Information and participation in the energy transition: A case study of the frontiers of green hydrogen in Uruguay

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Abstract

Debates about energy transition mostly focus on national policies and socioeconomic and environmental benefits; however, these processes occur in particular communities where energy transition projects have material and symbolic consequences. This article reports the results of a survey carried out in the area of influence of the Tambor Project for green hydrogen production in Tacuarembó, Uruguay. The work was carried out in response to a demand from the community to document the information and opportunities for participation that the population has had since the project was publicly announced in 2022. We present a contextualization of the case, the main results of the survey and a discussion of these based on existing data about the region and human rights standards for megaprojects. The article highlights the lack of access to information and participation about the megaproject, as well as topics of interest of the local population which included impacts on water and the possible creation of employment in the area. The research shows the effects of an energy transition policy based on a techno-economic sustainability approach that violates human rights.

Key words: energy transition, green hydrogen, human rights, citizen participation, access to information

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Resumen

Los debates sobre la transición energética se centran principalmente en las políticas nacionales y los beneficios socioeconómicos y medioambientales; sin embargo, estos procesos se producen en comunidades concretas, donde los proyectos de transición energética tienen consecuencias materiales y simbólicas. En este artículo se reportan los resultados obtenidos en la encuesta realizada en la zona de influencia del Proyecto Tambor para producción de hidrógeno verde en Tacuarembó, Uruguay. El trabajo fue realizado en respuesta a una demanda de la comunidad con el fin de documentar la información y oportunidades de participación que ha tenido la población desde que el proyecto fue anunciado públicamente en 2022. En primer lugar, se plantea una contextualización del caso, luego se presentan los resultados principales de una encuesta y finalmente una discusión de estos en base a datos y estudios existentes sobre la zona y estándares de derechos humanos para megaemprendimientos. Se destaca la falta de acceso a la información y participación por parte de la comunidad de la zona, así como áreas de interés de la población local mayormente centradas en los impactos en el agua y la posible generación de empleo en la zona. La investigación evidencia los efectos de una política de transición energética basada en una mirada de sustentabilidad tecno-economicista que vulnera derechos humanos.

Palabras clave: transición energética, hidrógeno verde, derechos humanos, participación ciudadana, acceso a la información

Resumo

Os debates sobre a transição energética concentram-se principalmente em políticas nacionais e benefícios socioeconômicos e ambientais; no entanto, esses processos ocorrem em comunidades específicas onde os projetos de transição energética têm consequências materiais e simbólicas. Este artigo apresenta os resultados de uma pesquisa realizada na área de influência do Projeto Tambor para produção de hidrogênio verde em Tacuarembó, Uruguai. O trabalho foi realizado em resposta a uma demanda da comunidade para documentar as informações e oportunidades de participação que a população teve desde o anúncio público do projeto em 2022. Apresentamos uma contextualização do caso, os principais resultados da pesquisa e uma discussão destes com base em dados existentes sobre a região e padrões de direitos humanos para megaprojetos. O artigo destaca a falta de acesso à informação e à participação sobre o megaprojeto, bem como tópicos de interesse da população local, que incluíram impactos sobre a água e a possível geração de empregos na área. A pesquisa mostra os efeitos de uma política de transição energética baseada em uma abordagem de sustentabilidade tecnoeconômica que viola os direitos humanos.

Palavras-chave: transição energética, hidrogênio verde, direitos humanos, participação cidadã, acesso à informação

1. Introduction

According to the latest IPCC report (2023) and other academic studies (i.e. Hickel & Kallis, 2020), the current level of global energy consumption is not sustainable and is causing serious environmental and social damage. The reduced availability of energy, with climate change and its impact on many ecosystems have generated a series of social and environmental crises. This polycrisis (Bringel & Svampa, 2023) manifests in different ways at global and local levels in terms of social problems and environmental impacts that result in the deepening of already existing inequalities and precarity. Similarly, the proposed solutions to these problems have different meanings when seen from geopolitical or local power arrangements. The establishment of energy transition policies entails decision-making processes at different scales that do not always consider ethical and social justice principles. On the one hand, energy transitions are presented as state-led interventions to promote investment in technological changes away from fossil fuels and towards renewable energies that promote decarbonization and mitigate climate change. On the other hand, just transitions incorporate a social and environmental layer to technological innovation and

transformation. This "just energy transition" (JET) challenges the extractivist nature of neoliberal economic policies that promote economic growth, ignoring its social and ecological impacts. Energy transitions involve political processes and transformations in technological, economic, social, cultural and environmental spheres of life.

