

Él Que se Apura, Pierde Tiempo He Who Rushes, Wastes Time*

Charting the Course for a Just Energy Transition in the midst of a Green Hydrogen “Rush” in Magallanes, Chile: The Critical Role of Local Voices

Word count: 9.884

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() Popular saying in Patagonia, where its people acknowledge the need to live by nature's pace*

Journal Article

A dissertation submitted to Ghent University in partial fulfilment of the requirements for the degree of
Master of Science in Conflict and Development Studies

Academic year: 2023-2024

ACKNOWLEDGEMENTS

I am grateful to the Faculty of Social Sciences at Ghent University and my promotor, prof. dr. Bert Suykens (UGent) and prof. Bedrich Magas (UMAG), and my co-promotor Mary Ann Manahan, for their support. Special thanks to the community members in Magallanes, Chile, for their essential contributions to this study. And even more thanks and eternal love to my parents for their support, inspiration, and for sharing their unique perspective on the world with me. Without them, I would never, in any life, be able to approach, or even work on this topic.

Informed consent statement: Informed consent was obtained from all participants involved in the study.

Data availability statement: The used data is confidential.

ABSTRACT

Amidst global climate goals and the push for renewable energy, Magallanes is poised to become a leader in green hydrogen production. This thesis examines the socio-environmental justice implications of the rapid development of the green hydrogen industry (GHI) in Magallanes, Chile. It focuses on the critical role of local organized civil society (OCS) in addressing, perceiving, and advocating socio-environmental justice in this energy transition. Employing a qualitative research approach, the study utilizes semi-structured interviews, ethnographic observations, and document analysis to gather in-depth insights from key stakeholders including activists and community representatives.

The findings reveal a complex landscape where the potential benefits of the GHI are juxtaposed with significant socio-environmental risks. The local OCS emerges as a pivotal actor, challenging the industry's narrative and advocating for a more equitable and inclusive approach to development. Key concerns highlighted include the transparency of the industry, the adequacy of public consultations, and the long-term ecological impacts on the region's unique environment. Other concerns included the time, scale, and dimensions of the GHI.

This research contributes to the broader discourse on sustainable energy transitions by emphasizing the need for slow, inclusive, and transparent processes that respect local voices and knowledge. The study underscores the importance of integrating socio-environmental justice into the planning and implementation of green hydrogen projects to ensure that the benefits of renewable energy are shared equitably and sustainably.

1. INTRODUCTION

As the world sets its sights on the ambitious climate goals for 2050, including achieving net-zero emissions, the nexus between technological innovation, energy production, and environmental sustainability has never been more crucial (Zografos & Robbins, 2020; Raihan et al., 2022). This drive towards a sustainable future relies heavily on increasing the efficiency and capacity of renewable energy sources, fundamentally transforming how societies generate and consume electricity (Ellabban et al., 2014; Perlaviciute et al., 2021). Among these innovations, green hydrogen (GH) emerges as a pivotal contender, recognized for its potential to catalyze a low-carbon future via renewable energy-powered electrolysis that converts 'green electrons' into versatile energy carriers (Tiwari, 2022; Gevaert et al., 2022; Sand et al., 2023).

From a Latin American political ecology lens (Leff, 2012), however, the global shift towards renewables necessitates more – and often disruptive – interventions in the landscape, underscoring a deeper reliance on the natural environment. Recent scholarship, including McGowan and Antadze (2023), emphasizes that sustainability transitions are not uniformly positive and can lead to green extractivism, especially for vulnerable groups in the Global South (Gudynas, 2011; Sovacool, 2021). The environmental and socio-economic implications of large-scale GH projects raise significant concerns, particularly in terms of land and freshwater resource utilization, which could exacerbate existing inequalities and tensions (Cremonese et al., 2023). This 'dark side' of sustainability transitions can entail racism and post-colonialism issues, prompting a deeper consideration of the broader implications these transitions hold for equity and justice in environmental policies (McGowan & Antadze, 2023). Moreover, the expansion of GH infrastructure risks reinforcing patterns of green colonialism, wherein the environmental and economic burdens of the energy transition are disproportionately borne by marginalized communities in natural resource-rich but economically disadvantaged regions (Dorn, 2022). Although research has touched upon the link between sustainability transitions, (green) extractivism, and impact on communities in, a.o. Latin America, few have yet analysed the rapidly developing GHI as a specific type of (potential) extractivism. The framework for this research integrates principles of political ecology, energy justice, and community engagement.

In this context we address the pivotal role of local organised civil society (OCS), as they advocate socio-environmental justice amidst the burgeoning GHI, facilitate the timely dissemination of information, articulate community grievances and concerns, and challenge the industry's narrative (Scheidel et al., 2020; Samnuzulsari et al., 2021; Kalt, 2024). In doing so, according to Scheidel et al. (2020), they influence broader socio-political dynamics, pushing for an equitable and inclusive approach to development. Focusing on the role of OCS is apt within the chosen framework (integration of Latin American political ecology, energy justice, and community engagement), since it emphasizes the interplay of power dynamics, knowledge systems, and social justice in environmental issues. In this sense, local OCS serve as a crucial conduit through which local voices can challenge or align with the overarching industrial and political agendas, thereby influencing policy and corporate practices at multiple levels (Rainey et al., 2017; Samnuzulsari et al., 2021). In this study we analyse their role in questioning the current model of the GHI development in Magallanes and Tierra del Fuego (Chile) highlighting shortcomings in terms of sustainability and justice, and ultimately challenging the external dimension in the narrative of EU policies such as the Green Deal. As the industry is rapidly evolving, it is now timely to analyse the role of OCS and dynamics of local populations that will most likely be impacted by these developments in the global transition towards net-zero emissions.

Based on Latin American political ecology, the theoretical framework will first be presented to discuss the concepts of GH production and local OCS, and its dynamics within socio-environmental struggles. Then, methods and case study selection are outlined. Finally, the results and findings are presented and discussed, revealing a complex landscape where the potential benefits of GHI are juxtaposed with significant counter-implications of the sustainability transition.

2. LITERATURE REVIEW

2.1 Critique of Traditional Development Models in Latin America

Traditional approaches in economic development emphasized capital and financial markets, macro-indicators, and the large-scale export of primary products, especially in economies based on raw materials and their export such as in many Latin American countries. In Latin America, criticisms on this export-driven model underscore how the traditional paradigm on development often overlooks the deeper, structural causes of socio-environmental conflicts and fail to comprehensively integrate natural and social dimensions (Svampa, 2012). A review of sustainable development studies by Scoones (2016) reflects on the importance of understanding the broader political nature of sustainability and development transformations, suggesting that future research should focus on detailed, context-specific analyses by emphasizing the politics of alliance building.

To address this need for a context-specific focus (Flyvbjerg, 2001; Scoones, 2016), the present thesis adopts a Latin American political ecology perspective. The field of political ecology provides a critical lens for examining the complex relationships between society and nature, influenced by power dynamics (Karlsson, 2015). Rooted in regional scholarship, a Latin American political ecology perspective is driven by the need for decolonization of knowledge and reappropriation of nature by local peoples (Leff, 2012; Porto-Gonçalves & Leff, 2015). Additionally, it engages with Marxist theories to explore the structural dynamics of socio-environmental conflicts, aiming to provide a more holistic and integrative analysis. This framework serves as the theoretical foundation that connects the discussions on energy justice, and the role of OCS in challenging exploitative practices and advocating sustainable development in Latin America.

