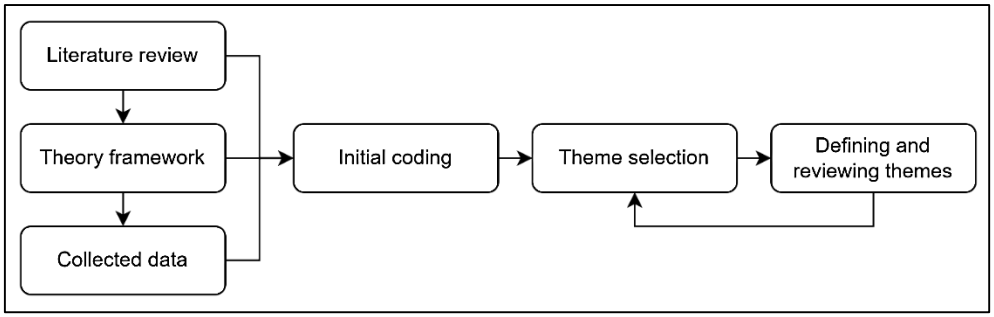

Figure 4.2 - Coding process, based on Linneberg and Korsgaard (2019), and Hanto et al. (2022).

Applying the coding process in the above figure, the following themes and codes were defined, using the program of NVivo, helping to structure the findings and provide a workable overview of the results. The codes were each linked to a specific justice principle to provide a more direct approach to answer each of the individual sub-questions. This led to some codes being displayed twice, but in relation to different themes.

Justice principle	Theme	Codes (in alphabetical order)
Distribution	Hydrogen commodity	Challenges; electricity; exports; land; opportunities; water
	Private sector	Benefits; burdens; privatization; risks; visions
	Climate change	Barriers; climate change; inequality; renewables
Recognition	Fossil fuels	Coal; mining; phaseout; renewables
	Employment	Community; education; unions; marginalization & inequality; mining; renewables; skills
	International interests	Cooperation; financing; inequality; partnerships
Procedure	Energy crisis	Coal; electricity; visions
	Energy governance	Community; decision-making; energy democracy; governance;
	Standardization	International; national; regulations

Table 4.1 - Overview of themes and codes

4.2 Research ethics and informed consent

While conducting social research, questions of how to treat the people on whom research is being conducted, and in which research activities to engage, often come up (Bryman, 2016). Therefore, the importance of anticipatory ethics consideration becomes apparent, as well as reflecting on conducted activities. When approaching people with the aim of finding out information that could contribute to the research, I made sure to always inform them of my position as a student and a researcher working on my masters' thesis, presenting my aims and purpose in an open and transparent manner. While making observations I made sure to include only information that has since been made available to the public through openly accessible (live)streamed online video services, unless I had previously introduced myself and my intentions to a person.

For the interviews specifically, every interview participant was informed of the specifics of the interview beforehand and was read a consent statement at the start of every interview, containing various statements regarding anonymity, to which they could either agree or not. This regarded publishing of shared information and personal details, but also safe data storage, as shown in Appendix II. I also discussed with the interview participants that before, during, and after the interviews it was possible to ask any questions they might have regarding me or my research, in order to maintain openness and ensure transparency. The specific interviews and interview participants will not be shared publicly at the requests of some interviewees, and to keep to the general format all details are displayed homogeneously. The specifics of the interviews and participants are known to the researcher and might be examined upon request. For the document analysis, only open access and impersonal documents have been used which required no special care or confidentiality.

4.3 Research method limitations

Reflecting on the research methodology some limitations to the chosen methods have come up and will be discussed in this section. The first limitation concerns the number of interviewed participants. Although the conducted interviews cover different perspectives on energy justice, the overall sample size is still limited. Many more potential participants were contacted, but most did not reply or conveyed a disinterest in being subject to an interview. While a small sample size is sometimes regarded as an ideal manner of doing research in exploratory research (Crouch & McKenzie, 2006), in the case of this research a sample size of 8 stand-alone interviews was regarded to not provide a full picture of the hydrogen economy prospects in South Africa. To mitigate this limitation an extensive document analysis was set up to fill possible gaps in the research by offering additional input from multiple policy documents, white papers and gray literature dedicated to green hydrogen developments and the just energy transition in South Africa.

Secondly, exempting one, all interviews had to be conducted remotely and by means of video calling, which limited certain spontaneous interactions and an element of physical connection that can help establish a closer bond with a participant (Janghorban et al., 2014). Furthermore, as was found by Carter et al. (2021), online interviews may include some and exclude others, as it offers both a solution to spatial limitations, while simultaneously bringing additional technological barriers. Thus, it is hard to say whether the overall impact on this research was positive or negative. In the end it did serve as a means to gather the main body of data and I managed to work my way around the limitations mentioned above.

Finally, due to sickness I was unable to attend part of the Green Hydrogen Summit and may have missed some valuable information. To mitigate this lost opportunity, I reviewed recorded sessions and asked colleagues from the partner organization and others who I had developed a closer bond with to possibly fill in some gaps. However, this would by no means account for being present at these events myself and I cannot be sure whether I missed anything that might have provided additional insights for this research.

4.4 Positionality statement

Every researcher attaches their personal experiences to conducting research. This embeddedness will reflect itself on the research outcomes and should therefore be openly discussed. Such transparency in the researcher's background and positionality can avoid false objectivity and therefore I will include it here. I am a White, heterosexual, cisgender male, who has lived in the Netherlands for most of his life. I have a Bachelor's degree in Mechanical Engineering, which for me translated to a technologically-centered and solution-oriented worldview. During my Bachelor's I was confronted with this worldview during an internship at a municipality in South Africa. This experience led me to pursue a Master's degree in Sustainable International Development in order to broaden my worldview to include qualitative aspects of academia. My natural science-based background presumably resulted in my picking the South African energy sector as a case study. Having been to South Africa makes me less objective as I carry previous experiences, while at the same time knowing what I can expect will make my experience less overwhelming and more focused. Although with new lessons learned from my Master's I hope to reflect on this perspective and review it, while being aware of what these experiences might add.

I carried out this research in collaboration with a host organization: Impact Hydrogen, providing guidance and consultation setting up green hydrogen value chains, while mitigating negative and increasing positive social and economic impacts of this development. They have facilitated contact with involved actors, by providing me with access to the two inaugural conferences on green hydrogen. This was of great help as I have actively searched for, and tried to set up interviews with uninvolved actors on my own accord, which proved much more difficult.

CHAPTER 5
HYDROGEN BENEFITS AND BURDENS

This first chapter of the results section is focused on theory on hydrogen as an energy commodity and presents a baseline for how this is linked to distribution aspects of energy justice. It is structured to answer to the first sub-question of this research:

How are the benefits and burdens of introducing green hydrogen distributed?

The chapter consists of three topics that have come up in the thematic coding of all data sources. The first of these is the value of hydrogen, which provides an overview of the risks and opportunities of green hydrogen production. The second topic is the role of privatization in developing green hydrogen, which focuses specifically on the benefits and burdens for the private sector. And finally, the third topic is the perception of climate change and its influence on renewable energy projects in general and, more specifically, on developing the green hydrogen economy.

5.1 The value of hydrogen

The commercial value of hydrogen and wealth it can bring to South Africa is a frequently discussed topic and appears to be largely dependent on the uses of the produced hydrogen. These intended uses range from exporting of the molecules to alleviation from domestic energy poverty, providing direct and indirect value to the South African economy. Furthermore, management of additional natural resources that are required for different aspects of the hydrogen economy is put forth. Varying from unexploited, valuable minerals and renewable energy potentials to already scarce resources like water, land and electricity.

5.1.1 Remedy to 'Dutch disease'

While there is consensus among interview participants that green hydrogen production will take place in South Africa, it is far from certain what will happen to the hydrogen once it is produced. The most straightforward proposition is to export the raw hydrogen gas. As demand from areas that are unable or unwilling to produce hydrogen themselves is assumed to increase over time, due to the ever increasing eagerness to reduce greenhouse gas emissions in the power sector (D1; D4). Exporting the product will yield direct income from hydrogen production which is deemed necessary to cover the cost of the initial investments in setting up hydrogen production (D4). Costs for the required equipment for renewable electricity generation, desalination of seawater, and water electrolysis are high and profits are needed sooner rather than later in order to cover them. This vision is shared by some governmental institutions, at least when discussing the initial phase of the hydrogen economy (D1; D4).

During conferences and in interviews and documents, common reference is made, both from inside the continent and on an international level, that Africa has access to vast amounts of potential renewable energy and South Africa is not exempt from these statements (D1; D7). Resources that are supposedly there for the taking. Indeed, sunshine and wind appear to be abundantly present in South Africa's interior and along the coastline, respectively. While the aforementioned Figures 3.3 and 3.4, displaying wind and solar atlases, show this to be true, there is broad support for South Africa to not directly 'ship the sunshine', but make sure that the

country itself is able to profit from their investments, not only by generating added value, but also allow society to flourish as part of its development (I4; I6; D7; D8). Thus, caution is advised regarding raw material exports by a multitude of actors, as it can reinforce or reignite neocolonial practices when the potential for much desired economic prosperity is exported with these raw materials, such is described by the following governmental actor:

> *"We're taught in economics 101 there's something called 'Dutch disease', which is closely related to what's called 'resource curse'. And the bottom line is that countries with a lot of resources, if that resource is not beneficiated but just exported, there are export revenues, but there is no development in the system of the economy. Over time you'll sell out the family jewels and the place where their value is being added, is the place where the economy is really developing."* (I4)

In order to avoid this resource curse, further value addition from hydrogen resources is proposed within the domestic hydrogen economy. Additional value can be created in multiple ways, and two streams of value addition are found within the acquired data. Firstly, more direct value addition, which is a result of using the produced hydrogen to create products in the domestic manufacturing industry. An example of this is proposed for the Saldanha Bay Special Economic Zone, where a mothballed steel manufacturing plant will be retrofitted to use hydrogen for green steel production (C1; I4). A product that is referred to as direct reduction iron can be made using green hydrogen, which significantly reduces the emissions and pollution that typically result from other steel making methods (Patisson & Mirgaux, 2020; I4). Since such steel has increased value and can be used for domestic projects or to be exported instead, value is retained within the country and further stimulates the local economy:

> *"How much value add can you do once the steel is flat rolled and comes out of the bottom of ArcelorMittal's facility. Is there an opportunity to make more products that are made of steel? So in other words, putting the value chains in the economy as opposed to the very early exit of either the hydrogen or the derivative of something like steel."* (I4)

Secondly, using hydrogen in the domestic energy system is proposed to help stabilize electricity supply, especially with increasing dependence on variable renewable energy sources. Maintaining a steady electricity supply and increased electrification is expected to contribute to poverty reduction and a population's general wellbeing (I3; I6; D9). Both visions for value addition are stated to add to the economic recovery of the country (D1) and also help decarbonize the South African energy system by using cleaner energy (D3).

5.1.2 Beneficiation and application of raw materials

According to one mining sector interviewee, a strategic role is laid out for the utilization of existing PGM reserves in the South African hydrogen economy, which is actively being pursued (I2). Reserves of these precious metals are mainly located in the North-Eastern provinces, an area that contains up to 75% of current global reserves (I2; D4). Localized beneficiation of these resources is expected to bring additional employment opportunities and financial benefits (I2; I5). Additional incentive to focus on introduction of hydrogen from the PGM mining sector is due to the lack of these materials in electric vehicles' lithium-ion batteries. PGMs are used to produce internal combustion engines and herein lies a risk of losing business in the car manufacturing sector when transportation transitions to battery electric vehicles (I2). Developments in hydrogen powered transportation

are proceeding, using fuel cell equipment, and even mining haul trucks have been successfully converted to its use (I1; I2). PGMs are abundant in electrolyzer and fuel cell equipment, both of which are essential for integration of green hydrogen in the energy system. Production of this equipment at large is considered to be conducted domestically in order to revitalize South Africa's manufacturing industry after years of continued decline (I5; D4). Such a development is thought to bring additional economic opportunities, but necessary preconditions, including a skilled workforce and sufficient capital need to be fulfilled for the industry to be rekindled (D4). Achieving this can bring a multitude of financial benefits, as is presented below by a representative of the national government:

> *"It was projected that if it leaves as a fuel cell instead of it being $900 as raw platinum. If it's a fuel cell, it would be about $12,000 and that tells you how much employment you can create."* (I5)

A potential shift in mining operations is envisioned as part of the energy transition, from being coal focused to increased beneficiation of PGM reserves. Due to climate change there is increasing international pressure to move away from coal fired power plants – which will be further addressed in Sections 5.3, 6.1, and 6.3 – and with the expected increased demand for other minerals, a shift in the South African mining sector is bound to take place. This will require a shift in employment and is envisioned to mitigate negative impacts to workers in the coal mining sector (I2; D1; D4). However, South Africa is warned to be vigilant regarding extractivism of PGMs, which are, like lithium, associated with 'clean' technologies, resulting in negligible climate adaptation and increased exposure to volatile mining developments for communities (Voskoboynik & Andreucci, 2022).

5.1.3 Resources scarcity

The hydrogen economy will have an impact on a variety of resources used in its development and operations. Some of these resources, such as the PGM, are abundantly available, while others are scarcer and possibly more valuable to some than any commercial value that can be put on it. Distribution and management of these resources is regarded trivial to the just transition:

> *"A just transition builds the resilience of the economy and people through affordable, decentralised, diversely owned renewable energy systems; conservation of natural resources; equitable access of water resources; an environment that is not harmful to one's health and well-being; and sustainable, equitable, inclusive land-use for all, especially for the most vulnerable."* (D3)

Being the base component for actual creation of hydrogen molecules, and one of the most critically unattainable in South Africa in recent years, water distribution was bound to bring some conflicting interests while setting up the hydrogen economy. Although some mention is made of refraining from existing freshwater sources for hydrogen production (C2), this statement altogether is more of a prognosis than actual observation. As of this moment, possible issues regarding water usage and scarcity in the hydrogen economy generally seem to be of little concern to involved parties. This may be due to the main proposed solution to this not yet existing problem, which is using abundant seawater and desalinating this before use in electrolysis processes. This process is expected to take up to five percent of energy used in green hydrogen production and just a fraction of costs associated with the production process (International Energy Agency, 2022; C1; D4). Additionally, it was suggested that waste water from mines can be used in green hydrogen production. The outflow of this contaminated water is known as Acid Mine Drainage (AMD) and poses a major challenge in the South African

mining sector (D4). Large amounts of water are used in mining activities and in the process this water is contaminated due to increased contact with acidic surfaces. At the start of the 21st century this problem faced increased attention in media and academic literature as groundwater and rivers were found to be contaminated (McCarthy, 2011). However, this problem is mostly caused by coal and gold mining, the former being the main attributor to AMD, due to the substantial scale of the coal mining industry in South Africa (McCarthy, 2011). This problem will persist as long as coal is mined and thus can prove a viable source of water in the initial phase of the hydrogen economy.