From a political ecology and a human rights perspective, understanding and promoting JET requires analyzing power relations, energy systems and social relations. Social discourse in Latin America tends to present the problem as a transition into new sociotechnical decarbonization processes without considering the injustices that operate at different scales (Benites Lazaro & Serrani, 2023). The predominant discourse also frames this transition as an economic opportunity for a region that has all the resources needed to participate in the new global renewables energy market (Benites Lazaro & Serrani, 2023). The reduced availability of energy in the global North, together with the increase in demand, climate change and environmental problems are driving a series of public policies aimed at promoting megaprojects in local communities in the global South to satisfy increasing energy needs of richer countries and affluent social groups. Taking a human rights stance to these issues entails setting more ambitious goals for the energy transition, that surpass technological innovation and decarbonization and push for a continued improvement of life conditions.

However, this new energy transition in Latin America is moving in a different direction that has generated a growing number of socio-environmental conflicts and violations of human rights (see Castañeda Olvera, 2020). The decision-making mechanisms for the installation of these projects do not involve local populations, which reveals inequalities and power differences between the various interests at stake. As Arocena (2024) points out, one of the main challenges for sustainable and inclusive development in the region is to reflect on "how to democratically address the double crisis of unsustainability combined with inequality" (p. 31).

From a critical human rights perspective (Herrera Flores, 2008), the development of just energy transition policies, plans and programs should be inclusive and participatory, always seeking to respect and guarantee the rights of all individuals and collectives (IACHR, 2018). These rights, conceptualized as an aspiration to expand ways to live a life worth living, are constantly challenged by the application of solutions to environmental and social problems in the region that are typically designed as if the territories where projects are carried out were "empty spaces." These energy transition models are designed and deployed without discussion or democratic participation of the communities affected by them, resulting in the violation of individual and collective rights. These unjust processes have been described geographically in the academic literature as 'sacrifice zones' (Lerner, 2010), 'socially voidable spaces' (Svampa, 2017) and in relation to energy ventures: 'green sacrifice zones' (Zografos *et al*., 2020). We believe that incorporating the social, cultural and human rights dimensions into the analysis and design of projects and public policies addressing the energy crises can ensure that the populations of the impacted areas do not suffer violations of their rights or basic needs.

In this article, we examine the impact of global energy transition trends on a small rural community, specifically in relation to the production of so-called "green hydrogen" and its derivatives. "Green hydrogen" has been promoted as a solution by industrialized countries to transition towards a more environmentally-friendly energy grid, and as a potential alternative to address the current oil supply crisis and the eventual depletion of fossil fuel reserves on a global scale. The promotion of industrial sites to produce these new energies, and in general green hydrogen megaprojects in Uruguay, has generated growing conflict in the territories where they are to be

installed.[2] The mechanisms through which this type of project is chosen do not incorporate the population in the territories in decision-making, revealing inequalities and power differences between different interests at the global, national and local scales.

These conflicts are manifestations of the intensification of land use for extractive purposes that impact ways of living, organizing, and being in those places, and provoke resistance. Social movements and activists organizing to defend these territories appeal to human rights discourses to challenge and critique this energy transition agenda. Current human rights laws and agreements provide tools for struggles and mobilizations in defense of small communities and vulnerable groups.[3] Human rights emerge as local ways in which communities struggle for a dignified life, and simultaneously operate as judicial tools guiding the obligations of the State to guarantee certain actions, processes and services when regulating and proposing new energy policies and projects (Hessling Herrera, 2025).

This article reports our work with environmental groups from communities within the Tambores area in the department of Tacuarembó (Uruguay) where a project to build a green hydrogen production plant was announced in 2022. Our ongoing participatory research since 2023 integrates ethnographic fieldwork and quantitative surveys, with the purpose of providing data and research, and serving environmental groups' needs for the defense of their rights. We seek to contribute to the discussion of just energy transitions with a territorial perspective, considering how people in the area experience this process and focusing on their rights of access to information and participation in decisions being made about their territories and places.