2.2 Redefining Development: Political Ecology and Neo-Extractivism in Latin America

The political ecology perspective provides a lens to assess (neo)extractivism in Latin America by highlighting how resource-based development models can perpetuate socio-environmental injustices under the guise of national interest. The literature on extractivism criticizes the continuous exploitation of natural resources in disregard of social and environmental consequences (Gudynas, 2011, 2021). More recently, the term neo-extractivism was coined to refer to a model of raw materials-based economic development in Latin America, promising the redistribution of surplus revenue to support social development and national sovereignty. Neo-extractivism, according to Burchardt and Dietz (2014), is the result when “the practice of extractivism is associated with an imagined national interest, and, consequently, becomes a politically legitimized new development project”. This way, the debate on neo-extractivism in Latin America suggests that development theories must consider the complexities of resource-based development, specifically linking it with political ecology (Burchardt & Dietz, 2014).

In the context of sustainability transitions, the concept of green extractivism has emerged to specify a form of (neo)extractivism by the appropriation and exploitation of natural resources under the guise of environmental sustainability (Dunlap et al., 2024). Drawing connections between green extractivism and concepts such as ecological distribution conflicts, green colonialism and green grabbing, Dunlap et al. (2024) emphasize the adverse political, economic, and ontological dimensions of extractivism. Recent scholarship stresses the need for comprehensive research on green extractivism to bring underlying ecological and social harms to the surface. In the case of the GHI, this debate is particularly relevant to accentuate how the extraction of water and the use of land for wind farms could disrupt local ecosystems and populations, exacerbating existing inequalities. However, it is important to acknowledge that GHI initiatives could potentially be implemented in ways that are more aligned with principles of sustainability and social equity, without the exploitative practices associated with traditional extractivism.

2.3 Green Extractivism: Unpacking the Socioecological Fix in Sustainable Development

Building on the political ecology framework, the concept of a socioecological fix is integral to understanding the intersection of environmental and economic systems within capitalist development models. Building upon David Harvey's (as cited in Ekers & Prudham, 2015) theories of the spatial fix, Ekers and Prudham (2015, 2017) define a socioecological fix as the strategies employed by capitalist economies to address environmental crises by integrating or reappropriating socioecological elements into market logic without addressing the underlying power imbalances and exploitative practices. A socioecological fix thus involves redirecting capital flows towards investments in fixed capital like nature, such as technological innovations and renewable energy infrastructure (Ekers & Prudham, 2017). In Latin America, these fixes are increasingly critiqued by local communities and academia as extensions of extractivism, interlinked with the potential to perpetuate the exploitation of natural resources and social injustices despite being marketed as sustainable solutions. Political ecology research on green extractivism highlights how projects constituting socioecological fixes may involve significant impacts, such as excessive/unsustainable levels of water extraction and conflicts in land use/tenure, disproportionately affecting local communities and perpetuating (post)colonial practices (Jerez et al., 2021; Sovacool, 2021; Andreucci et al., 2023). Moreover, Rudolph (2023) argues that the current modes of expanding renewable energy technologies in the Global North provide limited socioecological fixes to the environmental crisis while largely reproducing the political economic status-quo of fossil capitalism.

In sum, a Latin American political ecology perspective on export-driven economic models adds a critical layer by examining socioecological fixes in addressing climate change. This research builds on literature assessing the sustainability and democratic legitimacy of neo-extractivist development models by assessing the political and social processes at play.

2.4 Energy Justice: Integrating Social Equity in the Global Hydrogen Economy

In the face of a rapidly developing GHI, the presented literature provides a critical understanding of the link between environmental sustainability and social justice. Within this intersection, the concept of energy justice has emerged in the social science research agenda, exposing the implications for the ongoing transition to lower carbon-energy sources. As defined by Jenkins et al. (2016), energy justice "...evaluates (a) where injustices emerge, (b) which affected sections of society are ignored, and (c) which processes exist for their remediation in order to (i) reveal, and (ii) reduce such injustices". Moreover, Carley and Konisky (2020) review evidence showing that the benefits and burdens of the energy transition are not evenly distributed, identifying the need to integrate justice considerations into research related to energy and climate change mitigation for an inclusive transition. The conceptual review of energy justice by Jenkins et al. (2016) distinguishes three core tenets in striving for social justice: distributional justice, recognition justice, and procedural justice. These three core tenets resonate strongly with the focus of this research. Firstly, distributional justice focuses on the fair distribution of energy benefits and burdens, ensuring that no group is disproportionately affected by negative impacts or excluded from benefits (Jenkins et al., 2016). Recognition justice emphasizes the importance of acknowledging and fairly representing all social groups, particularly those often marginalized or ignored in energy decision-making processes (Jenkins et al., 2016). Lastly, procedural justice advocates inclusive and transparent decision-making, ensuring that all stakeholders, especially those (potentially) affected, have a meaningful role in the processes that govern energy policy and implementation (Jenkins et al., 2016). From a political ecology standpoint, energy justice is not just about equitable distribution but also about challenging the underlying power structures that perpetuate inequality in the global energy transition. In other words, this perspective emphasizes that energy justice must go beyond addressing surface-level inequities to fundamentally question and transform the socio-political dynamics that drive these inequalities.

Müller et al. (2022) expand on the energy justice framework by introducing three additional dimensions – restorative, relational, and epistemic justice – specifically within the context of the global GH economy. Research on energy justice is thus primarily directed to local communities, making this concept

highly relevant within this research (Osička et al., 2023). Dillman and Heinonen (2022) present a comprehensive examination of the hydrogen economy through the lens of energy justice, underscoring the importance of being proactive in addressing potential social injustices as the hydrogen economy develops. Since energy justice addresses inequalities in the production, consumption, and governance of energy, it calls for a balance that reflects the needs and rights of all stakeholders. This is increasingly being underlined by scholarship. For example, McCauley and Heffron (2018) address the relevance of unifying climate, energy, and environmental justice scholars to create an integrated approach to the challenges of decarbonization. A more recent study by Tafon et al. (2023) underscores the importance of adopting an integrated approach to justice that goes beyond human-centred frameworks. Their findings suggest that, for energy transitions to be truly just and sustainable, they must consider and address the interconnected wellbeing of both humans and nonhuman stakeholders, ensuring that ecological integrity and social equity are not sacrificed in the pursuit of decarbonization. Thus, to ensure the sustainability of GH within the energy transition, energy justice offers an essential focus on the inclusion of local populations and environments into the global energy markets.

However, research by Dunlap and Tornel (2023) highlight the crucial need to rethink the current frameworks of energy justice within the broader context of the global energy transition. They argue that while energy justice aims to address inequalities and foster inclusivity, it often remains tethered to the very system of capitalism, statism and extractivism that perpetuate these injustices. This critique underscores a significant contradiction in the field: the risk of energy justice being co-opted by the liberal, capitalist framework it seeks to critique, thereby reinforcing the status quo rather than dismantling it (Tornel, 2023). By questioning the foundations of energy justice itself, Dunlap and Tornel (2023) push for a paradigm shift that integrates decolonial, anarchist and post-development perspectives into the heart of energy transition discussions. This presents a profound challenge to the current energy justice discourse, highlighting the need to critically evaluate whether existing frameworks truly address the root causes of energy-related injustices or merely perpetuate a cycle of reform that leaves the underlying oppressive structures intact. Therefore, in the context of a developing GHI, it is essential to adopt a pluralistic and insurgent approach to energy justice.