Similar to water, the need for land and land use will increase due to initiation of the hydrogen economy. Mention is made of setting up rental agreements with landowners surrounding vital areas with hydrogen economy subsectors, which include the ports and mines that are set to operate within the hydrogen value chain (I2; I4). In I4 it was further mentioned that a measured approach should be taken by the government, in order to have the process of land procurement be inclusive and equitable and not be at risk of favoring specific cases unrightfully so. Similar to renewable energy projects, hydrogen project developers are expected to be approaching farmers and landowners in areas with good sunshine and wind (I4). Additionally, it is recommended by civil society actors that hydrogen production should be excluded from certain vulnerable areas, particularly those designated as biodiversity hotspots or lands where co-use with arable land is unattainable (D8). In order to achieve this, solar and wind atlases are recommended to be updated as these overviews serve as vital references for identifying suitable locations for renewable energy projects (D1; D4; D8).

A final issue that is often mentioned in the same breaths as the hydrogen economy and the just transition is responsible use of electricity (C3; I3; I5; I8). Since green hydrogen is made using precious renewable energy, this same energy can at that time not be used for supplying other consumers with electricity, which can become a problem, especially in the ongoing energy crisis. Although often mention is made of using surplus wind and solar energy to produce hydrogen (D7; D8), there is an increased risk of not upholding such promises if, at some point in time, producing green hydrogen becomes more valuable than provision of electricity. Also the focus on ‘going green’ is regarded as a risk of compromising electricity supply and even other societal developments if given too high a priority (I8). Some actors therefore propose that hydrogen only be produced using additional energy provisions that are disconnected from attempts to increase energy capacity aimed to solve energy shortage in the short term (I8; D8). This idea and the caveats to it are further discussed in Section 6.1.3 on additionality.

5.2 Private sector involvement

In hydrogen development planning, a clear role seems to be cut out for the private sector. Most actors mention the need for private investors to pick up on the green hydrogen economy and related renewable energy development after the government has successfully made initial investments. There are broad calls for ‘de-risking’, partnerships, and ‘leveraging’ in order to build the hydrogen economy (C1; C2; I1-I5; D1-D4). Simultaneously, other actors are hesitant for these sizable infrastructure projects to be handled by private corporations and rather see increased public ownership (C3; I6; I7; D9).

5.2.1 Pressure on private sector

From a government perspective the South African private sector is put under a significant amount of pressure to carry on the initial momentum and further develop the hydrogen economy after the initial kick-start. The

most prominent part of this expectation is the financial load distribution. In South Africa, the private sector is assumed to cover secondary investments for the just transition, which are expected to sit somewhere around 1,360 billion South African Rand (ZAR), or 90.7 billion US dollar, totaling about 90% of the total required investment (C3; D6). The initial investment of around 144 billion ZAR is then covered by the government, from a pool of international funding including from the JET-P, and is used to leverage the total investment required (D6). This proposition is made on the national level, while local governments have stated they wish to abstain from taking risks as it acknowledges that the private sector is better suited to pinpoint and exploit profitable investment opportunities (D5).

Both the private sector and the government seem keen on cooperation and show a need for each other's services in order to continue existing plans. Such public-private-partnerships (PPPs) are part of the neoliberal approach that is inherent in the government approach to setting up the hydrogen economy. Thus, generally market dynamics are expected to drive what proportion of hydrogen is actually produced renewably, but the push to phase out non-renewable hydrogen should originate from a governmental regulatory environment (D1). Scaling down, the local government aims to *"provide an enabling and responsive approach"* to support the private sector (D5). Strengthening the institutions and regulatory framework, along with these PPPs, will lead to increased mobilization of capital according to government plans (D3).

5.2.2 Visions of the private sector

Actors active in the private sector seem to handle these pressures laid on them – both internationally and by the national government – and propose ambitious plans with additional social impact mitigations in mind. The visions they have for the future South African energy system contain a variety of plans, some of which already in place. One actor mentioned a project in collaboration with the University of Pretoria, through which they aid previously unemployed youth with their fuel cell technology business, with specific consideration for disadvantaged black youths (I1). This project had at the time provided job opportunities to 38 young South Africans, most of which were graduates from technical and vocational education and training (TVET) facilities (I1). Due to the significant challenges that South Africa faces socioeconomically, it is stated that companies operating within that sphere are inherently more focused on activities that have a positive socioeconomic impact, even aside from designated government regulations (I3).

Additionally, more actors mentioned they are focused on creating broader positive impacts than those directly resulting from their day to day business. One aspect that was put forward by multiple actors was localization, entailing local capacity building, value addition of extracted resources, and further reliance on locally manufactured equipment (I2; I5). The effort of localization has been applied specifically in the already existing platinum valley, which – through the introduction of hydrogen – has also been coined the hydrogen corridor (I2). In this corridor, spanning from the port of Durban to Limpopo, two actors are cooperating in a multilateral partnership that focuses on local manufacturing of equipment needed in its commercial activities (I1; I2). The introduction of hydrogen into the platinum valley started with locally rebuilt mining haul trucks that were converted to run on fuel cell technology (I1; I2). This development then caused the need for additional hydrogen infrastructure to be available within that area, enabling further introduction of hydrogen related equipment, such as fuel cell buses for employee transport (I2).

Localization of these operations is said to increase local employment opportunities throughout the hydrogen corridor and sets precedent for future expansion of these operations (I1). Although a valiant effort, risks of unequal distribution of local economic development still persist and should be further addressed in the regulatory framework, as was found by Nkoana (2018), from researching local contractors of renewable energy projects in Limpopo, where white-owned businesses were still favored, even within the local context. On a broader scale, (inter)national localization was a recurring theme at two conferences, where it was mentioned that hydrogen and renewable energy projects should seek geographical spread across the country and possibly neighboring countries, in order to distribute benefits and burdens of these projects (C1; C2). This could allow for the hydrogen corridor to expand further, giving inland regions and landlocked countries, like Botswana and Zimbabwe, access to Durban's seaport.

5.2.3 Risks from privatization

Aside from opportunities for private sector involvement, there is a countermovement that has identified critical risks and challenges that arise from privatization of the energy system, based on a different ideology. At the national hydrogen conference an envoy from the Dutch state-owned enterprise that manages the natural gas network called for the South African government to keep their hydrogen assets in public hands, in order to maintain control over the energy system and be able to easily intervene should it prove necessary (C1). This vision is shared by actors falling under the joint trade unions collective, who see additional risks in privatization of the energy system, which includes the governmental visions for the hydrogen economy (C3; I6; I7; D9):

> *"Because of the commodification of electricity, there is currently no incentive on the part of either private energy companies or marketized SOEs to introduce measures that might control or reduce consumption."* (D9)

The biggest risks from privatization, as mentioned by these actors, are either stagnation or expansion of the energy system, which in turn would negate the actual transition that is supposed to come (I6; I7; D9). Stagnation of the energy system would come from private owned energy generating facilities that are for-profit and have a need for 'full cost-recovery' that would be translated directly into the energy prices (D9). This is expected to result in expensive energy projects that exclude impoverished energy users who cannot afford increased energy prices and thus create stagnation in energy services as energy demand decreases in certain areas (I7).

> *"And this, I think, is the fundamental problem that the neoliberal approach has. They say it's going to be a massive money-making operation and it's turned out not to be that way. And that means investment is not an opportunity in order to make the transition possible."* (I7)

According to these actors, such negative outcomes predominantly result from policies and regulations posed by influential financial agencies like the World Bank and IMF who manage and consult on a significant share of international loans and financial aid packages (I7; D9). These institutions promoted reduced state control over energy prices and markets and more privatization of energy services (I6; I7). In this neoliberal scenario the government should have an 'enabling role' in the regulatory environment, while the private sector takes on a 'leading role' for developing the renewable energy sector (D9). Presented this way, it is said to coincide with the 'green growth'-movement that aims to privatize formerly public goods and services (I7). A major critique here is that historically not any country or region has seen a successful, market-led energy transition or electrification

process and these financial institutions are wrongful in their assumption that it will be able to bring success in current developing countries in need of stable and fair energy systems (I7; D9). The overall sentiment from this union collective is that privatization is not going to help in any way and energy should become a fully public utility again. Mention is made that profits from having a stable energy system are mostly indirect and therefore immeasurable in a full cost-recovery system, in contrast to public ownership of energy that would require less of a need for direct profitability (C3; I7; D9).

5.3 Climate change

The distribution aspect of energy justice is incomplete without addressing climate change. The impacts of climate change are evident worldwide, but its causes and consequences are not fairly distributed on a global level. This section touches upon how actors acknowledge the divide and suggest distribution of benefits and burdens related to climate change and global warming. Here it is displayed how actors involved in this research recognize this divide and take steps to distribute the benefits and burdens associated with climate change and global warming in a fair and equitable manner, as one actor approaches metaphorically:

> *"We have a sinking boat as the world or the planet, and if you're going to close one hole and open another hole, you're still going to be sinking. So this is what when I'm talking to the issues of the risk in regards to climate change. Climate change affects everybody on this planet and we need to address it in such a way that it is met on all ends."* (I5)

5.3.1 Climate change acknowledged

First and foremost, it has been established that all actors acknowledge that global warming and climate change are pressing global challenges that should be mitigated and attempted to be reverted, although not necessarily at all cost. From the government and civil society perspectives there is consensus that South Africa should work towards a low-emission future (C1-C3; I4-I8). However, it is also mentioned that in the shorter term air pollution poses a bigger imminent environmental threat than climate change, although the causes – and therefore the solutions too – are similar (D1). From the private sector perspective, solving climate change appears to be a subordinate ambition, with their main objective simply being to remain profitable, while even having a positive social impact is valued higher than the environmental impacts (I1-I3). However, for one private actor combating climate change is inherent to their main activity: by promoting the use of fuel cell technology they are able to turn a profit, while simultaneously providing low-emission technology (I1). Another private actor mentioned that they put their investments into global trends, one of which currently is climate change (I2):

> *"When we look at where do we put our money in? We look at global trends and the biggest global trend right now is around climate change."* (I2)

In addition to acknowledging the climate problem, several actors go out of their way to mention that South Africa specifically is a significant contributor to climate change. Being a semi-developed economy with an energy system that is predominantly run on coal-fired power plants makes South Africa the biggest emitter on the African continent and 13th biggest globally in absolute measures (I6; I7). This is recognized as a point for improvement, but simultaneously most of these actors do mention that on the short term the country should not attempt to change this statistic too drastically, since with an ongoing energy crisis it would make overall

matters worse if coal was to be overzealously phased out (I3; I5; I6; I7; I8). While it is argued that to overcome the energy crisis the energy mix will have to change (I3; I6), cutting out on energy capacity during the ongoing energy crisis, even when highly polluting, is generally condemned and priority should be given to restoring energy security in the short term (I5; I7; I8). Save the coal burning, there are other ways in which emissions and pollution can be reduced and actors are finding ways to implement impactful measures. For example, in the platinum mining industry the largest onsite emitters are the mining haul trucks:

> *"One of these* [trucks] *uses 900,000 liters of diesel on an annual basis. That accounts for 80% of our CO2 emissions on site. We want to be carbon neutral as an organization by 2040, and in order for us to meet our decarbonization goals, we need to really look at new ways of mining and also mining haul trucks are quite important."* (I2)

5.3.2 Difficulties combating climate change

At one of the conferences general distinctions were made between the more imminent local problems and international issues (C1). One esteemed civil society actor remarked that there is a continuum of investments that should be given interest: with focus on ongoing critical problems, such as energy shortage, on the one hand and ranging to long-term future developments and ambitious ideas, such as the hydrogen economy, on the other hand (C1). Throughout this spectrum, investments can and should be made, as long as one carefully distinguishes between the imminent and the future and deals with these accordingly (C1). A similar remark was later made by the premier of the Western Cape province, who stated that local sustainability should be favored over global sustainability, specifically for the case of hydrogen production. People should first reap the rewards that this development might hold, while global efforts will have to wait, while referring both to exporting hydrogen for quick and easy income as well as global warming mitigation (C1). This sentiment is also held in national government reports, where it is stated that, in terms of the hydrogen economy, priority should be given to setting up hydrogen infrastructure while not immediately focusing solely on green hydrogen (D1; D4). Existing gray hydrogen production processes and with optional conversion to blue hydrogen should not be disregarded over the short term (D1). With green hydrogen's need for enormous amounts of renewable energy, this might bring its own specific issues, since currently South Africa is still figuring out the best approach to setting up renewable energy generating capacity.

In an effort to increase the share of renewables in the South African energy system, the government set up the REIPPPP for Independent Power Producers (IPPs) to bid on government issued renewable energy projects. While a noble idea with built in measures to account for community impact assessment and ownership structures, according to some the project is doomed to fail under its own weight (C3; I6). The various bid windows allow for new parties to join in and present their tenders, after which a final candidate is picked based on a thorough evaluation of the offer (C3). Where the project failed is through fierce competition and undervalued offers that are hardly profitable, leading to project costs that far outweigh down payments while energy prices soar, making renewable energy about 30% more expensive than fossil fuel alternatives (I6). This has caused subsequent government project offers to be far less popular and certain cases where only 20% of renewable energy capacity on offer were actually tendered (I6). Globally similar situations have presented themselves, with similar outcomes too, and this is presented as proof that such a privatized energy market is not the way forward and the chaotic nature of it is hampering actual progress made in the just transition (I7).

These initial problems in organizing renewable energy capacity further demonstrate the persisting need for coal in the South African energy system, at least for the short term. In the longer term it poses another question of how to deal with this climate change induced shift in mining operations? As stated before, due to attention to social impacts in South African policy and decision making, this is something that concerns actors on all fronts. While on an international level pressure to accelerate the transition and move away from coal increases, locally the future of coal mining communities and attached community centers is considered to be more pressing. While this will be touched upon into further detail in Section 6.1, in terms of distribution of benefits and burdens, the coal mining sector is said to profit from the persisting need for fossil fuel-based energy in South Africa in the short term. Since the last decade a Mining Charter has improved conditions for all mining communities, granting them increased rights and ownership in new mining operations (I3). For the long term, the need for coal will almost certainly decrease, but hope is put in the increased need for PGM mining to fill up this gap and set in motion the shift of employment and economic activity towards it (I2; I5; I7). The focus on coal might bring stability for now, but is not a sustainable solution in the long run, as negative effects of climate change disproportionately affect South Africa on a global scale (Lawrence, 2020b; Mirzania et al., 2023).