2. Just energy transition in Latin America

The debate over a just energy transition in Latin America is related to global discussions on how to achieve socioecological transformation of world ecologies tainted by capitalism (Moore, 2015), and the dangers of different forms of energy colonialism (Cerutti *et al*., 2025; Gudynas, 2024; Martínez-Alier *et al*., 2023; Riechmann, 2023; Svampa, 2022, 2023). Social and environmental justice are linked to multiple factors of anthropogenic origin such as CO_2 emissions, alterations to biogeochemical cycles, and exceeding the material limits of the planet. The acceleration of social metabolism is associated with unlimited growth and the deepening of inequalities between the global North and South. Latin America is a provider of global raw materials, now in the form of "green energy." Systemic collapse (Svampa & Viale, 2020), however, can also be seen as an opportunity to transition into more socially just and environmentally sustainable futures that consider the needs of

[2] According to the Ministry of Industry, Energy and Mining in Uruguay in 2024 there were four projects announced: Proyecto Tambor E-methanol in Tacuarembó, Proyecto HIF e-methanol and e-gasoline in Paysandú, Proyecto Kahirós for heavy transport in Rio Negro, and Proyecto H24U heavy transport in Durazno (https://www.gub.uy/ministerio-industria-energia-mineria/politicas-y-gestion/proyectos-hidrogeno-verde-derivados-uruguay).

[3] Projects and/or undertakings that affect the environment, health, participation and so many other human rights must be developed within a framework of protection and respect, as established in the various existing human rights instruments. Such is the case of the Regional Agreement on Access to Information, Public Participation and Access to Justice in Environmental Matters in Latin America and the Caribbean (hereinafter Escazú Agreement) in force since 4/22/21, which seeks to protect the environment and human rights by promoting: (i) access to Information; (ii) Public participation; and (iii) access to justice in environmental matters in Latin America. Another important aspect of the agreement is the protection of environmental defenders by proposing a framework to address their particular situation within the diversity of Latin America. It is worth mentioning that Uruguay was a promoter and one of the first signatories of the Escazú Agreement (Law 19.773, enactment: 17/7/19) and continues to work actively on its implementation.

the global South. Prioritizing the wellbeing of local and global populations requires critical thinking about transitions: for what and for whom (Martinez-Alier *et al*., 2023)?

The meaning of 'energy transition' depends on the interests in question, and the fields in which discussions are raised (Chemes, 2023). According to Gudynas (2024), transition models differ in three aspects:

- duration (short or long transitions),
- type of change (reformist or transformative transitions)
- origin (foreign- or locally-driven transitions).

Araya *et al*. (2023) and Muller (2024) developed frameworks to analyze energy transitions in terms of justice and colonialism. The energy transition in Latin America is presented in hegemonic discourses as a response to the climate crisis and an opportunity for sustainable economic growth (Araya *et al*., 2023; Svampa, 2019). That narrative is described by Bertinat & Chemes (2022) as a corporate energy transition, or as a consensus energy transition by Martinez-Alier *et al*. (2023). It involves technocratic solutions and processes of accumulation to respond to an environmental crisis that does not recognize differentiation in impacts, or shared responsibilities. There is also a counter-discourse of a popular energy transition (Bertinat & Chemes, 2022), a just energy transition or socioecological transition (Araya *et al*., 2023). These narratives foreground the need for anti-capitalist socio-ecological change that distinguishes responsibilities and impacts between countries of the North and the global South (Lang *et al*., 2023; Tornel & Montaño, 2023). In the region, this issue is currently being debated in terms of the search for an ecological and just energy transition that incorporates consideration of rights. For the energy transition to be ecologically and socially just, it needs to generate endogenous development while guaranteeing participation and democracy (Chemes, 2023). It also needs pathways out of energy colonialism (Lang, 2024; Müller, 2024).

The hegemonic discourse of energy transition in Latin America region is presented as a response to the climate emergency, proposing decarbonization and 'green' technological responses. This discourse hides the relationship between climate change and colonial relations through which unequal exchanges continue to be reproduced between the global North and the South. According to some authors (Bringel & Svampa, 2023; Dietz, 2023; Hanacek, Kroger & Martinez-Alier, 2023), these relations constitute a form of 'green' extractivism, in which natural raw materials like water, wind and solar radiation are converted into exportable resources to produce renewable energies or hydrogen as an energy vector for decarbonization. These "green energy" desires of international corporations determine the future and the lives of the populations of Latin America, who must pay the price for "securing the energy supply and solving the global climate crisis, to which they have contributed in minimal proportion" (Dietz, 2023, p. 118).