2.5 Challenging the Status Quo: The Role of Civil Society in Socio-Environmental Advocacy

As highlighted by McGowan and Antadze (2023), it is crucial to assess industries framed as sustainable solutions, such as the GHI, for their potential to perpetuate colonialism and resource exploitation. According to Burchardt and Dietz (2014), future research should focus on sub-national levels, addressing who benefits from and who bears the burdens of extractive activities. For example, research conducted by Villalba-Eguiluz and Etxano (2017) highlights the tensions and contradictions between neo-extractivism in Ecuador and the local population's ideals on *Buen Vivir*¹, which prioritizes ecological sustainability, economic diversification, and social equity. Consequently, this shows how in Latin America specifically, the struggles for justice against extractivism are often led by local communities in defence of their livelihood territories against external pressures (López & Vértiz, 2015). Sovacool (2021) reviews how communities actively need to protect their land, water, and cultural heritage through legal and direct actions, highlighting the need for a human-centred approach on energy development (Sovacool, 2021). This resistance is closely linked to social justice, human rights, and cultural identity (Leff, 2012). Incorporating a Gramscian perspective on conflicts, Kalt (2024) highlights how local struggle against extractivism in the context of sustainability transitions underscore the ongoing impacts of (post)colonialism and the importance of decolonizing knowledge and power structures by the local population. This aligns with Temper and Del Bene's (2016) argument that transforming knowledge creation for environmental justice requires collaborative, co-designed efforts between academics and social movements to produce knowledge that is both academically rigorous and practically relevant to the involved

¹ "Buen Vivir," which translates to "good living," is an Andean idea that prioritizes balance with nature, community welfare, and a holistic lifestyle, offering an alternative to Western development models that emphasize economic growth (Villalba, 2013).

populations. Their work emphasizes the need to address epistemic injustices by recognizing and incorporating the knowledge systems of marginalized communities, thereby ensuring that local civil society plays a significant role in advocating justice and sustainability. In addition, Scoones (2016) explains how actions organised by local populations can lead to radical transformations towards sustainability. This makes a local citizen-led movement an ideal focus of this research, as it can contribute to closing the gaps in current literature on green extractivism by focusing on the roles of marginalized groups and their potential for transformative change.

In this research, we draw on the term Organised Civil Society (OCS) by applying Gramsci's conception of civil society as a "subaltern", an entity that is excluded, yet exploited by hegemonic powers (Green, 2002). OCS refers to a civil society that organised itself, forming collective action and social organization by non-state actors aimed at influencing public policy, safeguarding community interests, and promoting social and environmental justice. The choice of the term OCS is deliberate, as it captures the structured and coordinated nature of collective action that goes beyond spontaneous or informal resistance or contestation. OCS reflects the ability of communities to mobilize, form alliances, and engage in strategic advocacy to challenge powerful interests, particularly in contexts where extractive industries are framed as sustainable solutions.

In conclusion, the literature review underscores the critical need to reconceptualize energy justice frameworks to ensure they address the root causes of socio-environmental injustice, rather than perpetuating existing power structures. A Latin American political ecology perspective is instrumental to address the critical need for a nuanced analysis of socioecological conflicts and emphasize the vital role of local civil society in advocating justice and sustainability amidst extractivist practices.

3. RESEARCH DESIGN

This study aims to elucidate the potential socio-environmental impacts of the emerging model of GH production in the region of Magallanes (Chile), by including the views and responses of the local community. We focus on the OCS and its role in challenging this development model. A single-case-study research design is employed. This involves an in-depth examination of one case to (ideally) gain a full understanding of broader phenomena. Specifically, we focus on a 'typical case-unit', as defined by Gerring (2006). This 'typical case-unit' allows an in-depth understanding of broader socio-environmental dynamics. These case types are representative by their pure definition, enabling a clear understanding and overview of a subject. This approach allows us to analyse how global processes in the transition towards sustainability and decarbonization are manifested in and contested at the local level, particularly by OCS.

3.1 Case selection

At the southern tip of Chile, the region of Magallanes and Tierra del Fuego is remarkable in various aspects. The strong, consistent wind regime makes the region ideal for renewable energy production such as wind farms, essential for generating the electricity needed for GH production through electrolysis. Electrolysis is the process whereby water (H_2O) is split in O_2 and H_2 . In 2021, this region was positioned at the forefront of Chile's renewable energy strategy with the announcement of a large-scale wind-powered GH project, planning to deploy extensive electrolyzer capacity and wind turbines by 2030 (Zolezzi et al., 2010; Bartlett, 2022; Garcia & Oliva, 2023). According to Norambuena et al. (2022), a projection of 25GW of new installed capacity is projected by 2030. Currently, the region's energy matrix consists of 97% fossil fuels (Proaño, 2018). Globally, efforts to mitigate climate change are aimed at reducing carbon emissions while generating energy wealth for all through accessible sources of cheap and safe energy. The GHI development is considered an opportunity for the regions' transition towards sustainable energy sources (Acosta et al., 2022; CORFO, 2023).

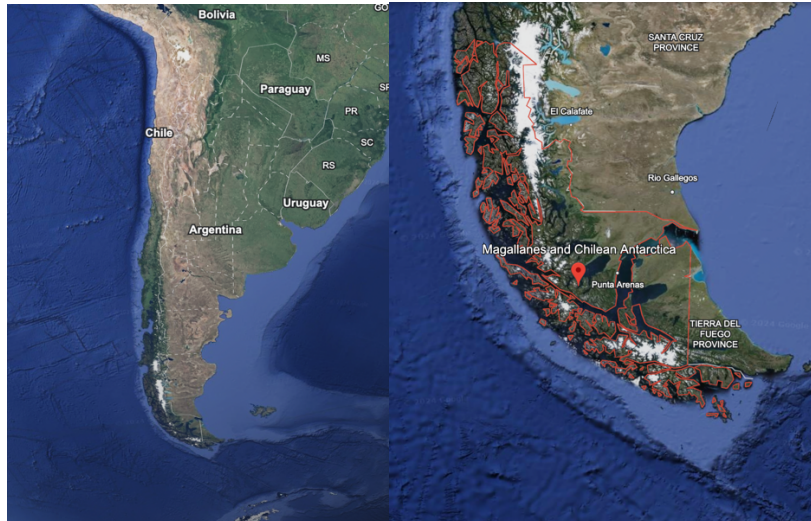


Figure 1: Southern South America (left) and the southernmost region “Magallanes”, including the western part of Tierra del Fuego Island (red contour, right). Retrieved from Google Maps on 12 December 2023

The geopolitical importance of the region adds another layer of complexity, since its location along the Strait of Magellan is strategically influential to global (energy) markets, while the stable political regime of Chile is a catalyst for international trade relations. Due to its geographic isolation, however, the region poses distinctive challenges for local and foreign investors and developers. As far as is officially known, the GHI developments are planned in the steppe, an ecoregion dominated by strong winds, and the harsh weather conditions of the subantarctic climate. This landscape and vegetation are characterized by water scarcity, which is a limiting factor for electrolysis and consequently GHI. Additionally, due to persistent droughts the region is declared as a Climate and Environmental Emergency since 2020 (Gobierno Regional de Magallanes y de la Antártica Chilena, 2021).