5.4 Conclusion

This chapter has an overview of findings in line with distribution justice that will help provide an answer to the first sub-question of this study: h*ow are the benefits and burdens of introducing green hydrogen distributed?*

Important choices still need to be made regarding exporting the resources or retaining economic value in the country through manufacturing of affiliated products. While the PGM mining sector has the potential to grow with the hydrogen economy, it poses a risk of increased extractivism under a banner of 'green developments', which will not benefit communities, but only bring economic opportunities to mine-exploiting companies. This neoliberal resource mindset appears throughout the general planning of hydrogen developments by the South African government, aiming to mobilize the private sector with maximal leveraging of initial public investment. In practice it seems that public funding will bear the brunt of the cost, de-risking opportunities for the private sector to collect profits. Participating private sector actors seem eager to invest themselves and even set up programs for promoting marginalized groups and individuals, these last efforts appear of small order, compared to the scale at which they plan to initiate a hydrogen economy. Meanwhile, civil society actors remain vigilant and opposed to ongoing privatization of the energy sector and fears for further collapse of the energy system, even though their efforts seem restrained. They also identify a risk of private actors leaving out climate change mitigation and adaptation goals in favor of profitability, even when renewable investments become viable. Overall, a bit of positiveness appears in intentions for fairer distribution of benefits compared to current practices, but burdens are hardly considered. Especially in the long-term climate change burdens are expected to befall South Africans in disproportionate levels, both for the marginalized within the country as for the country itself at the global level.

CHAPTER 6
RECOGNITION IN THE TRANSITION

This second chapter of the results provides an overview of the analyzed data associated with theory on inequality in South Africa and presents a baseline for how this is linked to recognition aspects of energy justice. It is structured to answer the second sub-question of this research:

> *Whose interests are recognized in visions for development of the green hydrogen economy?*

The chapter consists of three topics that have come up in the thematic coding of all data sources. The first of these is the continuation of fossil fuels, which presents the findings on visions for fossil fuel and renewable energy use in the near future. The second topic presented is the hydrogen workforce, which focuses specifically on recognition of workers in soon-to-be redundant sectors and future hydrogen economy employees. And finally, the third topic is international interests and cooperation, which addresses findings surrounding international partnerships and financing. The interests included in this analysis originate from the data sources displayed in Appendix I, and include actors from the private sector (I1-I3); government (I4; I5); and civil society actors (I7-I9).

6.1 Fossil fuel continuation

In this section the visions for coal mining and usage of coal in the energy sector will be presented. While coal is known to be a continuously extremely polluting energy carrier, it is what makes up the majority of South African electricity generation capacity, totaling 73.5% in 2021 (see Figure 3.2). International pressures to abandon coal are rising, but at a time where the energy system is unable to provide sufficient output in its current state this seems counterintuitive. Especially considering the plans for the transition to not only combat climate change, but also address local poverty and unemployment challenges. The need for coal is therefore apparent, but more than that a significant number of households and entire communities depend on coal mining to sustain themselves, posing increased risks for them as well:

> *"Some of the other concerns are that the transition from coal affects many jobs and livelihoods. The reason I say jobs and livelihoods is that there are some small businesses that are not necessarily people working in coal mines. But there's businesses that develop around an economic zone."* (I8)

6.1.1 The necessary evil

All around, actors recognized that coal, for all its faults, is fundamental in the attempt to maintain the highest possible level of stable energy provision country-wide and thus the highly polluting power plants are stated to remain pivotal to assure as high a level of energy security as possible in the near future (I1-I8). Suggestions for increasing the capacity of the energy system over the short term are made by various actors, which include to keep on working with the existing energy infrastructure to the best of its ability (I5; I6; I8) and reducing energy intensity on a country-wide scale to relieve pressure on existing power stations (I6). Similarly, the Development Bank of South Africa is suggesting to not abandon coal immediately, but focus on creating a more resilient energy system first (C1).

In line with these suggestions, in a few cases mention is made specifically of the latest addition to the power station fleet, consisting of two high-grade coal-fired power plants: Medupi and Kusile, located in the North-East (I6; D6). These sites have been subject to controversy both due to coal being used for electricity generation and the numerous issues delaying construction and commission (I6). At two conferences, suggestions were made to abandon or prematurely decommission the projects and focus instead on cleaner and renewable alternatives (C1; C2), but such statements are strongly opposed by the majority of domestic actors (I1-I5; I8). As mentioned before, the ongoing renewable energy programs have seen their fair share of issues as well, and because South Africa already has sizable coal infrastructure in place this should be exploited to fill the existing energy gap, despite international criticism (I5; I6; I8; D6). That is not to say that renewables or not considered at all:

> *"A public pathway approach must address a critically important question: how can energy poverty in the global South be addressed without significantly increasing greenhouse gas emissions? Put differently, what are the alternatives to coal and gas that could be scaled up to meet the energy needs of countries that are today 'energy poor'?"* (D9)

Even when in the future renewable electricity can become more readily available, the issue regarding intermittency of wind and solar power remains and thus there is a need for backup power generation. While this is something where hydrogen could come in, large scale implementation of hydrogen is reckoned to still be far off and to require huge investments not easily acquired (C3). Until that time, coal or other fossil fuels can still be used to provide electricity during renewable downtimes and at peak moments, and these options should therefore not be disregarded easily (I8). Providing energy security should remain the highest goal for the South African energy system and by all means necessary (C3; I6; I8; D1).

Apart from being the most liable option to uphold energy security, coal continues to provide livelihoods, both directly and indirectly, to numerous households spread across the country. These coal mining communities have historically been mistreated and abandoned after operations were seized, but current regulations surrounding the mining industry aim for better care of local communities during and after operations (I3). For this reason, the Mining Charter was set up in the early 2000's and expanded over the last decades (International Bar Association, 2021; South African Government, 2018). It dictates a set of regulations in the South African mining sector that enable disadvantaged groups to attain more power and rights within the mining industry (I2; I3). Even with the pressing necessity for coal mining to continue at least for the near future, coal mining communities face an uncertain outlook. With this in mind, plans are being set up to guarantee some form of future livelihood as part of the just energy transition. One example being the redistribution of former coal workers over different mining industry branches and the new manufacturing industries, which remains a main challenge in the JET (I1; I5; D6). Locally, the provincial government is promoting and assisting in setting in motion this jobs transition from the primary mining sector to the secondary manufacturing sector, which stimulates economic development (I4). The prospects of this new hydrogen workforce will be further elaborated on in Section 6.2.

6.1.2 Slow phaseout

Despite the expressed need for coal in the near future, there is also plenty of talk of phasing out coal and how to approach this aspect of the energy transition. From the government perspective it is suggested to take this transition slow and make use of existing infrastructure for as long as possible (I5). While simultaneously initiating the transition and aiming to reduce emissions by using upcoming technologies, such as carbon capture and

storage, both in a setting where coal is still being used for electricity generation (I5), as well as in scenarios where blue hydrogen is created based on fossil fuels (I5; D1). The Presidential Climate Commission (PCC) acknowledges the concentrated nature of the coal mining sector in Mpumalanga and specifically designates local and regional governments to design development plans for decent livelihoods in a future low-emission society (D3). The South African Local Government Association, consisting of all South African municipal governments, has directed their focus on finding new employment opportunities in mining-centered municipalities in the Mpumalanga region, where most affected coal miners are located (I8). For this just labor transition to take place, the current and future energy sectors need to be better aligned and gaps filled with retraining opportunities (D4). Opportunities for diversification of coal-based local economies should be assessed in the next few years and suitable picks should be exploited between 2025 and 2030 in order to be resilient to the rise of renewable energy at later stages in the transition (D3).

> *"It's not just going to be overnight and tomorrow coal stops. In the country we're trying to advocate that from coal to renewables, the whole transition needs to be over a long period of time. Where we still reduce CO2 by using coal, by doing carbon capture, which is the blue hydrogen.* [..] *We've got existing infrastructure right now that can be used to kick-start the economy, but allow us to go through this transition."* (I5)

> *"Creating change is not easy. And it's better to move slowly with everybody and in an inclusive manner, as long as you are being transparent and making milestones versus having very grand plans that allude to instantaneous change."* (I1)

The abovementioned prospect of a steady coal phaseout stretched out over a longer period of time is welcomed by both private sector and civil society actors, who share the vision of taking a more prudent approach to better allow for justice elements to be part of the transition. In order to be inclusive it is suggested by the above quoted actor to approach the transition by moving by inch, which would allow for better measures to be taken to include marginalized and disadvantaged groups (I1). While this is acknowledged, the global trend surrounding low-emission energy production has already set in motion some private actors towards phasing out coal. One mining corporation has mentioned they are slowly letting go of their South African coal assets through divesting opportunities, to reach their self-imposed climate measures before 2040 (I2). In financial services, special bonds or loans are offered to assist clients on their transitionary, net-zero path (I3). This so-called 'green financing' is offered to companies and individuals who are willing to invest in sustainable opportunities or finance the phase-out of climate damaging assets (I3). Such 'green' discourse, however, is often linked to neoliberal objectives of extractivism and economic growth, resulting in further climate stress (Voskoboynik & Andreucci, 2022).

Civil society actors are not fixed on abandoning coal momentarily either. Although they repeatedly acknowledge the environmental damage that coal burning causes, they stress that careful proceeding in the coal industry is required (I6; I7; I8). I7 is quoted saying: "*South Africa should get off of coal, but so should the rest of the world.*" Although it is stressed that this cannot happen overnight and is probably a matter of decades before South Africa can completely abandon coal (I7). It is stated that over accelerating this transition would only put additional stress on society through the energy and employment crises; that it would be a mistake to think that this would put a significant dent in the global energy transition; and anything that can be done simply does not outweigh the damage it would do in the short term (I7). Meanwhile, an important remark is repeated by multiple actors regarding the addition of energy, pointing to the fact that current developments show immense growth in

energy use, facilitated both by a rise in renewable energy sources, but also by ever growing fossil fuel use in the energy system (I6; I7; D9). They state that this development should be monitored carefully as the coal and gas industry should plan for structured disintegration rather than growth opportunities, even in the face of the ongoing energy crisis (I7; D9).

6.1.3 Additionality of renewable energy

In line with visions for slow and steady introduction of green hydrogen is the vision for additionality of hydrogen and renewable energy in general. Additionality regarding hydrogen and renewable energy in general implies that these developments should not inhibit other more pressing issues such as dealing with loadshedding. The Premier of the Western Cape province states that if hydrogen developments are initiated without dealing with loadshedding, every contributed investment will have been for nothing due to unstable foundations in the energy system (C1). This statement is in line with earlier statements regarding the continuation of coal, the hydrogen workforce and energy future in general, which press the need for careful consideration of hydrogen developments and its impact on other prevailing societal issues. However, the concept of additionality takes on other forms which are apparent in the acquired data, and views on these matters are divergent as well.

While initial mention of additionality set hydrogen versus the current energy crisis, other mentions of the concept plot hydrogen against other sources of renewable energy. Due in part to the efficiency losses when using electricity to convert water to hydrogen, a risk is uncovered in focusing too much on green hydrogen production, as it will restrict addition of renewable electricity to the domestic energy system. Adhering to additionality principles is therefore mentioned as a necessity for hydrogen developments (I5; I8). Only when there is a temporary surplus or energy poverty has been diminished should hydrogen be produced from otherwise precious electricity (I8). Government and civil society actors are warned to be vigilant for misconducts regarding hydrogen production, when actors are focused on scoring easy income exporting hydrogen and electricity by extension (D7; D8). These sources even go so far as to suggest strict standards should be kept regarding additionality and countries not following them should be inhibited from exporting hydrogen (D8):

> *"This could be resolved if renewable energy for hydrogen production is unambiguously 'additional', that is, that it would not have been installed in the absence of green hydrogen production."* (D8)

Further mention of the concept of additionality is more critical towards it and identifies risks in the overemphasized focus on additionality of renewable energy in general. From the union perspective, additionality is heavily criticized in the context of climate change and emission reduction, including these globally pressing matters in the discussion. It is argued that while the share of renewables is increasing globally, there is a global case of energy addition rather than transition as fossil fuel use increases still (C3; I7). Although they assess, like most everyone else, that the South African energy mix is in dire need of change, they warn not to try to change the mixture simply by adding to it (I7; D9). Instead they argue to focus on reducing energy usage and increasing efficiency, stating that a lot of ground can be covered in doing so (I6; I7). By then simultaneously increasing the share of renewable energy South Africa can carefully transition its energy system (I7). Furthermore, it is suggested that the idea of additionality be extended to additional socioeconomic benefits for both countries and communities hosting developments to prevent exacerbating inequalities (Cremonese et al., 2023).

6.2 Hydrogen workforce

It is widely recognized that the forthcoming hydrogen economy should aim to provide replacements and additional employment across the whole of South Africa. Visions on how this is set to take place are described in great detail by a wide variety of sources. Both through education and employment programs newly skilled workers are set to find a place throughout the various branches the hydrogen economy will offer. This view is not limited to only hydrogen-based placements, but also throughout the whole renewable energy and post-transition mining sector.

6.2.1 Employment & education

Aside from the ongoing employment crisis, the South African government is facing additional employment related challenges as part of the transition towards a renewable energy system. It is estimated that around 124,000 jobs are at risk as a direct cause of coal phase-out, not counting any employment from economic activity surrounding coal-mining communities (C3). Critiques on the incoherent 'green industrialization' strategy and lack of support that seems to be given to the mining communities at risk make for additional loss of trust in the government to find sufficient jobs in the upcoming renewable energy sector to provide stability and security (C3; I6). As is stated below, South African industrialization has taken a big hit in recent years:

> *"So similar countries to ours, Mexico, Poland, Turkey, have between 30 and 40 percent of the economy in the secondary sector, in the industry sector. We have over the last 15 years gone down as a country from something like 21% to 14% and so we're deindustrialized."* (I4)

The current trend shows that implementation of localization strategies to increase local economic activity will be a challenge. In order to make the REIPPPP attract more interested parties, localization rules have been relaxed over the course of the program, such as reduced import tariffs on renewable energy equipment (C3; I6). So far, employment from REIPPPP is limited to temporary construction jobs related to onsite assembly of wind and solar farms, since the small renewable energy manufacturing industry closed down due to insufficient profits (C3; I7). Which is another example of deindustrialization in South Africa, that results in decreased economic activity and stability (I4). Overall, the JET Investment Plan is deemed to show very little appreciation towards localization efforts, with only 0.1% of planned budgets reserved for investments in local manufacturing industries, even though one of the major promises was to cover lost coal jobs with a renewed manufacturing industry (C3; D6). Challenges and questions remain, not only from civil society, but also the private sector:

> *"A simple example. If you have a mechanic who knows how to operate and maintain a diesel bus or truck. And now there's fuel cells and there's this transition that needs to play into renewable technologies. [...] What happened to that individual? Who's thinking about them, you know? Are we really true in our just transition? Can we realistically accommodate everybody?"* (I1)

It is hard to find an answer to these questions, but the JET and the supplementary green hydrogen economy are still believed to provide significant employment opportunities when approached deliberately. Meaning that in the case of the REIPPPP, if local communities are to be supported, the regulatory framework should have the flexibility to take specific local requirements into account (Mirzania et al., 2023).