On the one hand, the challenge is to overcome the historical pattern of exploitation of natural resources destined for international commodity export (Bertoni, 2023). On the other hand, for social movements this energy transition implies confronting not only the expansion of the exploitation of common goods such as water, but also challenging a techno-economist discourse that makes it difficult to create alliances at the local and international level (Dietz, 2023). According to Martinez-Alier (2023), the new consensus around decarbonization is an expansion of the frontiers of commodification and waste disposal to so-called green sacrifice zones. Hydrogen production requires large amounts of water, wind and photovoltaic energy. This translates into megaprojects involving the installation of wind farms and solar panels that span large areas, industrial plants for the hydrolysis process that extract water in places experiencing water crisis, and forms of transportation that often

depend on fossil fuels or rely on renewable sources that use minerals and scarce materials that intensify mega-mining. These transformations have cultural, social and environmental impacts.

From a human rights-based perspective, the energy transition must be socially and environmentally just, linking agendas to preserve the climate, and meeting the requirements of economic and social agendas. In other words, the responses to the challenges posed by the climate emergency must be based on solutions that do not reproduce unequal relations at the global or local level. A holistic and integral perspective that incorporates a human rights approach is needed, to ensure that the ways of addressing the problem do not result in the intensification of social conflicts, ecological destruction, or the substitution of alternative livelihoods in rural areas. A human rights-based perspective includes recognizing people's aspirations for basic needs to guarantee a good life, as well as the States' obligations to fulfill their international commitments expressed in regional and global legal frameworks, treaties and agreements.

A just energy transition aims not only to reduce greenhouse gas emissions through decarbonization, but also to reduce the social and environmental injustices resulting from extraction, production, transport, distribution and consumption of energy. A territorial ecological transition would also challenge structural inequalities and power relations that characterize local and regional extractivism.

3. Energy transitions and green hydrogen

Green hydrogen plays an important role in energy transition discussions in Latin America. Globally, there are different scenarios about the place that hydrogen will occupy in the world energy grid, expecting it to be up to 12% of energy availability by 2050 (IRENA, 2022). However, critics say that this represents a process of energy expansion and not necessarily a substitution of fossil energies, because the use of renewables is growing, while fossil energies are still in use. The green hydrogen boom in Latin America is linked to lobbying by the fossil industry and the European Union. A series of trade agreements have been made between countries of the European Union and Latin America to promote the development of this new energy industry. In Latin America, there is competition to see who will be able to produce the cheapest green hydrogen for export to Europe; local uses are not contemplated except for some figureheads related to public transport.

In the region, the promotion of green hydrogen focuses on the search for profitability and accumulation, reproducing the logic of the fossil fuel model that produced the current crisis (Wyczykier, 2023). Big transnational corporations and multilateral financing organizations (e.g. World Bank, IDB, CAF, etc.) as well as some European governments are promoting a "green energy transition" that has green hydrogen as one of its main products in the renewable energy market. Despite there being around 2,462 green hydrogen projects worldwide, only one hundred are currently active (Serrani, 2024). In this context, local governments in Latin America are promoting green hydrogen projects that come from the global market rather than from local development policies designed to respond to local social needs.

In Uruguay, the government's green hydrogen policy presented in 2023, *Green Hydrogen Roadmap for Uruguay*,[4] was framed by the country's *Long-term Climate Strategy* presented in 2021.

[4] The document was prepared by an inter-institutional group, coordinated by the Ministry of Industry, Energy, and Mining (MIEM), the Ministry of Environment, the Ministry of Foreign Affairs, the Ministry of Economy and Finance, the Planning and Budget Office, the Ministry of Transport and Public Works, the Ministry of Housing and Territorial Planning, and the Ministry of Defense, with support from the Inter-American Development Bank (IDB), along with the National Administration of Power Plants and Electrical Transmissions (UTE), the National Agency for Research and Innovation (ANII), the National Ports Administration (ANP), the

The document presents green hydrogen as an opportunity to accelerate the "successful" decarbonization of the national electricity grid and contribute to carbon neutrality by 2050 (in line with international commitments). The focus is on energy-intensive sectors such as long-distance transport (maritime and air) and other energy-intensive industries. The national strategy is based on the premise that Uruguay has a structural competitive advantage in wind and solar resources, which can complement the renewable energy sources currently being exploited. These would power the electrolysis process necessary for green hydrogen production. The document also highlights another key aspect, the availability of biogenic carbon dioxide (CO_2) from biomass generated from forest and agricultural waste, as well as from fermentation processes, which are essential for producing green methanol and synthetic aviation fuels.