Two main instruments are key to the current regional strategy for GHI: the “Programa Transforma Regional Hidrógeno Verde Magallanes², and “Asociacion Gremial de Empresas H2V³. The Transforma Program is a “public-private initiative that was born from the need to collaborate in the articulation of local, public, private, academic, science and civil society representatives, to ensure that the development of this new industry is in harmony with the social, environmental and economic environment, promoting the production of GH and its derivatives, as well as local demand, regional production chains, talent training and care for the environment, among others.” (CORFO, 2023). The Asociacion Gremial de Empresas is a trade association (with members EDF Chile, EDF Renewables, HIF Global, HNH Energy, TEG Chile, Total Energies H2) aiming to “ensure a close relationship between companies and the community, promote regional production chains; culture,

² The Transforma Program is a “public-private initiative that was born from the need to collaborate in the articulation of local, public, private, academic, science and civil society representatives, to ensure that the development of this new industry is in harmony with the social, environmental and economic environment, promoting the production of H2V and its derivatives, as well as local demand, regional production chains, talent training and care for the environment, among others.” (Hidrógeno Verde Magallanes Programa Transforma Regional, 2023).

³ This trade association (with its members EDF Chile, EDF Renewables, HIF Global, HNH Energy, TEG Chile, TotalEnergies H2) aims to “ensure a close relationship between companies and the community, promote regional production chains; culture, science and research, as well as the sustained and sustainable socioeconomic growth of the region, in full respect of the environment and communities, minimizing potential impacts, generating synergies and positive externalities” (Asociación H2V Magallanes, n.d.).

science and research, as well as the sustained and sustainable socioeconomic growth of the region, in full respect of the environment and communities, minimizing potential impacts, generating synergies and positive externalities” (Asociación H2V Magallanes, n.d.). Complementary, the Acuerdo de Escazú⁴ (Escazú Agreement) is a legal framework across Latin America and the Caribbean which supports activists to press for information, participation, and protection. In 2022, this treaty has officially been ratified in Chile to ensure that environmental concerns are adequately addressed.

Currently it is yet unclear how the landscape will be affected in terms of location, dimension, temporal and spatial scale of the GHI. Once permits are in place, the average construction phase of a wind-powered GH project takes approximately two years. Since colonization by mostly European settlers in the 19th century, much of the land was privatized for livestock farming, particularly sheep. Thus, opposite to solar-powered GHI in the northern region of Chile, where the economic relations are mainly between the state and private actors, the GHI plans depend on lease contracts with private landowners, represented by the Association of Livestock Farmers (ASOGAMA). While some landowners prospect economic benefits from leasing their land for hydrogen projects, concerns about the disruption of traditional farming practices and the ecological impact persist even among these stakeholders. Municipality representatives in the region tend to publicly support the GHI as a means of economic growth, yet they also underscore the importance of investing the returns in community benefits and express their concerns related to pressure on non-renewable resources such as freshwater, and sand and gravel for construction (Oyarzo, 2022; personal communication, January 15, 2024). Their main aspirations are, “to become more developed”, e.g. by obtaining improved community services (such as medical care centres or hospitals, schools, access to cheaper energy, water, better waste management, etc.) (Ministro de Energía: “El Hidrógeno verde detona un polo de desarrollo muy importante de la región”, 2021; Foro H4D busca acelerar el despliegue de la industria del hidrógeno verde en Chile, 2023; personal communication, January 15, 2024). Reminiscing consecutive negative experiences with arrivals of other industries (e.g. whaling, oil and gas, forest logging for chips/paper pulp, coal, salmon farming, etc.), concerned locals recollect contextual knowledge, critically highlighting external costs and benefits of the GHI in local newspapers and social media, seeking to warrant more equitable benefits locally.



Figure 2: Scenic view of a fenced off private terrain in the steppe, with a drying salt lake, and a scenic view of the steppe during summer. The low and dry sclerophyllous vegetation illustrates why the ecosystem might be perceived as ‘desert-like’. Photo taken by the author, January 2024

⁴ Also known as “The Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean”

3.2 Methods

This study uses qualitative methods to analyse the role of OCS in advocating (climate) justice, and broader community engagement, concerning the GHI in Magallanes. Structured as a typical case study (Gerring, 2006), this research provides an in-depth examination of OCS resilience and resistance dynamics related to the GHI, revealing broader principles and trends that can potentially be relevant for similar energy transition case studies. Additionally, this approach captures detailed, nuanced interactions among stakeholders, which is essential for understanding complex social phenomena.

Data were collected through 12 semi-structured interviews of stakeholders, ethnographic observations, and document analysis. Interviews, lasting 45 minutes to two hours, included activists and community representatives, covering key topics such as perceptions, views, committedness, and aspiration regarding the GHI. Ethnographic observations at community meetings and daily interactions provided contextual insights into community dynamics. Document analysis included policy reports, newspaper articles, and civil society reports, enriching the data with formal perspectives.

A purposive sampling strategy was employed to select individuals based on their roles and perspectives related to the industry. Although 20 individuals were initially contacted, theoretical saturation was reached after eight interviews, providing a depth of data sufficient for robust analysis. This strategy ensured a comprehensive understanding of diverse community viewpoints, essential for addressing the research question. While this study focuses on the OCS, additional interviews were conducted with stakeholders who did not identify as part of the local OCS, with the aim of providing additional and valuable contextual information to supplement the description of the case study area (cf. section 3.1).

Data analysis involved verbatim transcription of interviews in Chilean Spanish, followed by thematic analysis in English. Initial codes were refined iteratively to develop themes related to the research sub-questions, using digital tools for transcription and coding (Microsoft word, NVivo). Field observations were also coded to capture significant interactions and dynamics, enhancing the analysis with ground-level insights. The key structuring themes that emerged from this thematic analysis can be summarized as 1) attitudes, 2) aspirations and 3) actions of the interviewees relating to the GHI developments. These three meta-categories were developed during the thematic analysis process and presented in the results section below.

Ethical guidelines were strictly followed to protect participants' confidentiality and sensitive information. Informed consent was obtained through bilingual forms and verbal explanation when necessary. Data were stored on a secured encrypted hard drive to prevent unauthorized access. Challenges included scheduling interviews with stakeholders and addressing linguistic and cultural nuances in Magallanes. Extending the data collection phase from two weeks to about 3 weeks allowed for more flexible scheduling, which was necessary due to the long distances. A virtual interview was exceptionally conducted in 1 case when in-person meetings was not feasible, ensuring the research could proceed without significant delays. Lastly, while concerns of fishers about the potential environmental impact on marine life - which is crucial to their livelihood - were initially anticipated, attempts for interviews or light-hearted conversations about the industry were unsuccessful and thus not included into fieldwork data.

4. RESULTS AND DISCUSSION

The current study analyses the role of OCS in challenging the GHI as a model for sustainable development in the region of Magallanes, Chile. The findings are discussed following three structuring themes that offer collective insight into the community's stance on the burgeoning GHI (attitudes), its vision for the future (aspirations/alternatives), and its engagement in the processes (actions).