From the union perspective, a proposition is made for over one million additional climate jobs that can be capitalized on throughout the JET, provided the necessary resources and policies are mobilized (C3; I6). A reimagining of green industrialization is needed to absorb these jobs, and it is assessed that solely relying on installation and maintenance of renewable energy from IPP is not going to be able to provide decent permanent jobs at the scale required (C3; I7). In order to create the additional climate jobs, the government is again counting on beneficiation of raw materials to help generate employment opportunities grounded in the added revenue streams, mentioned in Section 5.1 (I5; D4). In line with this, the Western Cape government desires to inspire economic growth and job creation through exploitation of its competitive advantages in existing infrastructure and renewable energy potential (I4; D5). They are still examining what comprises hydrogen skillsets, which jobs are needed, and how to make sure that enough people are skilled – or skilled people attracted – to provide the economic development they so envisage (I4). The provincial governments in general conduct a more hands-off and facilitating approach, as per their constitutional mandate. Therefore, they will be offering training incentives, but state that it will be up to the companies to place these trainees into their businesses (I4). This goal is set to allow significant numbers of people to rejoin society and actively contribute to it:

> *"And we're trying to say: get the masses* [...] *into higher earning jobs and into higher value add activities. But you can't do that unless you graduate people, processes, economic systems. So our main aim for green hydrogen is in industrialization drive and not so much an energy drive and maybe that's the link, maybe that's the J, that it would then be just."* (I4)

One of the interviewed private sector actors is eager to step in this prospect given by the provincial government. Having a job through which one can contribute to society and develop oneself is said to help increase and restore human dignity, specifically for commonly disadvantaged people (I1). Due to initial successes in their program to find jobs for unemployed youth (see Section 5.2.2) they are now looking to scale up their own employment projects by increased cooperation with universities and colleges (I1). Additional education spaces will also be required to facilitate reskilling of former coal workers and workers in other affected sectors, in order to help provide new livelihoods. Compensation for lost employment can be further diversified to include education facilities for other sectors, such as agriculture or transport sectors (Hanto et al., 2021; Mirzania et al., 2023).

A national education and training strategy is set up to cover the existing gap between the informally or poorly educated and the portion of the population that has enjoyed university-level education. This strategy focuses on enhancing the ecosystem surrounding technical and vocational education and training (TVET), providing both employment and educational opportunities (D2). Not all of the envisioned climate jobs shall be opportunities for the currently unemployed, as a significant part is envisioned to cover for jobs that are lost as a result of cuts in polluting industries (I6). But for both of these so-called reskilling and upskilling practices the TVET strategy is devised for artisans to transition with the energy system to new and upcoming sectors (D2). The national government has high ambitions for the TVET ecosystem and puts significant pressure on its ability to deliver the desired employment quantities, which aims to grow its employment share beyond that of university-level education (I5; D1; D2). Although it is expected that initial job requirements for the hydrogen economy will be university-level skills, once production of hydrogen and manufacturing of related equipment scales up, the need for skilled artisans with technical and vocational training will rise too (D2).

6.2.2 Workforce marginalization

Within education strategies presented by government and the private sector, specific mention is made of disadvantaged and marginalized unemployed and how to help them participate in the South African economy. In this case education is used as a social protection measure, targeting the vulnerable groups mentioned in these strategies, which include the Black population, women and youth (D1; D2; D3). Starting with the former, the South African Black population is historically disadvantaged, but receives recognition and support in employment through the BBBEE act and in education through similar affirmative action policies (D2; D3). However, it was found that these policies appear to increase individual gains, rather than improving the situation for the entire target group (Webster & Francis, 2019).

Among the Black population, young people and women have been found at an additional disadvantage and thus specific strategies targeting mitigation of their vulnerability are discussed. Young people represent a considerable amount of the potential South African labor force, but experience significant unemployment of over 50% until the age of 30 (Statista, 2023). They are a focal point of policy recommendations as they represent the future and are therefore considered valuable assets worthy of appreciative investments. A specific instrument designed for inexperienced employees is workplace-based education, which should help transition more smoothly from school to jobs (D2). Furthermore, young people will be stationed in educational advisory boards to help steer and further develop educational facilities to better meet their needs (D2). It is also mentioned that more than focusing on job-specific education, students will be trained to create and pursue self-employment opportunities and employ others in order to make them more independent and self-reliant (D2).

A similar strategy is envisioned for female-targeted education. Other than young people, women are a specific target group for education strategies that aim to give them more representation and equal participation in society (D1; D2). Although women are well represented in the current TVET ecosystem, it is stated that unemployment is higher among educated women compared to men, who enjoy labor market favorability (D2). Gender response measures are deemed necessary especially since women are affected by unemployment and poverty more than men (I8). Furthermore, women are found to be disproportionately affected by climate change and its adaptation measures, further increasing the need for affirmative action (Dematteis et al., 2021). Therefore, specific programs are organized to educate and employ women in technical branches in which they are massively underrepresented, by designing female-only internships, similar to the workplace-based education for the younger population (I1; I8).

6.3 International interests and cooperation

From the collected data it is clear that South Africa does not envision establishing a hydrogen economy on its own and there is much talk regarding possible partnerships, both for financial support as well as non-financial cooperation. In today's globalized world it would be hard to imagine otherwise even if the country wanted to approach the project by themselves. There is growing international interest in green hydrogen as supply and demand seem to be unbalanced globally and global hydrogen trade is expected to boom. In this section the recognition aspects and subsequent fairness of existing and proposed partnerships resulting from these interests will be presented.

6.3.1 Non-financial partnerships

It is frequently stated, throughout all sources of analyzed data, that the government of South Africa is looking for all sorts of international partnerships in their JET (C1; I5; I6; D1; D3; D6; D9). At the first conference, the Saldanha Bay Mayor emphasized the importance and power of collaboration, between diversified national parties as well as international parties, in order to acquire the knowledge and resources to bring about the just transition (C1). This desire to acquire additional knowledge was linked to educational collaboration by one of the interviewees. They stated that international partnerships with educational institutions would help identify and establish the required accredited courses needed to train a national hydrogen workforce (I5). Because green hydrogen is a new and upcoming innovation, such partnerships are needed to speed up development at an international level (I5). Furthermore, a requirement for international partnerships is expressed as it would help mitigate climate change, being a pressing global issue in need of a synchronized, international effort (I5; D9). The African continent, including South Africa, is stated as disadvantaged capacity-wise compared to Europe and to therefore require European support to help combat climate change and bring about the transition (I5).

From the European perspective, the EU is presenting itself globally as a trading partner regarding green hydrogen and this includes extension of ongoing bilateral relations with South Africa into the hydrogen realm (D1; D4; D5). As stated before, South Africa is looking to export a share of its produced hydrogen and European countries collectively and individually are showing their interest, even more so since the Russian invasion of Ukraine and subsequent ban on Russian natural gas imports are threatening European energy security (D4). Competition for EU hydrogen demand is expected to be fierce and main competitors in this market are mentioned to be Morocco and Ukraine, both of which have entered talks with the EU regarding long-term hydrogen partnerships (D4). The EU is considered to have enormous influence on the local hydrogen market, both in terms of its own interest in importing hydrogen, as well as how its regulations influence global – and thus also South African – practices (I5). Strict emission regulations will also have an impact on hydrogen and other exporting sectors like the automotive manufacturing industry (D4). As such a need is expressed to advocate South African interest in EU policy-making:

> *"So some of these delegated acts that are being adopted as regulations from the* [European Commission] *side have trade implications for us, and by that, have societal implications of unemployment. For example, Sasol is one of the big companies that is contributing taxes in South Africa, which is where the government gets its source of funding to run the country. And by losing that, it would have a huge burden and negative implications for us."* (I5)

Besides trade agreements with the EU, other eligible opportunities for international cooperation are presented and explored by South African actors. More examples of hydrogen export opportunities are referred to, in relation to other countries' energy transitions that require green hydrogen, but where they lack the comparative advantages to produce the product themselves (D4). While South Africa is looking for a considerable market share in the global hydrogen economy, and importing countries aim to improve future energy security, opportunities for long term supply agreements are expected to present themselves (D4). In this case South African competitive advantages, like having access to both the Atlantic and Indian ocean and satisfactory conditions for renewable energy generation are expected to help the country look more favorable (D4). This already seems to be the case for the Western Cape economic zone, which is overwhelmed with requests regarding their green hydrogen export potential:

> *"We've got this special economic zone that is being clouted in all kinds of international studies and in their own market analysis as one of the hotspots for green hydrogen. The market is jumping up and down trying to establish projects and our main role at this stage is to make sense of the whole picture. And that includes which projects are sound and which are not."* (I4)

The hydrogen visions for the Western Cape are a good example of government to government arrangements, while there are plans for the area, along with designated areas in the Northern Cape province, to closely collaborate with Namibia on developing a hydrogen valley along west coast (I4; D1). With the established port in Saldanha Bay the Western Cape counts itself ahead of other parts of this proposed hydrogen valley and they look to capitalize on this lead, stating that they will be able to export hydrogen and affiliated products within a few years (I4; D5). Hard-to-abate sectors like cement, steel and heavy transport are prominent in the area and are viable candidates for local offtake green hydrogen pilot projects (D5). The Western Cape government is exerting an intermediary role between national government regulations and private sector implementation, while focusing on partnerships that are most likely to increase economic development of the area (I4; D5).

6.3.2 International financing

International partnerships, especially bi- or multilateral agreements between importing and exporting countries often involve some sort of financial aid or loan in order to help materialize the initial ideas regarding setting up local production of a product. Green hydrogen is no exception and South Africa has seen many propositions and deals being made over the last few years between all sorts of parties willing to get involved in the global hydrogen trade. Even the PCC regards partnerships – and specifically financial partners – central to the JET:

> *"The just energy transition needs partners to agree around the pace of decarbonization, the scaling up of low carbon energy and the value chains that support it, the upgrading of the energy grid and the mobilization of climate finance, at scale, to enable a just transition."* (D3)

Much emphasis is placed on the enormous financial costs that will be needed for the JET and in order to take in the scope of it all, the South African government has set up the JET Investment Plan (JET-IP), focused on the five-year-period from 2023 to 2027. The investment plan is a direct result of the JET Partnership and showcases the distribution of these funds and additional financial means needed for a broad range of aspects of the JET (D6). The international partnership has pledged an initial 8.5 billion USD pledge (loan and 2.7% grant), *"with strong promises on paper to protect workers, enable low carbon industrialization, mine rehabilitation etc."* to contribute to the justice element in the South African energy transition (C3).

This pledge is less than a tenth of expected financial budget of the JET in South Africa over the course of the aforementioned period, with the remaining 90% expected to come from a combination of private investments, public resources, and development finance institutions (C3; D6). The initial ten percent is expected to be a catalyst for the full required amount of JET funding (D3). This idea is being criticized by union opposition, stating that the amount of leverage is far too little in proportion to what is asked from the private sector, and not enough to sufficiently de-risk and guarantee profits (I7). Figure 6.1 displays the allocation of the total JET budget over the categories electricity, new electric vehicles and green hydrogen, and the projected origins of the financial requirements (D6).

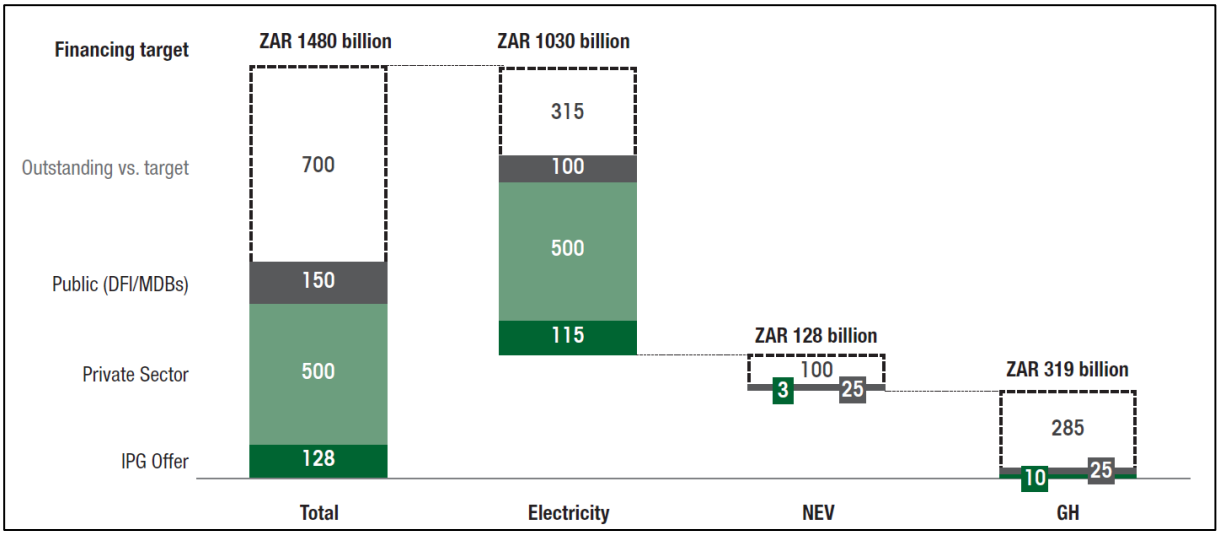

Figure 6.1 - "Projected funding needs and estimated availability, by source and sector" (The Presidency, 2022, p. 124)

About two thirds of the investments are planned to be spent on electricity, and of the already pledged JET-P funding 7.5 billion will be allocated to financing the electricity sector (D6). Apart from enormous investments in wind and solar – making up half of the electricity share – another large portion will go to Eskom's transmission equipment and services, in order to enable additional renewable energy grid connections from IPP's (C3; D6). In total, a little over 300 billion ZAR – or about 22 percent – is budgeted for setting up the green hydrogen economy, while only five percent of the initial 8.5 billion USD JET-P pledge is reserved for it. As the figure shows, almost half the budget is still unaccounted for even in terms of projected origins, let alone actual tangent funds. Only the JET-P funds are actually committed, although they come with additional conditions, such as accelerated phaseout of coal power plants, which has been considered unrealistic, even by national government:

> *"Yes, there is additional international pressure, but at the same time* [...] *it's not yet realistic. Poland still has large reserves of coal, which they are still very heavily dependent on."* (I5)

Having to set up a green hydrogen economy as part of climate finance agreements, such as the JET-P, is stated to limit the freedom and flexibility to address issues of the just transition in a manner that suits the local situation best (D8). These strings attached, or so-called 'conditionalities', are mentioned repeatedly regarding climate and development finance specifically. These financial schemes are heavily criticized by political leftist actors, stating that while the idea of such financial support measures was for industrialized donor countries to address and pay off their ecological debt it will actually result in further increase of financial debt and burden for the receiving countries (I7; D9). The neoliberal focus of the South African government has led to this increased dependence on international finance through foreign direct investment, which has exported growth prospects, leading to economic stagnation (Mosala, 2022). Additional interest payments for already debt-burdened South Africa would further incapacitate its autonomy and ability to address increasing issues in the country (I7). Specifically, development finance institutions like the World Bank and IMF have been incriminated for this behavior of setting additional conditions that further impoverish or hamper development of countries receiving financial aid (I7; D9). The risk of imbalanced financial and trade agreements surrounding green hydrogen that disfavor exporting countries is acknowledged and suggestions are made for financial assistance to be at the center of trade agreements, making deals equally lucrative for all parties involved and help spread the potential risks (D8).