4.1 Attitudes: Perceptions of OCS on the Developing Hydrogen Industry

The findings presented under this theme highlight how the OCS relates to the hydrogen industry development, while framing them in the broader contextual background (above).

4.1.1 Paradox of the green transitions

Document analysis and fieldwork observations revealed how stakeholders with a positive perception towards the GHI underline the opportunity it offers for the socio-economic development of the region, and positive contribution to mitigating the global climate crisis.

In general, a sense of acquiescence towards GHI was observed among interviewed local OCS, as they seem convinced that GHI will, eventually, (have to) be developed regardless of their reservations. This acceptance, however, appears to stem from a combination of strategic realism and the pressure of external forces, rather than wholehearted support. This way, their acquiescence is coupled with significant scepticism about whether GHI truly aligns with local socio-cultural and environmental values. Still, in comparison with stakeholders like ranchers and municipality (representatives), interviewees representing the local OCS voiced a much more critical stance towards the GHI development in the region: each of the interviewed OCS members described their perception of the GHI by making direct or indirect references to the concepts of (green) extractivism and green colonialism. Seven OCS interviewees expressed their discontent on how the global socioecological and climate crisis is used to legitimize and accelerate the instalment of the GHI in the region. Furthermore, the narrative of the GHI was often explicitly assessed as 'not green' due to its export-oriented nature and scale, minimal local benefits, and the risks of greenwashing. To correctly refer to the industry and its relational implications, OCS representatives from several social or environmental organisations suggested labelling the GHI as an "industry for hydrogen exportation", rather than "GHI". The following quote by an environmental organization member and OCS representative reflects this critical stance: "...I don't see it as a contribution to our local society. Our region doesn't have low employment rates. So, we must name this business by its name: it's a contribution to the [financial] capital, especially if developed in Tierra del Fuego⁵...". This quote reflects a broader concern within the OCS that the GHI might represent a continuation of historical extractivist practices. These concerns are rooted in past experiences with other extractive industries, leading to scepticism about whether GHI is genuinely different, or merely another form of exploitation disguised as a 'climate mitigation effort'.

The critical stance taken by the OCS emphasizes their proactive nature and deeper understanding of social and environmental justice, essential to assert their agency and rights in the face of global challenges. By the imbalance illustrated by the OCS representatives, this perception aligns closely with Jenkins et al.'s (2016) emphasis on distributional justice, which advocates for equitable sharing of benefits and burdens in developing an energy infrastructure. In this context, distributional justice becomes a significant issue as the economic benefits of the GHI (i.e., profits and energy production) are largely exported out of the region, while the local population is left to manage the environmental and social impacts with minimal local advantages. This imbalance highlights the concerns that this industry might exacerbate existing inequality. Additionally, linked to the OCS' references to historical examples of extractivism in the region, the findings resonate with Dunlap et al. (2024). Dunlap et al. (2024) argue for the importance of voicing energy justice from a non-Western centric conception to tackle the injustices it often tends to reproduce, underscoring the implications of green extractivism.

Furthermore, exposing the paradoxes of green extractivism, the analysis provided by Dunlap and Laratte (2022) regarding the EU Green Deal highlights how the rapid deployment of renewable energy projects can lead to what they term "infrastructural colonization". This process, wherein ecosystems and communities are sacrificed under the guise of climate mitigation (i.e., becoming sacrifice zones), mirrors the concerns expressed by the local OCS regarding the GHI. Just as Dunlap and Laratte (2022) argue that these green initiatives often perpetuate existing inequalities and environmental harms, the highlighted paradox reflects a similar concern that the project in the region may exacerbate local socio-environmental injustices rather than address them.

⁵ Here, it is referred to law 19.640 in Tierra del Fuego, which exempts activities carried out in the territory from paying national taxes, both for natural and legal persons.

4.1.2 Green Hydrogen Industry: scale matters

Members of the local OCS explained their criticism and dissatisfaction by pointing at various shortcomings of GHI development over the past years, that are considered problematic. The OCS representatives reported a clear discontent over the lack of (prior) consultation, inclusion, and context-sensitivity. As expressed by an OCS representative, this exclusion from the dialogue also indicates a lack of transparency towards the local population: "...What will actually happen in the region, is not being visualized. The knowledge of any person outside the industry is much lower than what it should be. How can anyone say they agree to something if you only have selective information?". Another example of the GHI's shortcomings in terms of transparency is the unclarity concerning the anticipated scale of the GHI. As explained by an environmental organization member, there is currently no precedent for a 'green' hydrogen project of this scope: "We [the region] have been transformed into monster numbers in terms of potential production... We are always being told about our region's potential, not about real, clear goals. Our potential this... our potential that... But are we actually able to imagine an industry of this magnitude in our pristine region, since there is no place on earth similar to us?". The frustrations that were expressed about ignoring the region's specific values suggests a strong local engagement of the OCS in striving for environmental and social justice. The data also suggest a strong awareness of the shortcomings in the distributional, recognition, and procedural conditions for energy justice. As Jenkins et al. (2016) emphasize, procedural justice goes beyond mere participation; it also requires the transparent disclosure of information to all stakeholders. Additionally, the concerns expressed by the OCS indicate awareness about potential environmental and social consequences related to the lack of community involvement in the decision-making process. According to several interviewees, this lack of active engagement of the local population was explained by several factors, like inadequate efforts for outreach, or incomplete/misinformation. For example, companies developing their hydrogen project in the region are required to organize information events, however these often failed to take into account local culture and habits, ultimately failing to sufficiently reach the target public. Two representatives of the local OCS also reported efforts from hydrogen companies to target children in vulnerable communities: e.g., through gifts. While this might have raised awareness of the industry's arrival within a community, and trigger interest from citizens on the GHI, a representative of the local OCS questions whether such gestures translate into meaningful engagement or serve as a superficial public relations strategy: "It cannot be a direct deal between a company, a service and the community, because that breaks the relationships and social fabric in the communities. It's a kind of purchase of the will".

This section aligns with the findings of Valenzuela-Fuentes et al. (2021), who explored socio-environmental activism in a Chilean sacrifice zone. Similar to the observations in our study area, their research highlights how the viewpoints of the studied local communities criticize the extractive industries in their place of residence for its exclusionary practices. The parallels between these findings underscore the broader regional patterns of resistance to green extractivism and the critical need for approaches that reflect the needs and values of local populations (i.e., energy justice) who are, or at risk of becoming, sacrifice zones.

This is where the expressed concerns by the OCS appear as a paradox, indicating that clientelism or charitisation might increase the vulnerability of these communities, as is often the case in sacrifice zones (Schilling-Vacaflor, 2017). These results corroborate existing studies that flag the 'darker' sides of sustainability and renewable energy transitions, as outlined by McGowan and Antadze (2023), suggesting they may be reinforcing neocolonial patterns and overlooking the needs of marginalized populations. This way, these concerns highlight a deeper issue of epistemic injustice. This concept, as discussed by Müller et al. (2022) underscores the marginalization of local knowledge systems in favor of dominant, often Western, perspectives. The exclusion of local voices in decision-making processes not only undermines the social and environmental values of the region but also perpetuates historical patterns of knowledge dominance.