The mobilization of a global climate combating budget that was part of the Paris Agreement is repeatedly mentioned as another valid source of funding for climate mitigation and adaptation projects (D3; D6). However, this budget has as of yet never met its annual mobilization target of 100 billion USD and is therefore regarded as an unreliable financial plan that has failed dramatically in the eight years since it was concocted (D9). It is also assessed that a scaling up of climate finance might help progress social and economic objectives in the short term, but would not strengthen state capacity to restrict the types of growth – like energy expansion – that have gotten the world into the climate crisis in the first place (I7; D9).

> *"Grant finance* [...] *alongside direct technical assistance, skills development, and technology transfer, can begin to build an institutional framework of cooperation, thus replacing public-private partnerships with public-public partnerships"* (D9)

The above quote shows an alternative perspective to finance structures that would further benefit the receiving country and its populace by focusing on partnerships between two or more public institutions. Such partnerships are mentioned in international 'just transition' approaches as well and are presented in similar fashion to cooperatives, which will boost local energy transitions and development in general as opposed to PPPs which are said to favor larger, often multinational, corporations that can bargain more competitively (D8). Similarly, in the public pathway approach to the JET, it is stated that development finance should not focus on 'unlocking' or 'leveraging' private funding, but should be directed towards restoration of public utilities in the energy sector (D9). This ideology regarding public-public partnerships is focused more on producing local partnerships rather than international, which will be further addressed in Section 7.1.4 on community involvement.

6.4 Conclusion

In this chapter, the findings pertaining to the recognition justice aspect were presented that allow the second sub-question of this study to be answered: w*hose interests are recognized in visions for development of the green hydrogen economy?*

In opposition to international pressure to accelerate decarbonization, South African actors unite in an effort to hold off on coal phaseout for the time being. Recognizing the need for a stable electricity system, coal is needed to provide as much stability as can be expected of the aging coal-fired power stations. In addition to managing energy capacity, this will allow for coal sector workers and surrounding economic sectors to catch up to the transition and allow reskilling programs to be initiated. Schemes put in place to ensure employment opportunities for redundant jobs and new workplaces, especially growing TVET facilities and opportunities as the manufacturing sector is revitalized. In these programs, specific attention is paid to women and youth, in an effort to revert historical marginalization. On an international level, however, South Africa seems dependent on international financing to continue its transition efforts. These financial pledges come with conditions and often suffocating interest rates, further increasing international dependence. If local South African interests are considered, according to civil society actors, international financing should instead originate from a global climate fund with a true justice agenda, and aimed to bring decarbonization without the redundant restrictions.

CHAPTER 7
HYDROGEN GOVERNANCE PROCEEDINGS

This third chapter of the results provides an overview of the analyzed data associated with theory on energy governance and presents a baseline for how this is linked to procedure aspects of energy justice. It is structured to answer to the third sub-question of this research:

> *To what extent does energy justice influence procedures of green hydrogen decision-making?*

The chapter consists of two topics that have come up in the thematic coding of all data sources. The first of these is the future energy system in South Africa, which presents visions from actors on how to overcome the current energy crisis and how the just transition will take shape. The second topic is regulation and standards, which provides an overview of various types of requirements, both national and international, that are needed to guide actors through the just transition and help maintain a successful renewed energy system.

7.1 Future energy system

With the South African energy crisis at its worst as of yet, increased hope and effort is put towards a stabilized future energy system, a vision that is shared by all interviewed actors and found throughout other sources connected to the JET. However, as has been made clear in the previous chapters, visions on that future differ greatly and so do proposed procedures to get there, with some being criticized heavily by others. This quote from one criticizing actor presents a short overview of their envisioned future, with a combination of general consensus and diversification for national policy in its solution:

> *"So we propose that we need to take a three-tip process. The first thing to argue is that we need to plug the immediate energy gap and we make concrete proposals on how that can be done. Then we say once the energy gap is plugged, we need to look to stabilize the energy fleet. In other words, fix the fleet and stabilize energy supply. And three, we argue that lays the basis to expedite the transition through a public pathway approach to a low carbon economy."* (I6)

7.1.1 Energy crisis visions

Within the context of shaping the energy future, a critical aspect involves determining procedures for working out the current energy crisis. for which multiple options are presented by interviewed actors, based on diverging standpoints. However, amidst these divergent viewpoints, there is a notable consensus on one topic: the undeniable reality of climate change and the urgent need to tackle it in conjunction with resolving the energy crisis. An effective approach to simultaneously tackle these issues is focusing on changing the energy mix, a suggestion that was made in the initial proposal for a just transition by an international collaborative of trade unions (I7). It is hoped that by diversifying electricity generation that loadshedding activities can steadily be reduced (I3). In the near future, when renewable energy becomes the dominant source of generated power, it is stated that green hydrogen will have to account for ten to twenty percent of the energy mix if global warming is to stay below the agreed-upon threshold of 1.5 degrees Celsius above pre-industrial levels (D6).

Regarding the state-owned electricity provision corporation that is at the center of every energy crisis discussion, opinions are divided and can be considered in either one of two approaches. The first – and currently being implemented – suggestion is that of unbundling of Eskom, meaning that it will be restructured into three separate entities for generation, transformation, and distribution of electricity (D3). As such, an example of the future energy system is presented, in which Eskom's role will be to make sure that the system runs smoothly and transmission and distribution are in order, while on the private side the IPPs take care of the lion's share of electricity generation, predominantly through renewable energy (D6). In line with diversification of energy sources, it is suggested that the ownership of the energy system should also be diversified and to a greater extent privatized, creating a competitive energy market (D3; D6). This competitiveness is then envisioned to reduce the cost of electricity, while the diversification of power production should ensure increased energy availability (D3). It is stated that all parties will need to make sacrifices to ensure a sustainable energy future, while intending minimal impact and sustainable livelihood for workers and communities (D3). To further boost energy availability in the short term it is stated there will be no accelerated phaseout of coal power plants, and only aging facilities will be decommissioned in the near future (D3). Furthermore, natural gas will be kept on low availability due to its flexibility, also and especially when renewables take up a larger portion of electricity provision (D3).

The alternative Eskom approach is offered by the labor movement, which opposes privatization of public utilities and thereby Eskom's unbundling, although it acknowledges the need for rigorous restructuring. With Eskom being set to scale down generation and distribution parts and mostly focus on transformation and energy infrastructure (I6). They assess this presents a risk for increased costs and debt while Eskom generates smaller income from energy sales, and simultaneously needing to provide services for the entire grid (I6; I7). In the short term, the current organization structure should be kept as is and existing power network used to the best of its ability, focusing on plugging the energy gap. On the supply side the proposal focuses on four central power stations, Medupi and Kusile, the latest and most efficient additions to the coal fleet, and Ankerlig and Gourikwa, two open-cycle gas turbines running on diesel and already scheduled for decommissioning. The coal-fired power stations are in need of expensive maintenance which will give a significant boost to energy availability that will easily compensate for its cost over a short period of time (I6; I7). The gas turbines and some other end-of-life power plants will be needed to stay in service for a short additional period in order to cover maintenance of other facilities (I6). On the demand side, it is stated that energy intensity in South Africa should be reduced to global average, lowering energy demand and thus increasing capacity (I6; I7). Overall it is explained that the first two years will be dedicated to plugging the existing energy gap, bringing increased costs and pressure on existing infrastructure, after which work on stabilizing the energy network can commence (I6). Finally, the financial situation of Eskom is discussed, which is centered around its significant debt accumulated over the years due to bad financial policy and shortfall of back pay from municipalities handling energy distribution. It is suggested that the overflowing state-owned pension fund can give some relief and that bad loans with development finance institutions (DFIs) should be reconsidered or its suffocating terms relaxed (I6). The overall sentiment for change is positive and the labor movement presents a pathway that they state could turn the current energy crisis into a future with stable and diversified energy supply for all South Africans, increasingly benefiting poor households who are disproportionately affected by unstable energy and stand to gain more from increased stability (Hashemi, 2022).

7.1.2 Energy democracy

The key aspect to formation of a new, publicly owned, energy system is making it less centralized and more democratic. The current South African energy system is structured around self-sufficiency and profitability since commercialization of Eskom in the late 1990's (I6). However, it is argued that this for-profit energy system is not bound to help solve the energy crisis, as direct value of electricity is not enough to compensate production costs, making any type of 'full cost-recovery' strategy is hard to implement (I6; D9). Simultaneously, indirect value and profitability for households that have access to affordable electricity is enormous (D9). This focus on marketization and commercialization is stated to increase energy poverty, as consumers end up paying for cost-reflective energy costs that not everyone is able to afford (C3; D9). Such reasoning to de-commodify energy does not originate solely from an ideological social justice philosophy, but is also rooted in the global effort to fight climate change:

> *"The simple premise is that the decommodification of electricity is crucial, because if people make money, whether they're private or public by selling electricity, there is an incentive to sell more of it and therefore less of an incentive to conserve energy."* (I7)

The current direction of the South African energy system is heading towards increased commodification of energy, as is the case with the REIPPPP's focus on independent, private producers. The lack of success is this program is quickly turning into a lose-lose situation with both the private sector and the public losing out to these renewable energy projects. The following is stated regarding ongoing privatization of renewable energy provision in the REIPPPP, referring to the bidding by private entities:

> *"They have to win. The winner does very well, losers don't do well. So there's this hustling around to try to win the contracts, which is completely out of sync with any planned and orderly approach to an energy transition. So we see profit levels in the renewable sector very low and therefore the investment levels are low, because the private investors don't want to finance a project that isn't going to make the money. It's as simple as that."* (I7)

This is presented as a clear argument to why the REIPPPP is currently struggling to bring the desired effects, both to the share of renewable energy in the South African energy system as well as its provisions regarding community welfare and positive social impacts (I6). Furthermore, the IPPs participating in REIPPPP take on contracts with Eskom to make use of their electricity transformation and distribution infrastructure, making a financial loss for the IPPs also result in a risk of losing profit for Eskom (I6; D3; D9).

This struggle between public and private ownership in the energy system is not unique to South Africa, and other countries in Sub-Saharan Africa are presented to face similar situations that might be used as examples or learning opportunities. In general, it is mentioned that global privatization policies, which are also enacted by large development finance institutions, have done little in terms of decarbonization of energy systems (D9). These policies are said to have mostly paralyzed state-owned enterprises, which are inhibited in carrying out even the most mundane tasks they were left with (D9). Alternatively, the idea behind public energy services is that by making energy cheap it stimulates economic growth, which yields indirect profits that the government can benefit from. Suffice it to say this does not work the same for private corporations in need of direct profitability.

In this regard, Kenya is mentioned as an example of private ownership decline, which was countered when public utilities were reinvested in again. During the 1990's, Kenya was in the process of expanding electrification among its urban and rural populace, and the World Bank put pressure on the public energy utility to unbundle and privatize, stating this was needed to catch up with increased electricity demand (I7; D9). This process revealed the conflicting priorities between public-focused and neoliberal policies, with lucrative deals for private investors turning into additional long-term risks and increased costs for the off-taker, being either the SOE or the state itself (D9). However, over time most of Kenya's power sector ownership remained with the state and electrification of rural areas increased due to non-profit policy in the grid expansion, counting on profits through increased economic activity and overall wellbeing over time (I7; D9).

A similar situation unfolded in Ghana in 2019, when re-evaluation of purchase agreements with IPPs found that long-term contracts lead to excessive electricity supply, far exceeding then-current demand, and would produce an overload of the electricity system and immense losses for the government (I7; D9). As a result, the government decided to pay off remaining contracts, which would save them over 7 billion USD in between then and 2030 (D9). These energy contracts had higher set prices as previous risks of loadshedding allowed IPPs to increase fees due to high demand for additional capacity (D9). In the end this has led to a situation that could have been avoided with better initial policies, and planning to avert loadshedding using public utilities, but instead brought about an energy crisis that Ghana is yet to recover from (I7; D9).

These examples are being used to state that the public pathway is not necessarily the perfect solution, as costs are high and financial inputs need to originate from somewhere (I7). But in the long run it is shown to prove a viable alternative to the neoliberal approach the World Bank and other – mostly state financed themselves – DFIs have posed on aid-receiving countries (I7). To counter this approach, having been set in motion for the South African energy system already, an alternative public pathway is presented with the means to circumnavigate some the resulting problems:

> "*A core feature of the public pathway approach is the comprehensive reclaiming of power systems and key technology supply chains. By comprehensive reclaiming we mean extending public ownership to include electricity generation* […]*, transmission and distribution systems, as well as customer service or retail operations."* (D9)

The public pathway approach is presented as part of the just transition proposition that was initially introduced in 2011 by an international collaborative of trade unions focusing on energy democracy (I7; Sweeney & Treat, 2018). From the collective session and interviews it became clear that some resentment toward the South African government resides among them due to the fact that similar terminology is used in the government-led JET proposals, but that there had been no consultation whatsoever with South African trade unions, regarding the JET-P, JET-IP, or JET-F, all of which have enormous impacts on parts of the South African workforce they represent (C3; I6; I7). The governmental framework around the JET is even called out to be *"a very diluted version"* (C3) of the just transition framework they envisioned. This approach by the government contradicts any idea surrounding energy democracy that they view should be central to any just transition.

7.1.3 Taking small steps

Among the interviewed and observed actors, it is often mentioned that South Africa has seen a history of big ambitions, but where there was little success in the process. An example of this is the REIPPPP which has failed to bring the expected results in terms of significant renewable energy addition to the South African energy system. Hence it has been suggested that an ambition such as bringing a just energy transition – and by extension setting up a hydrogen economy – should be approached with care. *"Inch by inch movement"* is encouraged by one actor, saying that creating change by taking small steps should be more appreciated, specifically in the case of South Africa, where trying to move by yards has historically been proven disastrous (I1). This has been shown by the initially ambitious efforts of multiple South African programs, including the REIPPPP and BBBEE, which failed to bring the proposed socioeconomic changes and stood only to benefit the few (Francis & Webster, 2019; F. Müller & Claar, 2021). It was further stated that moving slowly will also allow everyone to keep pace and make the process more inclusive, especially when setting up intermittent goals and being transparent about progress (I1). This mindset is agreed upon and further concretized by another actor:

> *"A slow transition that enables everybody to feel that they're comfortable, and we are able to ensure and keep the jobs, but also grow the spectrum of jobs that would exist within the green space, which is when we're completely using renewables."* (I5)

What this means in practice of the hydrogen economy is that developments and change will not be rushed, including phaseout of coal use and the introduction of hydrogen into the energy mix. In the hydrogen roadmap, blue and gray hydrogen are envisioned to make up essential stepping stones before reaching a green hydrogen economy (D1). Especially in the early stages, when electrolyzer costs are still high, hydrogen infrastructure can already be constructed and used for other types of hydrogen that will allow the economy to develop and get set up before full rollout of green hydrogen (D4). This will reduce some of the first mover disadvantages that are associated with hydrogen. Sasol, one of the largest gray hydrogen producers in the world, resides in South Africa and thus already has hydrogen infrastructure in place to some extent, as well as the competency to run intricate Fischer-Tropsch processes to create hydrogen-based fuel from fossil sources (I5). Nevertheless, gray hydrogen is mostly interesting for the domestic market, since the designated importing countries will or are expected to have certain requirements regarding hydrogen imports that will have an effect on production methods. Blue hydrogen can under certain conditions be accepted in the international market, but it is not accepted everywhere. For example, exports to the European Union are already stated to need certain 'green' requirements, which is not limited to hydrogen, but also includes other produced materials and equipment. This is stated to pose a risk to the South African economy:

> *"The last delegated act* [...] *had unintended consequences for South Africa because it was completely saying we going green, and by green there was talking green fields, green infrastructure, new infrastructure. And what that meant is that we would have redundant assets in South Africa. And by having redundant assets, it will spin off again into huge unemployment in the country, because the entities that are in that space would not be able to run their businesses, because they won't be able to export into the European Union space."* (I5)

Therefore, going green is proposed as a comparatively slow process in South Africa, allowing for industry and people to catch up and move collectively towards a sustainable future in which green hydrogen will end up being the dominant variant. The hydrogen giant Sasol should be allowed time to steadily convert and retrofit its assets,

while new actors join in, and current assets and fossil fuel reserves are not wasted (I5). Similarly, other aspects of the hydrogen economy will have to be given sufficient time to transition, easing the transition into everyone's minds and activities (I1; I5). In doing so, other actors agree that in five years' time the future of green hydrogen is certain and the initial novelty of the hydrogen economy has passed as it will be an established sector (I1; I3).

7.1.4 Involving communities in hydrogen developments

When hydrogen developments take place, the local environment is bound to be impacted in a variety of ways presented in these results and surrounding communities will not be exempt. Along with the hydrogen economy plans are being developed to involve communities in ongoing processes one way or another. Either through information campaigns, by consultation, or cooperation, means are being established to limit and mitigate negative impacts related to the future hydrogen economy.

Hydrogen, climate change, renewable energy, and similar topics can seem foreign and obscure to many, and related developments come with a number of uncertainties (I8). It is therefore deemed necessary to inform the public of these developments to help create understanding and support. Part of setting up the hydrogen economy is a governmental public awareness and engagement campaign, in order to establish a national discourse and facilitate dialogue between concerned parties (D1; D4). This approach is stated to require partnerships spanning the whole of society, including public, private, union, academic and community actors (D1; D4). The process culminates in a Just Transition Centre, established together with the South African trade union federation COSATU, focused on empowering workers and creating opportunities for social dialogue (D1).

> *"Yes, everybody has heard of green hydrogen and some of them even think green hydrogen is going to be the new energy that is replacing Eskom or whatever, so there's a lot of misconceptions about green hydrogen, but less literate masses do not really understand the ABCs of green hydrogen."* (I8)

Secondary to this approach, other parties have also initiated a coordinated information campaign surrounding green hydrogen developments, that specifically targets communities with limited information regarding the matter, as displayed in the quote above (I8; D8). The goal of these activities is to provide communities with the tools to engage meaningfully with project developers and it specifically targets areas where green hydrogen projects are likely to take place (I8). Furthermore, by building capacity for local civil society organizations and equipping people with the abilities to educate and inform others on these matters they aim to exponentially spread knowledge on green hydrogen (I8; D8).

> *"I am fully for the environment, but I am also fully for my people, and so we need to find a balance there."* (Saldanha Bay Mayor, C2)

While informing communities of the pros and cons of green hydrogen is one step, other plans take this approach further, stating that people need to be consulted or cooperated with for upcoming hydrogen developments in order for the transition to fully incorporate the justice elements. The Mayor of Saldanha Bay stands up for his community, declaring that they should profit from upcoming projects and should be actively involved in local developments (C1). Taking this statement further, he expresses the need for including future generations in his viewpoint and that he wants to provide them with a voice in the present, thereby creating a sustainable legacy for the current generations to leave behind (C1).

Taking the process of consultation further, additional empowerment of communities can be established through direct cooperation and ownership structures in green hydrogen projects. While local ownership in hydrogen developments is not addressed by the sources, when extended to renewable energy projects in general it is argued to be a possibility for elevation of marginalized communities. It is assessed that taking part in such arrangements on one's own accord is reserved predominantly for middle and high-income households who have funds available to actively participate in local ownership structures (D7).

Meanwhile, South Africa is working on more passive participation methods – meaning households do not have to actively involve themselves using financial or other means – as well. An example being the REIPPPP setup, in which local needs should be considered and community benefit requirements reached (C3; D7). Although certainly not a complete success in regards to this aspect – as was previously stated in Sections 5.3.2 & 6.2.1 – a non-negligible sum of 11.5 billion ZAR has been made available for community developments through this program (D7). The REIPPPP is internationally regarded as good policy practice on social inclusion and community ownership structure, although it is recognized that up until now it still has not delivered the expected results for either of these goals, as it is expensive and tough for IPPs to fulfill all requirements (D7). Additionally, monitoring of the social inclusion methods seems to be lacking, posing additional risks for injustices through the REIPPPP program even when project developers have the right intentions, and making it to what extent these community development funds ended up in the right places (F. Müller & Claar, 2021).

7.2 Setting standards

For South Africa to fully exploit their estimated hydrogen advantage, to use hydrogen as a boost for development and to become a noteworthy global actor in hydrogen developments, it is found to be of vital importance to establish the right standards and regulations surrounding the hydrogen economy. Setting standards and also removing unnecessary barriers is stated to be one of the most critical elements in creating an enabling environment for the hydrogen economy to unfold (D1; D4). Mention is made not only of hydrogen production and manufacturing standards, but also regarding the surrounding areas of mining, mobility, and environment – which includes both ecological and social regulations. In this section, standards are categorized into national and international standards. National standards cover technical regulations and sustainability standards, while international standards are mostly linked to requirements for international trade.

7.2.1 National standards

On a national level, standards for hydrogen production are discussed invariably in the analyzed government-published documentation, but mentioned only occasionally in interviews. As part of a collaborative process, representatives of the South African Bureau of Standards were present at both governmental conferences (C1; C2) and the bureau is stated to closely cooperate with other governmental departments in order to set off the hydrogen economy in a streamlined and orderly fashion (I5). The standardization and regulation discussed here refers mostly to technical aspects of the hydrogen economy, such as health and safety regulations, and standardization of processes regarding production, storage and transportation of hydrogen (D1; D4).

Acknowledgement of the procedural importance of setting standards is shown by it being one of six critical elements in the commercialization strategy (D4), as well as it being the subject with the second largest number of key action points in the roadmap (D1). In line with setting up a regulatory framework it is also recognized to be cautious of setting unnecessary barriers, going through evaluations of the standardization process, and aiming to remove them when encountered (D1; D4). The standards are needed to extend further than sole focus on hydrogen production, and will play a key role in approving locally manufactured equipment for domestic use (D1). Furthermore, close collaboration with the education and training system is also envisioned here, which will help align supply and demand of the workforce and align quality requirements (D2). A possible barrier and risk is posed by such misalignment, which will result in highly trained workers leaving the country for lack of adequate placement or an overly ambitious manufacturing industry with an employee shortage (D2).

While technical regulations account for the majority of standardization discussion, sustainability of society and environment is also considered in the procedure. A similar setup to the Mining Charter is considered for hydrogen and other renewable energy projects, which compensates community impacts and empowers the marginalized (D1). In order to establish how compensation structures are best applied to specific communities, a development toolkit is put into practice in close collaboration with the International Council for Mining and Minerals, which developed a similar toolkit for the mining sector, and provide lessons learned from their initial approach (I8). This toolkit aims to advise private companies in good practices to engage with communities and integrate community development into project planning (I8). While currently not mandatory, it is considered to also be in the companies' best interest to follow through with such procedures in order for their projects to gain sufficient local support (I8). Moreover, it is stated that for South African businesses, accounting for local social impacts is more inherent compared to elsewhere, due to the legacy of apartheid and the subsequent focus on fighting inequality (I3). It is also determined that managing and balancing the intersection between human rights and environmental rights will help ensure a sustainable transition (D4). While environmental sustainability is fundamentally more apparent in the low-carbon prospects of the green hydrogen economy, it is mostly included in global sustainability standards. Regarding local environmental sustainability, the focus is placed on tying regulations to the National Environmental Management Act, which is put in place to limit local environmental impacts (D1). However, there are disadvantages for the local environment from such national strategies as they pose a risk of leaving out non-universal – often marginalized – cases with standardized practices as specific local needs are potentially overlooked or unaccounted for (Mirzania et al., 2023; Ngarava et al., 2022).

7.2.2 International requirements

Extending to the international sphere, the standards and regulations for the hydrogen economy are mostly focused on establishing competitive advantages – or reducing disadvantages – and addressing requirements for international trade. Sustainability requirements dominate the agenda and international partnerships are considered critical in reaching or omitting them. The general aim is to have set up sufficient standardization for national production within the next two years and by 2030 adhere to quality standards fit for international trade (D1; D4). A satisfactory regulatory framework throughout the hydrogen economy will help streamline processes and increase tradability of all hydrogen-related products on the international market (D4).

In order for hydrogen to become the low-emission fossil fuel alternative that it is promised to be, production methods have to be 'green', requiring regulations to ensure that there are no unanticipated emissions throughout the value chain. Incentives for businesses to achieve low emissions are increased if commercial preference is given to green hydrogen in the global market, but in order to have the desired effect there is a need for origins to be verifiable through international standards and certifications (D8). Such a guarantee of origin is an approach the European Union is already using in the regulatory framework regarding renewable energy production by its member states and has recently passed an amendment to extend the framework to include all energy imports, including hydrogen-based products (D4). As the EU is one of South Africa's prime targets for exporting hydrogen and hydrogen-based products, the report states that there will be additional focus on traceability, tradability, transparency, and trustworthiness (D4).

However, solely being 'green' does not suffice as part of a just transition, as social impacts require additional consideration of sustainability regulations, which can lead to regulatory clashes. Efficiency and empathy rarely combine in a single approach and will most likely require compromise, leaving both objectives wanting (D8). Finding a balance between these opposing targets could be aided by international earth, social, and governance (ESG) standards, and again examples can be found in the mining sector through the Initiative for Responsible Mining Assurance, whose regulations help minimize risks and damages from malpractice in mining operations (D8). With the many, previously addressed, risks attached to green hydrogen production, having such an international regulatory environment can help sustainable reduction of emissions globally. Some even go as far as to state that, along with fossil fuel alternatives, hydrogen that does not pass international ESG standards should be boycotted globally in order to minimize negative impacts (D7). Returning to the concept of additionality, which can also be integrated in regulations, in order to ensure local efforts for energy security endure the prospects of financial opportunities from hydrogen exports (D7).

International partnerships are considered to be an important aspect in creating and adhering to international regulations, both through diplomatic and learning processes. Having transparent and open discussions regarding standards, regulations and certifications can help ensure fair competition among hydrogen exporting and importing countries (D8). An example of international partnership leading to increased tradability is given, by learning from China to remove possibly redundant barriers. In an attempt to simplify all processes surrounding hydrogen production, they have changed the chemical classification from being a hazardous element to being an energy carrier (D1). Such an example shows that being progressive and adaptable to changing circumstances can help reduce barriers and mitigate increasing challenges resulting from rigorous regulations surrounding sustainability. Along that line, the International Partnership for Hydrogen and Fuel Cells in the Economy, of which South Africa is currently filling the position of chairperson, can help South African green hydrogen and affiliated products to conform to, and influence international standards (D1). Simultaneously, international regulations posed on South Africa can significantly limit its opportunities for developing a successful green hydrogen economy and these risks are taken into account by the national government (I5). Although the need for international standards is acknowledged, it is stated to be considerate with such previously mentioned boycotts, as it might inhibit local developments even when long-term intentions are good (I5).