4.1.3 A fragmented approach to the climate crisis

Lastly, a closer analysis of the local OCS' critical attitude towards the GHI development revealed an essential characteristic of the Latin American political ecology perspective. Fieldwork revealed how time, while being

ubiquitous, affects all stakeholders in a contradictory manner, inflicting fragmentation. The climate crisis calls for urgent and immediate action, pushing a global pressure to accelerate the renewable energy and GHI development. Simultaneously, this global 'green rush' increases tension at the regional level and local population. Although initiated in the previous decade, the upcoming GHI projects have only recently entered the public discourse. With the region expecting to become a major exporter of hydrogen in the coming six years, the local OCS expressed struggles to catch up on the velocity of this capital-intensive industry. As a member of a social organization from the OCS stated: "How can we evaluate this industry if there's this much pressure to make the development happen as fast as possible, without having conversations from the territory, with the territory? Were we even ever asked whether we wanted to do this in the first place?". This statement highlights how the fragmented approach to our global climate crisis results in the exclusion of many. It suggests that sustainability should incorporate by design the acknowledgement of diverse and heterogeneous times and spaces, in striving for energy justice.

Notably, the government's approach was subject to criticism across the spectrum of stakeholders, regardless of their stance toward the GHI development. Stakeholders who viewed the GHI positively expressed frustration with the government's slow licensing process and 'permitology', arguing that bureaucratic hurdles are hindering timely progress. On the other hand, those from the OCS with a more critical or cautious perspective criticized the government's approach for its inadequate regulation and its emphasis on promoting⁶ rather than properly regulating the industry. A representative from an environmental organization highlighted this concern: "Even if there would be more regulations on, for example, the industry's spatial occupation... If they would ask our opinion, there are no regulations or legal framework enforcing consideration of our opinions. That's how permissive our open economy is". These findings reveal a critical tension at the heart of the GHI development: the clash between the urgency imposed by global climate goals and the need for more rigorous regulation, and thoughtful, inclusive processes that respect local contexts. The widespread criticism of the government's approach, whether for being too slow or too permissive, highlights the challenges of balancing these competing demands.

Furthermore, the critiques of how the global socio-ecological crisis is being used to justify large-scale projects that prioritize external interests over local needs echoes Dunlap et al.'s (2024) call for rethinking energy justice in a way that includes rather than sidelines local voices and knowledge systems. These results align with Leff's (2012) argumentations, emphasizing that "Sustainability is built in the encountering of these conflictive processes [...] in the negotiation of diverse interests and meanings that trigger counteractive economic, ecological and technological processes that in the coalescence of their timings, will determine the future to come".

Additionally, this analysis reveals the need to critically assess the GHI by taking into account the notion of a socioecological fix, as defined by Ekers and Prudham (2015, 2017). These findings corroborate with Rudolph (2023) on how socioecological fixes disproportionately affect local communities, and only offer limited fixes to the environmental crisis.

4.2 OCS Aspirations and Alternatives for Securing (Energy) Justice

While the attitudes within the local OCS are important for politization and action, expressing aspirations about alternative visions for the future are as valuable. With the concept of "imagined futures", Suckert's (2022) work emphasizes that these aspirations are not passive dreaming but active and strategic visions that guide community actions and resistance. These futures are informed by the socio-cultural and environmental contexts of the communities and reflect their collective desires for autonomy, justice, and sustainability. Amplifying the aforementioned paradox of the green transitions, the topics below further document the aspirations of the OCS in Magallanes and Tierra del Fuego.

⁶ "Current tools" are Transforma (CORFO) and the Plan de Accion the H2 verde (cf. 3.1). Both are plans/tools focused on the promotion of the industry.

4.2.1 Energy democracy as a condition for energy/hydrogen justice

In line with the local OCS' stance towards the exclusionary nature of the GHI, fieldwork findings reveal the OCS' demand for a voice in the decision-making process. Several OCS interviewees expressed their vision for a political horizon that fosters inclusion, self-determination, and enhanced public participation. An OCS active in biodiversity conservation encapsulated this sentiment by stating, "There is a lack of taking into account the local opinion. More so, the opinions are currently not even reflected in the [current GHI's] plan of action". These aspirations propose responsible future planning that addresses the risks and uncertainties of establishing the hydrogen industry, including those identified by citizens. These findings indicate that access to and transparent sharing of information, along with meaningful participation by the local population is a crucial starting point towards genuine and inclusive sustainability. This demand for inclusion and influence reflects the broader framework of energy democracy as conceptualized by van Veelen and van der Horst (2018), who argue that energy democracy is essential for shifting towards decentralized and participatory energy systems. Their work underscores the importance of involving local communities in energy decision-making to ensure that energy transitions are not only technically successful but also socially just and inclusive. This argument is further reinforced by Szulecki (2018), who positions energy democracy as a challenge to the technocratic and centralized decision-making processes traditionally dominant in the energy sector. Szulecki (2018) emphasized that for energy transitions to be genuinely democratic, they must incorporate popular sovereignty, participatory governance, and civic ownership, all of which are echoed in the demands and aspirations of the local OCS.

Moreover, these findings also resonate with the concept of hydrogen justice as articulated by Müller et al. (2022), who highlight the critical importance of procedural justice in the development of GH projects. Procedural justice within the frameworks of energy and justice, which focuses on inclusive and democratic decision-making processes, is positioned as a fundamental condition for achieving sustainability in developing a GHI. However, to nuance these concepts, it is crucial to recognize that while procedural justice and inclusivity in decision-making are foundational, they may not fully address the deeper structural issues inherent to the global energy transition. As Dunlap and Tornel (2023) argue, these frameworks risk perpetuating the very systems they aim to critique.

This indicates that the introduction of GH as a future energy source involves not just technological advancements but also the social acceptance and willingness of local communities to engage with and use new technologies. As Perlavuciute et al. (2021) note, the transition to net-zero systems requires significant changes not only in technology but also in human behaviour.

4.2.2 Including subalterns: environmental appreciation/conservation vs (re-)appropriation

As a reaction against the perceived extractivist nature of the GHI, interviewees expressed a holistic desire towards inclusiveness. Identifying as a group that is being excluded from the decision-making processes in the development of the GHI, it is interesting to highlight that urban socio-environmental activists strive for a future where there is space for environmental conservation efforts which incorporate the voices of all 'subalterns,' including non-human entities, i.e. nature itself. As one interviewee stated, "...We should try to be guided and inspired to change our miserable reality as it exists today... There is an interplay between ecological conservation and human development... I would like to see our realities as synergies...". Their perspective on the inclusion of nature highlights how nature is recognized as a critical stakeholder in environmental dialogues, advocating conservation strategies that do not compromise ecological integrity and align with global sustainability goals, while protecting local interests. Although not explicitly mentioned by interviewees, this data aligns with the research findings of Valenzuela-Fuentes et al. (2021), highlighting how urban activism in comparable regions in Chile reflect values of Buen Vivir as an alternative path for extractive industries. By aligning with the values of Buen Vivir – an alternative path present among many Latin American indigenous populations that seeks harmony between human development and ecological conservation – the

OCS are implicitly supporting a transformative agenda that seeks to dismantle the power dynamics entrenched in current global development models.