7.3 Conclusion

This final results chapter has displayed findings that concern aspects of procedural justice, structured to provide an answer to the third sub-question: t*o what extent does energy justice influence procedures of green hydrogen decision-making?*

With regards to overcoming the energy crisis, two visions dominate. The first vision concerns privatization of assets and depending on IPPs to overcome faults in the current system, such as incompetency of government institutions. The second vision focuses on the return of public power to bring indirect value to overcome lacking profitability. Both have their apparent advantages, but neither find a way to overcome their own respective disadvantages. While the public pathway aims to promote state ownership with a minimal influence of private actors in the energy system, there seems to be too much discontent with government practices to facilitate such state power for the time being. Simultaneously, the government proposes grand plans, with energy justice principles accounted for, but previous ambitions like the REIPPPP and BBBEE have left the majority of marginalized wanting and expectations for future change are mediocre at best. Meanwhile, South Africa is again looking to the international theater for partnerships to set up a regulatory framework surrounding green hydrogen. However, risks for injustices remain in such efforts if the local context is either not taken into account or national proposals lack the flexibility to provide localized solutions. While the JET Framework promises to work with energy justice principles in setting up a new future energy system, practice is again moving toward the overly ambitious and too far encompassing measures that will be found lacking. Whether the small steps approach will prove genuine remains to be seen, but with the currently restrained energy system, a small step could be the biggest effort South Africa can make in the ongoing energy crisis.

CHAPTER 8
DISCUSSION

Following the three results chapters, this chapter will further integrate the concepts and theory with the research findings, showcasing to what extent the findings can be validated or offer alternative perspectives and ideas. The first section evaluates the justice aspects of both the neoliberal approach to the energy transition as well as the public pathway alternative. The second section provides a look at the justice dilemma that arises from choosing between coal or climate. The third section assesses ongoing governance strategies in the South African energy system and how this affects marginalized groups and individuals. This is trailed by a reflection on the research process, theoretical implications, and recommendations for policy makers. While the results were structured with a mutually exclusive focus on the individual elements of energy justice, these sub-concepts often intersect in practice. Therefore, the elements are combined in this chapter while approaching the conclusion, where the energy justice concept is addressed holistically.

8.1 Public-private crossroads

From the findings it became apparent that the South African JET is at a crossroads, with the main path of neoliberalism and privatization ahead, the one the government has been on for the past three decades, and one which promotes economic growth and prosperity. Simultaneously, a side road is presented in the public pathway, an alternative approach with visions for the future energy system that disregards full-cost recovery and strangling international debt incurrences and embodies public ownership.

The South African government continuously advertises the fact that it aims to mobilize private sector actors, both internationally and domestically, by leveraging a relatively small amount of initial expenses to attract a tenfold private investment into the just energy transition (The Presidency, 2022). This state effort aims to provide everyone with electricity access through privatization of the energy system, and can be regarded as an attempt at universal energy justice (LaBelle, 2017). In turn, private sector actors that are involved in the green hydrogen sphere show eagerness to initiate and take over development of a hydrogen economy and when prompted address the additional focus on social developments, though through small scale pilot projects.

The government leads the way with their carefully crafted regulatory framework that incorporates positive community impacts into its renewable energy plans: the REIPPPP. However, the same opposing voices of praise and criticism that became apparent from the research findings can be traced through academic literature. On the positive side, the community benefit schemes and efforts of the government to facilitate private renewable energy projects are praised for their progressive community development guidelines and equal opportunities for potential bidders (F. Müller & Claar, 2021; Papapetrou, 2014). Unfortunately, the community benefits are often at risk of being misplaced as project developers are found to lack understanding of local dynamics and misrecognize community needs, spending community funds on projects while disregarding consultation (Lawrence, 2020a; Mirzania et al., 2023). To counter these misunderstandings, they are employing 'community engagement professionals' who facilitate dialogue and collaboration, in order to fulfill the socioeconomic requirements (Funder et al., 2021). Further research found intermediaries to be crucial in addressing energy injustices (Lacey-Barnacle & Bird, 2018). Despite this, during this search for alignment the communities often lose out when they are unwilling or able to cooperate (Funder et al., 2021; Lacey-Barnacle & Bird, 2018).

The previously introduced Minerals-Energy Complex (MEC), which resulted in a strong, fortified position of associated private actors (Ashman et al., 2011; Lawrence, 2020b), seems to persevere in the new renewable energy strategies set up by the South African government. Through privatization and trans-nationalization of the South African renewable energy sector, the government is again sidelining public development proponents, while influential corporations lobby and bargain their way around public-focused regulatory frameworks (Caprotti et al., 2020; F. Müller & Claar, 2021). It is widely acknowledged that neoliberal, market-led approaches to the energy transition have lacked meaningful results in terms of absolute emission reduction and societal benefits and the alternative, public path should be given further consideration if the goal is to bring true justice in the energy system (Ashman et al., 2011; Chavez & Steinfort, 2022).

In direct opposition to the transnational, centralized MEC continuation, the public pathway offers an alternative approach with a democratic and public-oriented energy system as the final destination. Interestingly, the approach is more ecocentric, focused on the inherent values of whole ecosystems (Pellegrini-Masini et al., 2020), combined with the anthropocentric goal to provide more sustainable livelihoods for workers and communities over the long term. As such, public pathway proponents advise on risks of ongoing energy additionality, where the share of renewables is increased without reduction of fossil fueled energy capacity. Although they acknowledge the imminent need to solve the energy crisis, they state that the focus should be on reducing energy intensity rather than adding capacity. Since coal-based pollution does not limit itself to climate change contribution, but also negatively impacts local air quality, it is a case of both universal and practical energy justice to limit and eliminate these emissions (Pellegrini-Masini et al., 2020). Recognition of the most coal-polluted area of Mpumalanga is an important step in addressing energy injustices regarding coal use and phaseout. This recognition works two ways, as the main provider of coal-powered electricity in South Africa is bound to undergo an employment transition as much as an energy transition, with current estimates expecting employment from renewable energy to fall behind the jobs lost in the coal sector (Hanto et al., 2021).

After the initial dust of the energy crisis has cleared, public prospects for the energy transition center around state ownership of electricity, which should benefit both the individual people and the government of South Africa in the long run. From the public perspective, hydrogen counts towards the low-carbon energy future as well as using any other form of renewable energy – nuclear energy exempt (Treat, 2022). A public approach regarding hydrogen would make sure that social and environmental impacts are considered rather than generating profits (Treat, 2022). Otherwise, public money is being wasted on private corporations through profit guarantees without significant contributions to societal wellbeing (Chavez & Steinfort, 2022). Furthermore, there is a need for public ownership and direction in order to actually achieve an energy transition, as market-led energy systems fail to deliver electricity to marginalized locations such as townships and scarcely populated rural areas (Chavez & Steinfort, 2022; Swilling, 2014). One problem with this approach, however, is the origin of finances for the transition, if not from leveraging the private sector or international sources? While Winkler et al. (2021) state that public finances can also have concessional and private origins, others suggest international climate grants from high-emission countries to be a source of funding as well as debt reliefs opening up additional financial avenues (F. Müller & Claar, 2021). In any case, the public pathway requires a great deal of responsibility from South African governing authorities, which have a poor track record when it comes to accountability and transparency, although these might be mitigated by setting up more decentralized governance structures including shared ownership models that help exercise mutual control (Lawrence, 2020a; Sovacool, 2021).

With the government set on their path and the lack of consultation from civil society actors on their JET planning, specifically for the JET Partnership and JET Investment Plan, it seems like the public alternative will remain sidelined for the time being. With the need for immediate investment for the energy transition to take place, the neoliberal approach can seem justified, but regarding energy justice principles it is found significantly wanting. Although the national government attempts to enforce distribution and recognition justice through its REIPPPP and additional upcoming hydrogen development, in practice it fails to do so due to the neoliberal policies and procedures, and failings of market forces to provide sufficient social development (Chavez & Steinfort, 2022; F. Müller & Claar, 2021). Consequently, a diversified approach is suggested with a range of models including private, state, community and municipal ownerships (Winkler et al., 2020). Such strategies are found in transition planning of China, Japan, and the United States, which use a combination of market-led and government-commanded approaches (Trencher et al., 2021). While in these cases close collaboration between public and private actors was observed, *"civil society actors play a negligible role"* (Trencher et al., 2021, p. 20).

Finally, with all South African parties promoting a deliberate and slow transition, this is one aspect that seems to be given nation-wide consent, although possibly with varying intent. While the notion that a considerate approach will allow for an inclusive transition accommodating everyone is given, there remains a risk of not moving enough and certain parties being benefited disproportionately from a slow transition. From a study in Germany it was found that both trade unions and the private sector are influencing government to slow down, respectively favoring stability for the mining sector, while electricity sector actors delayed consumer level photovoltaic power installation in favor of centralized power stations (Sovacool et al., 2019b).

8.2 The energy conundrum, coal or climate?

To successfully follow through with the justice-infused energy transition in South Africa, it is imperative to address ongoing energy injustices. The initial major hurdle will be resolving the ongoing energy crisis, which not only hinders societal and economic developments across South Africa, but also further exacerbates deeply entrenched inequalities. Followed by further issues regarding employment, equality, and poverty which all come into view throughout the energy transition planning and require just approaches to reach sustainable solutions.

Starting with the energy crisis, for which the state endeavors to provide everyone with electricity access as part of their universal energy justice approach (LaBelle, 2017). Building on neoliberal principles, the government provides the regulatory framework in which the private sector is expected to facilitate accessible, low-cost electricity through a competitive environment. This process neglects unequal starting points, however, and requires an in-depth look at recognition aspects of energy justice in order to create a truly equitable energy system in which the marginalized acquire a relative advantage. Disadvantages from electricity scarcity have been recognized to disproportionally affect poorer households, who are often limited in their capacity to mitigate the adverse effects (Hashemi, 2022). Consequently, these marginalized households stand to profit more from a stable electricity system, on top of the general economic benefits for small businesses and reduction of pollution from small-scale diesel generators (Hashemi, 2022). Such a universal energy solution would result in an equitable outcome that takes specific needs of individuals or groups into account (Pellegrini-Masini et al., 2020). But to reach this outcome, the energy crisis has to be solved, opening up further local and global injustices.

With the current coal-based energy system, the focus on solving the energy crisis is stated to entail that coal will remain the prominent energy carrier in South Africa for the foreseeable future, in spite of its highly pollutant emissions. The extent to which this approach can be considered just, depends on the justice perspective and scope used in the assessment, involving either of the aforementioned anthropocentric or ecocentric viewpoints (Pellegrini-Masini et al., 2020). As the focus in South Africa is mostly on mitigating economic and societal damages, as seen from plans to lengthen the lifetime of coal-fired power plants and retain sector-related jobs, it relates mostly to anthropocentric value systems. This stands in contrast to earlier research which found that the focus of the South African energy transition had been mostly prioritizing the macro-economic impacts of moving away from coal (Strambo et al., 2019). Three years later, the plans have become more context specific and actors on the local level are involved in the future coal phaseout, with more regard for regional impacts. The current plans for coal are even regarded a 'phase-down' as any notions to abandon coal are disregarded by South African actors (Mirzania et al., 2023). While providing increased stability for now, the fuel source is foreseen to economically destabilize the country in the long run, due to a combination of future unavailability of fossil energy sources, increased international pressures, and the importance to the national and regional economies (Hanto et al., 2021; Mirzania et al., 2023). These statements are in line with the impending disasters resulting from climate change, for which South Africa is found to be at a comparatively high risk in terms of drought, flooding, and all their repercussions (Lawrence, 2020b). Neglecting such issues serves as misrecognition of its own populace, and although climate change is acknowledged, solving the more immediate local issues are stated to have priority over long-term global issues and innovative grand ideas, like hydrogen.

That is not to say that hydrogen developments are neglected. Further highlighting the need for alternatives to bring down both global and localized energy injustices, hydrogen is introduced as a complementary energy source to further diversify the energy mix. The potential for hydrogen to bring a combination of emission reductions and increased prosperity is generally agreed upon, although not without certain caveats. Initially, views of green hydrogen's potential to decarbonize remained critical, while international strategies were omitted (Griffiths et al., 2021). But more countries have since published national strategies and pledged international cooperation, warranting the future possibilities of green hydrogen, including in low- and middle income countries (L. A. Müller et al., 2023; Sharma et al., 2023). For South Africa it is stated that initial focus will include all feasible types of hydrogen, including gray, blue and green. Green hydrogen production at an industrial scale will take some time to become feasible, making short-term expansion of the hydrogen economy in the form of gray hydrogen more acceptable, but caution should be kept for such approaches not to inhibit green hydrogen developments in the long run, considering the need for emission reduction (Griffiths et al., 2021).

8.3 Transition governance

The ways energy justice is touched upon throughout governance approaches for the energy transition are manifold. Energy governance and policy-making are central to this research as they provide guidelines to which the transition will eventually unfold. While the South African government has incorporated the energy justice framework into its transition, how this will show itself in hydrogen developments is not directly made apparent. Meanwhile, specific topics, such as employment, education, community involvement, and standardization are found to contain risks of injustices, requiring further consideration. Energy governance approaches that can diminish these injustices are assessed and compared to the South African approach.

Specific groups in South Africa will undergo disproportionate hardships originating from energy sector proceedings. First and mostly addressed, workers in industries that stand to lose their jobs due to the energy transition, most notably the coal mining and power sector. While the discrepancies between phased-out and upcoming sectors can be reduced by offering community supported education programs to workers falling through the cracks, this might not suffice to cover all losses (Hanto et al., 2021). Furthermore, pressing on diversification opportunities, such as using the significant amount of unexploited arable land within the region of Mpumalanga to build a strong agricultural sector also offers some resolution (Hanto et al., 2021). Additionally, setting up facilities to spread knowledge of renewable energies can help acclimatize to the transition and increase awareness regarding social and environmental implications (Mirzania et al., 2023; Ngarava et al., 2022). Looking for alternatives instead of transferring employment opportunities across the country is doing justice to local populace, however, the possible need for geographic relocation of workplaces should not be overlooked as it can increase overall employment opportunities (Mirzania et al., 2023). Under these circumstances, specific attention is given to women and youth, who are regarded more vulnerable, such as. Recognizing disadvantages is a first step toward justice, but procedures for reducing disadvantages can start to bring actual change. These procedures are discussed in the hydrogen road map, where lacking awareness and access to economic opportunities are presented as the most prominent barriers (Department of Science and Innovation, 2021).