Furthermore, the emphasis on an integrated approach to inclusiveness and the recognition of non-human entities as critical stakeholders resonate deeply with the arguments presented by Dunlap and Tornel (2023) in their critique on the energy justice framework. They argue that traditional models of justice, including those embedded within energy systems and broader development paradigms, often remain entangled in Eurocentric and statist frameworks that perpetuate extractivism and socio-ecological domination. This insurrectionary approach to justice advocates for a radical rethinking of justice that challenges the foundations of capitalism, statism, and colonialism (Dunlap & Tornel, 2023). In addition, the emphasis on inclusiveness and recognition of non-human entities in this study resonates with the findings highlighted by Tafon et al. (2023). Tafon et al. (2023) argue for a justice framework that centres on ecological reflexivity and the recognition of non-human nature as subjects of justice. This approach challenges traditional anthropocentric justice models and aligns closely with the interviewees' desires for inclusion. The alignment of these perspectives underscores the necessity of moving beyond human-centred frameworks to embrace a broader understanding of justice.

4.2.3 Supporting all voices

Moreover, several OCS representatives underscore the need for less invasive construction techniques to minimize environmental disruption. For example, there is a strong call for incorporating adaptation strategies alongside mitigation in environmental planning and impact assessments. Interviewees both with and without an academic background emphasize an imagined future wherein the knowledge of both local experts and those strongly concerned with nature is respected and considered. That is, for example, the case for a local activist with a background in marine biology: "...Politics often focus on the short term, while science tries to be substantial in the long term... My whole life I have been working on this very specific scientific knowledge from my region...I really hope we will overcome the challenge of becoming able to have a voice, to at least help politics more with mitigation measures...". Nevertheless, interviewees warned that they refuse to offer their expert knowledge if it would solely serve to support and justify the GH companies' environmental impact assessments instead of genuinely being taken into account, as has been reportedly the case with at least 3 interviewees active in environmental conservation. This emphasizes the importance of balancing environmental, social, and economic considerations with the technical aspects of energy transitions. Insisting on the evaluation of the industry's impact from a scientific and participatory standpoint, the data suggest that making room for local experts in consultation conversations could ensure that both local scientific knowledge and local citizen experiences can inform decision-making processes, and foster more comprehensive and inclusive environmental governance, leading to increased social and environmental justice. This strategy of co-design aligns with broader sustainability principles that emphasize reducing human impact and enhancing ecological resilience. While such co-design might take more time, posing a challenge for the urgency for action in our global crisis, this strategy corroborates with the concept of Slow Science. The concept of Slow Science is rooted in the belief that science should be robust, socially relevant, and responsive to the needs and values of the community it serves (Stengers, 2018). According to Stengers (2018), this approach calls for extending the timeline of scientific research and decision-making processes to ensure comprehensive community involvement and thorough environmental assessments, by allowing adequate time for thorough investigation and the integration of diverse perspectives (Stengers, 2018). According to O'Lear (2016), the call for this approach can be especially relevant in regions where rapid industrial development threatens to outpace the capacity for adequate environmental oversight and community consultation.

Lastly, Mode2Science, a framework for knowledge production that emphasizes inclusivity, context-driven research, and stakeholder engagement, is highly relevant to the findings from the OCS representatives. These representatives critique the prevailing sustainability narratives, which often prioritize industry prosperity under the guise of environmental respect, without the integration of local knowledge or

public engagement. This approach suggests a more transparent, inclusive, and effective environmental management, ensuring that both scientific and local expertise inform decision-making processes in a coherent manner (Nowotny & Gibbons, 2003, 2005).

4.3 Actions: Navigation, Involvement and Advocacy

This theme flags the OCS' actions and responses towards the burgeoning industry. OCS representatives reported active participation in public forums, dialogues with industry representatives, and governmental negotiations. This involvement aims to insert socio-environmental considerations into the development discourse of the GHI and articulates how the OCS's attitudes and aspirations turn into action.

4.3.1. The Organised Civil Society Collective

In August 2023, the *Panel Ciudadano sobre Hidrógeno en Magallanes* (PCHM) arose as a collective network representative of 13 local and regional socio-ecological organisations and (scientific) expert advisors to the promotion of the hydrogen industry in the Magallanes region. Identifying as the OCS, the PCHM voices a critical perspective on the environmental crisis, framing it within a broader context of unsustainable land-use changes, the inappropriateness of certain technological innovations for local territories, and the deficiencies in capacities of governance systems to regulate and control the industry. The PCHM's arguments underscore the disproportionate impact of environmental crises on vulnerable communities, which worsens social inequalities. As one representative articulated, "...Are we combatting and trying to abandon fossil fuels, or are we adding another one [unsustainable practice] to the matrix? It is true, our world is globalised...and industrialised...I'm not against industries. I am, however, aspiring to develop industries that make sense in respect to the crisis. If we know that the crisis is an issue that has to do with how we are relating to our environment, it cannot be that, to solve the crisis, we do exactly the same [as before] ...". Moreover, the panel raises specific concerns about the GHI discourse. These concerns include the extensive scale of intervention needed to meet production goals, the GHI potential impacts on local communities and ecosystems, the fulfilment of commitments to democracy and environmental justice, and the practicality of using this energy vector in the region considering its technical feasibility, efficiency, costs, and its potential to replace current fossil fuels. The data on the PCHM's stance suggests that while the GHI has the potential to contribute to climate goals, its implementation must be carefully managed to avoid repeating past mistakes associated with extractive industries. This highlights the complexity of balancing economic development with environmental and social responsibilities, and the need for inclusion of public opinion and proactive civil engagement in the governance of the GH project.

With the precautionary principle⁷ in mind, their coalition-building approach seeks to standardize sustainability practices across the industry, reflecting the collective interests of the community and the ecosystem. This collectivized action is crucial for effective transformations, as emphasized by Scoones (2016), highlighting the need for alliance-building in addressing complex socio-environmental challenges. Moreover, in line with Gramsci's concept of civil society and the potential power of the subaltern to inflict transformation, the PCHM emphasizes the importance of recognizing and valuing 'differences' within the PCHM (including expert academic knowledge as well as non-academics) as a potent tool for social change (Hoare & Nowell-Smith, 2005). By advocating a broad inclusion of diverse voices and perspectives, the initiative directly challenges the 'problem of universality' that often pervades historical and contemporary narratives. Vinay Bahl's critique of universal narratives in historical analysis underscores the importance of

⁷ The precautionary principle refers to a risk management strategy that advocates taking preventive action in the face of uncertainty, opting for the side of caution when there is potential for harm to human health or the environment, for example, when some cause-and-effect relationships are not fully established scientifically.

this approach, arguing that a deep engagement with 'differences' enriches the dialogue and leads to more equitable and context-sensitive outcomes (Bahl, 1997).

4.3.2. Diverse and mixed use of tools and strategies

The PCHM's proactive involvement extends beyond active participation in public forums, dialogues with industry representatives and governmental negotiations. Their strategy emphasizes professionalization, litigation, and community-based actions, such as calling for a moratorium on the GHI until comprehensive evaluations of its environmental, economic, and social impacts are conducted. The PCHM's proactive stance and collective initiatives highlight their critical questions about the scale of intervention necessary for achieving production goals and the potential socio-economic and environmental impacts on the local communities. With an emphasis on the need for strategic planning that incorporates environmental conservation and social equity, the PCHM sends a call for clarity on how the production in Magallanes will contribute to the decarbonization goals in the region, especially since the region has been declared a Climate and Environmental Emergency area (see 'Case study'). An open letter was directed towards several regional government and strategic committee leaders, including the presidential delegate, regional ministers (such as CORFO), and GH committee members. The PCHM requested a scientific and participatory evaluation of the industry's scale and scope, along with its environmental, economic, and social impact before proceeding with its installation.