Standardized practices are offered from a national standpoint to help smoothen the transition for the more vulnerable, but for a significant impact on these injustices, it should be considered to provide concrete solutions at the community level (Mirzania et al., 2023; Ngarava et al., 2022). Standardization is also said to bring additional risks, with an example – again – provided by the REIPPPP community benefit scheme, with its nationally set procedures (Mirzania et al., 2023). Addressing local problems specifically requires localized governance, according to multiscalar governance theory from Caprotti et al. (2020), currently being practiced to some extent in the South Africa energy system, where a division of power among national, provincial and local government exists with separated responsibilities for each level (Caprotti et al., 2020; Field, 2021). The multiscalar governance approach, with more region-specific conditions and freedom of interpretation could reduce risks for injustices (Mirzania et al., 2023). Transnational governance also plays a role in the South African energy system, with international actors attempting to influence the South African energy system, exemplified in concessional financing. For green hydrogen to become viable, countries with little means may depend on international cooperation (Sharma et al., 2023). From a justice perspective, however, it is not in South Africa's best interests to unquestioningly follow international orders as local dynamics require ardent consideration.

A final mention of the pathway of governance to bring about a just transition is regarded as a compromise between the earlier discussed approaches. As civil society actors highlighted the fact that energy systems have never been successfully set up without significant public investments, a similar case might be made of the renewable energy transition when surveying the two global economic powerhouses China and the United States. Both countries are found to have put into practice the governance approach of a developmental state, where the government takes on a leading role for the sake of development, in order to engage in their specific energy transitions (Kuzemko et al., 2019; Tshishonga & De Vries, 2011). Whether this approach is also viable for South Africa remains to be seen, as the country since long retained more prominent international dependence and meddling in its activities, limiting the possibilities for the developmental state approach (Swilling et al., 2016; Tshishonga & De Vries, 2011). With additional support from international financial institutions – who are switching to an integrated private and public focused course, allowing for increased public ownership (Chavez & Steinfort, 2022) – sufficient incentive seems to be given for South Africa to chart a more public course.

8.4 Research relevance

The relevance of this research is shown in this section through a reflection of the research process, including recognition of research limitations. This is followed by an overview of theoretical implications and policy recommendations that result from its findings.

8.4.1 Research limitations

The first limitation of this research resides in the speculative nature surrounding South African renewable energy and hydrogen developments. As stated before, in literature and by interviewees, South Africa has a track record of presenting strong and noble ambitions, while the following policies fail to deliver expected results in practice. The REIPPPP is an example of such an occurrence, at least up until the point of writing this report. The same goes for private sector plans, for which ambitions might involve inclusion of negative social impact mitigation and positive impact encouragement, but whether such ambitions survive economic adversities remains to be seen. As was also suggested by Hanto et al. (2022) on which this research is based, the genuineness of interviewees should be questioned when it concerns these matters of publicity and goodwill.

As such, due to the premature state of green hydrogen developments most data is based on ideas and speculation, which' truthfulness and long-term dependability can never be fully assured. Therefore, it is challenging to give definitive answers regarding the extent to which hydrogen developments contribute to a just energy transition. Nevertheless, the importance of keeping track of visions and ideas in these early stages of developments remains as it matters to look into justice of proposed plans while still able to influence such developments. But in order to be able to make final statements more relevant, this research has expanded focus to include additional perspectives on renewable energy in general and coal phaseout, both of which share a direct connection to hydrogen developments in the South African energy transition.

Furthermore, the findings of this research lack direct inclusion of community perspectives in the research findings. Although this was not part of the research framework, which aims to map prospects from decision makers and organized opposition, it could have complemented the results of this research. Although no South African community has experienced direct involvement in hydrogen developments as of yet, either communities that are familiar with either REIPPPP developments or foreign communities who are familiar with hydrogen, could have been contacted. As a consequence, this would have increased the breadth of this research to proportions exceeding this thesis' scope and will therefore be regarded as an avenue for future research.

8.4.2 Future research

While the global hydrogen economy is developed further, research regarding this topic will retain relevance. The theoretical implications of this research are presented in avenues for future research, which focus on both covering limitations of this study, as well as possibilities to inquire into regarding the future of green hydrogen.

Covering the final limitation of this study, additional research that incorporates the community perspective would directly complement any findings that this research has produced. This research could follow an approach similar to Lacey-Barnacle and Bird (2018), who conducted a qualitative assessment of community involvement in energy projects in the United Kingdom, based on a theoretical framework similar to this study.

The concept of energy justice is often promoted for its uses in informing policy makers at the different governance levels (McCauley & Heffron, 2018; Sovacool & Dworkin, 2015). From the national perspective it is imperative to incentivize monitoring strategies into regulation frameworks and specify the need for involving civil society organizations and local actors in setting up hydrogen developments. On a local level, inquiries can be made to the specific needs of affected communities, while continuing to provide feedback to higher governance levels. Because the intermediate provincial governance level is currently not directly involved in such operations – as was made clear from one of the interviews (I4) – they should act out the facilitating role they have stated to fulfill concerning hydrogen and other renewable energy developments, and further seek opportunities for equitable economic prosperity.

Furthermore, academic criticisms of the REIPPPP involved instances where monitoring of community developments schemes lacked, resulting in insufficient or incorrect implementation of proposed measures (Mirzania et al., 2023; F. Müller & Claar, 2021). Thus, it is to be expected that green hydrogen developments and any accompanying community-focused regulations follow a similar path, highlighting the importance of critical investigations of results of any community development program set up alongside hydrogen projects. Academics and civil society organizations should continue to provide invaluable examinations and feedback to the different governance levels as they might be found trailing behind.

Finally, this research partly included international meddling in South African affairs – discussing governance structures and the global green hydrogen economy. Additionally, a research scope with international hydrogen dynamics at the center can expand the scope of hydrogen-related injustices, specifically examining the potential effects of cooperation and competition on trade deals, financing, and knowledge sharing among others. Hydrogen developments taking place at a global scale is already happening and power imbalances dictate with almost certainty that vulnerable countries will receive the short end of any deals taking place. Additional research is required, at least for the specifics of hydrogen, to further prevent recurrences of colonial practice.

CHAPTER 9
CONCLUSION

Based on the South African government incorporating the concept of energy justice in their just energy transition framework, and the intention to leverage a wide variety of national and international actors to set up a hydrogen economy, this study evaluated the visions of involved actors, guided by the main research question:

How can energy justice be realized during the initial planning of green hydrogen developments in South Africa from an actor's perspective?

The current limited application, but simultaneous high potential of green hydrogen to have a significant impact in global energy transitions have emphasized the need to observe justice principles as developments are accelerated. The South African case was studied by employing a combination of qualitative research methods, which generated findings from the government, private, and public perspective. Analysis of the acquired data, based on distribution, recognition, and procedural justice principles, and accompanied by theory on hydrogen commodification, equality, and energy governance, culminates in this final concluding overview.

Moving on from a carbon intensive economy is widely regarded as a positive development, especially in the context of climate change aversion and mitigation. Taking local dynamics into account, however, makes the assessment more complex as the agendas influencing visions and planning for the green hydrogen economy are multiple and at times strongly conflicted. In the current coal-focused, low-capacity energy system, the need for continuation of fossil fuels is made clear from both an economic and social viewpoint, promoting stability of the electricity system to support businesses in their operations and the population in day-to-day life. From a justice perspective, this approach accommodates local populations, but yields injustice in the intergenerational and global spheres. At the global scale however, it is argued that more significant injustices are being conducted by even larger and more unwilling polluters. From an alternative attempt to increase local energy efficiency, both capacity can be increased comparatively, and overall carbon emissions reduced, providing a more just system on all fronts, but making energy more scarce, requiring increased distribution injustice awareness.

This dynamic shows the difficulties in combating the triple challenge of inequality, poverty, and unemployment, while also including climate change mitigation into a single just transition. While one aspect of justice is fulfilled, more come up, leading to question whether everyone can realistically be accommodated in such transitions. When this situation presents itself, recognition justice principles advocate that disadvantaged and vulnerable groups and individuals are given priority, for which suitable plans are put in place by the South African government. Building on principles that the most capable actors bear the greatest burdens, focus is given to the marginalized by putting in place a regulatory framework focused on social impacts. Although with specific needs for different localities, a risk of generalizing issues and solutions is posed when this framework is implemented at the national governance level. A more localized effort is required with sufficient channels of communication up through the highest levels of governance for reflection and re-implementation of measures. Thus, it is suggested that combined implementation of the three elements of justice, throughout the various levels of society will provide the best chances for a just energy transition, that will leave no-one behind and consequently put no one too far in front.

Both in this research and in the general approach to the hydrogen economy, the use of hydrogen is assumed to be an inevitable step in the just transition, leading to little wiggle room for concerned parties to negotiate their perspectives. Even currently unconcerned parties, who are unaware and have not been involved in planning for the hydrogen economy, should be given opportunities for assessment and criticism. The idea of politicizing transition discourse is presented by Blythe et al. (2018) as a means to achieve this and is in the process of being extended to South African hydrogen developments. This assuring process serves to make the general public more aware and be given tools to take action toward ongoing and potential injustices in the upcoming transition.

Keeping in mind the need for a global effort to combat climate change and the pretentious attitude of Western countries and institutions towards emerging economies, one thing becomes abundantly clear: the broadest shoulders should indeed bear the highest load. It is time for the big emitters, with the highest responsibility for global warming, to face and reproach themselves on the environmental, social, and economic damages they have done. From an international justice perspective, all the way to the local level, it has become clear that a global just energy transition can only take place in a combined effort, with affirmative action policies. With its previously ambitious legislation in the BBBEE and REIPPPP, South Africa has at least shown the political will for equitable social change, and thereby already provides a great justice example for the world to follow.

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APPENDIX I – PRIMARY DATA SOURCES

Appendix II includes a list of all consulted primary data sources as discussed in the results section.

Code	Conference	Date
C1	South Africa Green Hydrogen Summit	28-29 November 2022
C2	Science Diplomacy for Economic Development through Hydrogen	5-6 December 2022
C3	Taking Back the Just Transition	30 November 2022

Table I.1 - List of attended conferences

Code	Interview	Date
I1	South African Hydrogen Technology Company	16 December 2022
I2	International Mining Company	18 January 2023
I3	South African Financial Services Company	5 January 2023
I4	South African Provincial Government	17 February 2023
I5	South African National Government	13 March 2023
I6	South African Societal Think Tank	14 February 2023
I7	International Union Advisor	14 February 2023
I8	International Development Organization (multiple participants)	18 January 2023

Table I.2 - List of interview participants, including partial anonymity

Code	Document	Author
D1	South African Hydrogen Society Road Map (2021)	DSI
D2	South African Green Hydrogen TVET Ecosystem Just Transition Framework (2022)	DSI & DHET*
D3	A Just Transition Framework for South Africa (2022)	PCC
D4	Green Hydrogen Commercialisation Strategy (2022)	DTIC**
D5	Western Cape GH Position Paper (2022)	Western Cape
D6	South Africa's Just Energy Transition Investment Plan (2022)	RSA Presidency
D7	Technical potential & challenges of renewable hydrogen (2022a)	HBS
D8	Green Hydrogen: Key success criteria for sustainable trade & production (2022b)	HBS
D9	Towards a Public Pathway Approach to a JET for the Global South (2022)	TUED***

Table I.3 - List of analyzed documents.

* *DHET: Department of Higher Education and Training*

** *DTIC: Department of Trade, Industry and Competition*

*** *TUED: Trade Unions for International Development*

APPENDIX II – INTERVIEW GUIDE

Appendix I contains an overview of the interview guide, including conversation topics and question suggestions. The interview guide is based on the interview guide from Hanto et al. (2022) and was reconsidered depending on the background of each participants.

Interviewee: *[Name, if applicable]*
Organization: *[Organization, if applicable]*

Introduction and informed consent

I am Derek Vonk, I am a master student in Sustainable Development and International Cooperation at Utrecht University in the Netherlands.

I am collaborating with Impact Hydrogen for my master's thesis on green hydrogen and energy justice. Green hydrogen is part of the Just Energy transition in South Africa, and I am researching is how actors involved in this development define and apply energy justice in relation to the introduction of this new energy commodity.

I wished to set this meeting so I can ask you about your professional perspective on this topic. The goal is to find narratives of energy justice from different perspectives and see how they support or differ from one another.

Participating in this interview is entirely voluntary, refusing to participate does not have any negative impact, and you can withdraw your consent at any point without any consequences. Also after the interview has taken place. You can contact me for this using the email I provided, also if you have any follow-up questions.

Do you consent to this?

The time needed for this interview is expected to be around 1 hour.

Would it be alright with you if this conversation is recorded for future reference?

Any collected data, recording and notes, will be stored safely on secure Utrecht University servers. The data will be used only for the purpose of the research topics. Furthermore, this data can stay anonymous if you prefer.

Would you mind if we use your name or the name of your organization in reference to this interview?

1. Participants personal standing

1.1. Could you please shortly introduce yourself and elaborate briefly on the topics you work on and the main objectives of your work related to the South African energy sector?

1.2. Does climate change play a role in the professional decisions you make on a day-to-day basis?

1.3. Does equality play a role in the professional decisions you make on a day-to-day basis?

2. Energy justice

2.1. Could you briefly elaborate on the just transition discourse in South Africa and its importance for the energy sector development from your perspective?

2.2. From your perspective, what are the most important goals for the development of the South African energy sector?
- What are the challenges?

2.3. From your perspective, what are relevant existing policies or government decisions to implement these energy goals?

2.4. How do you imagine the future of the energy system in South Africa?
- What policies or other enablers could be implemented to achieve this?

2.5. How do you assess the plans proposed in the JET IP?
- Are they feasible?

2.6. Do you think anyone or anything is unequally represented in the just transition debate?
- Anyone/anything that requires additional attention?

2.7. How would you define energy justice?
- And how would you aspire to achieve it?

3. Hydrogen economy

3.1. How are you involved in articulating plans for a green hydrogen economy?
- Where did the push for hydrogen originate from?

3.2. Could you elaborate briefly on societal and economic roles hydrogen could play in South Africa
- And the challenges it could face?

3.3. What opportunities do you see in initiating a South African hydrogen economy?
- For any groups in particular?
- How to fairly distribute?

3.4. What risks do you see in initiating a South African hydrogen economy?
- For any groups or communities in particular?
- How to fairly distribute?

3.5. In terms of hydrogen infrastructure itself, what potential do you see in co-ownership structures?
- What is needed to set this up?

3.6. How do you evaluate additional competition for resource use in a green hydrogen economy?
- Water rights?
- Land rights?
- Finance?
- (Human) capital?

4. Summing up

4.1. Is there anything else you would like to share on this topic?

4.2. Can you recommend further contacts I could talk to?