This included a call for a moratorium – relating to the perceived pressure of time - on the installation of the hydrogen industry to address the identified risks comprehensively and integrally. A specific example is how the PCHM has facilitated community engagement by organizing information evenings and workshops to coach citizens on how to make formal observations on Environmental Impact Assessments (EIA). This initiative culminated in almost 500 citizen observations being submitted for one particular GH project by the close of the public consultation period on March 27, 2024. While observations can almost only be flagged in terms of methodological shortcomings⁸ of the projects, this public consultation was already seen as a valuable step towards inclusiveness. This corroborates with findings of Agostini et al. (2017), who discuss the failure of energy mega-projects in Chile, underscoring the critical role of environmental evaluations in preventing adverse social and ecological outcomes. Furthermore, these findings align with earlier research conducted by Valenzuela-Fuentes et al. (2021), illustrating how populations in a comparable Chilean case combine similar and mixed strategies to advocate justice and defend their values. Furthermore, these findings suggest that mixing different strategies can serve as a valuable tool to become more resilient as a movement.

Lastly, it is worth mentioning that the legal framework of the Escazú Agreement was not (yet) being perceived as a tool towards an ultimate solution. Litigation was rather seen as a 'last resort', due to its time-consuming features, as explained by a member of a social organization and PCHM representative.

4.3.3 Navigating challenges, promoting inclusive dialogue, participation, and engagement

The creation of the PCHM also sparked debate over the adequacy of existing participatory mechanisms in the representation of diverse interests of the local population. The panel stressed the importance of fulfilling commitments to democracy and environmental justice and scrutinized the feasibility and sustainability of using GH as an alternative and renewable energy source in the region. Through public campaigns and workshops, the PCHM tries to inform and engage with the community to enhance understanding and participation in environmental assessments. As explained by an active PCHM member and professional in the animal health sector, it aims to provide a formal channel for informed public concerns to be systematically

⁸ Examples of mentioned methodological shortcomings were, e.g., the usage of incorrect binoculars for bird observations, making observations only during daytime, or making observations only during a limited period within the year

and transparently considered in governmental decision-making and underlines the urgency expressed by the scientific community and United Nations to address the 'global boiling' through means that also advance social justice. This data supports the growing acknowledgement of the importance of inter- and transdisciplinary collaboration in assessing the ongoing transformation of economies as they transition toward 'green' alternatives. As highlighted by Lang et al. (2012), this approach not only fosters interdisciplinary collaboration but also promotes the development of alternative knowledge systems and counter-hegemonic strategies that challenge dominant paradigms. The integration of diverse perspectives and empirical approaches is crucial for retooling the way public concerns are understood and addressed, particularly in the context of this GHI within the climate crisis. This way, it facilitates a nuanced comprehension of public concerns, enabling a more effective and inclusive dialogue between scientific knowledge, policymaking, and community interests.

Furthermore, in the hopes to sensitize the public to the value of nature, the initiatives of individual OCS representatives aim to give nature a voice. For example, by sparking children's interest over nature, an activist tries to promote a deeper appreciation for nature, hoping to foster a community-wide ethos of respect and stewardship, ensuring that conservation strategies are not only effective but also deeply rooted in the community's values and aspirations. As such, various interviews discussed the challenge of informing the general local population better, since, for example, the affected ecosystem is being perceived as an 'empty desert', i.e., the steppe, also named 'la pampa'. The efforts to deconstruct this kind of perception could also be seen as an emancipatory purpose to co-create solidarity towards nature, and, eventually, foment a countermovement to transform the general public's attitude towards nature. However, the cultural field wherein critical whistleblowers from the PCHM are navigating, is not free from obstacles, as poised by a professional experienced in the conservation of nature, "...It's difficult to be critical and to express concerns related to nature... Not that I care what they think, but it's difficult to be heard when some want to polarize our region by calling us 'eco-terrorists'... These practices fragment the social fabric, and buys out local support. That, I think, is a clear marking of social injustice...". This way, it remains a challenge for the PCHM to actively work with schools. As explained by a key representative, these actions are often be seen as "a political act", a sensitive topic which is "somewhat frowned upon in this post-dictatorial society". Embracing differences and building a common understanding, OCS is laying the foundations of a potential pathway for sustainable transition. However, all remain voluntary actions amidst a field full of obstacles, as public participation is not sufficiently enshrined in the process.

5. CONCLUSION

This research examines the emerging GHI in the region of Magallanes and Tierra del Fuego (Patagonia, Chile) through the lenses of political ecology and socio-environmental justice. The study highlights the close interaction between the local organized civil society (OCS) and the rapid development of the GHI, illustrating both the significant challenges and potential alternative pathways.

The findings reveal that, despite the GHI's promises to contribute to global climate goals, it also raises serious concerns about the scale and dimension, velocity, discourse, (lack of) transparency, socio-environmental fairness, and sustainability. In this context, OCS emerges as a proactive advocate for a more inclusive and equitable energy transition. The formation of the Panel Ciudadano H2 Magallanes (PCHM) exemplifies such a proactive approach. By questioning the narratives of green growth and extractivism, their advocacy draws attention to the often-overlooked local impacts of global environmental strategies. However, the current legislative framework in Chile limits support for the OCS and potentially affected communities. This could be strengthened to facilitate an inclusive participation, to ensure that local concerns are addressed and legally enshrined in public consultation processes, and to demand common standards for the GHI practices.

One of the contributions of this research is its meta-reflection on the intersection of global environmental developments and local realities. The study contributes to existing theories by underscoring a more nuanced understanding of sustainability transitions and energy justice that incorporates local voices and knowledge systems. The findings align with and extend the discussions on green extractivism, by illustrating how green energy projects might perpetuate neocolonial dynamics and socio-ecological injustices.

The study also reflects on its own shortcomings, especially regarding the extent of data collection and the challenges of fully capturing the diversity of local perspectives. Future research could adopt a more extensive longitudinal approach, enabling a deeper comprehension of the evolving relations between the GHI and local populations. Comparative studies of projects and stakeholders in similar regions could shed light on the global implications of green energy transitions.

In conclusion, this study adds to the growing body of knowledge on sustainable development while also highlighting the crucial role of OCS in fostering socio-environmental justice in the face of rapid industrial change and decarbonization. As the world strives towards net-zero emissions, the case of the OCS in Magallanes and Tierra del Fuego provides valuable insights on establishing socio-environmental justice in energy transitions. This research suggests co-creating energy futures with the communities they aim to serve, emphasizing that success in sustainable energy transitions should be measured not only by technological advancements but also by the fulfilment of justice, equity, inclusion, and resilience. The GHI in the region stands at a pivotal juncture, where technological innovation should be harmonized with the needs and values of all parties involved to protect the region's ecological integrity and the wellbeing of its inhabitants. The journey of Magallanes towards embracing GHI is a microcosm of the global challenge of achieving sustainable energy transitions, where success is measured not only in gigawatts but in the fulfilment of justice, equity, and community resilience.

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