Green hydrogen research and development projects in Uruguay began in the late 20th century, with academic initiatives that demonstrated the country's national technological capacity and know-how (Zinola, 2025). In 2018, the Uruguayan government made its first attempts to introduce green hydrogen into the energy grid by developing heavy and long-distance transport fueled by H_2 (Waiter, Cohanoff & Contreras, 2025). Most current green hydrogen development projects are driven by foreign and private groups and are in different stages of implementation. At present, there are two academic networks, H2UY and HUruguay Project (HUruguay [n. d.]; H2uy Network [n.d.].), which focus on developing the science and technology research needed for the green hydrogen industry. Many of the academic and private green hydrogen projects receive funding and are developed within trade and cooperation agreements with the European Union, Germany and other long-term partners.

Currently Uruguay has an energy grid that covers its electricity production from 99% renewable sources (43% hydroelectric, 28% wind, 24% biomass, and 4% solar). The first energy transition in Uruguay[5] reduced the country's dependence on imported sources of energy. Uruguay is now at number 21 in the World Energy Council rankings, which indicates that the country has energy security, equity and environmental sustainability.[6] However, the goal of this "second energy transition" is not to respond to local energy demands, but to export the green hydrogen to European countries.

The "second energy transition" is constructed as part of a mode of production based on growth using renewable energies as its driving force, but this increases demand for natural resources and expands extractive frontiers while unequally distributing externalities (Ávila, 2023, p. 23). Green hydrogen energy transition policies and projects are accompanied by water and land grabbing that impact local communities. When considering all the green hydrogen production chains there are also mining and transport impacts associated with fossil fuels, which increase CO_2 emissions. The installation of these projects in small communities also comes with movements of people that produce

Uruguayan Agency for International Cooperation (AUCI), the Technological Laboratory of Uruguay (LATU), the Agency for the Promotion of Investments, Exports, and Country Image (Uruguay XXI), the Regulatory Unit for Energy and Water Services (URSE), and the National Development Agency (ANDE).

[5] The first energy transition was marked by institutional milestones including the Executive Branch's approval of the Energy Policy Project (2005-2030) presented by the National Energy Directorate in 2008, and the signing of the document summarizing the conclusions of the Multiparty Energy Commission (January-February 2010). In 2021, the Executive Branch presented Uruguay's Long-Term Climate Strategy as a framework for advancing the second energy transition, incorporating climate mitigation objectives. Subsequently, during the same administration, the Ministry of Industry and Energy published the Green Hydrogen Roadmap for Uruguay (2023) with the aim of promoting the development of the green hydrogen industry in Uruguay as part of a national policy toward the country's second energy transition.

[6] https://www.gub.uy/presidencia/comunicacion/noticias/industria-presento-balance-energetico-nacional-2024

social and cultural transformations. As a result, new social conflicts emerge, centered on disputes over land, water and other resource uses as well as over the quality of livelihoods and life.

The design of a just energy transition requires considering the material expression of policies and projects on the lives of the people living in the territories where renewable mega-projects operate. Is it possible in this scenario to construct a just energy transition? What characteristics would a just transition need to have?

From a rights perspective, we seek to recover the idea of energy as a tool to satisfy human needs in a context of finite resources and in a region with great social inequalities. This aspiration to link the energy transition to a human rights-based perspective makes us pose other questions that need to be taken into consideration when promoting a just energy transition: In whose hands will these new energies or energy carriers be? For what purposes will this energy be used? What social and cultural impacts do the implementation processes have on people's lives?

In this article, we report on one part of our work accompanying two environmental groups that have organized to respond to the implementation of a green hydrogen project in their locality. The following section describes the methodology and then, some of the findings of the work we have conducted over the past three years.

4. Methodology

In this article, we explore how the population of a rural territory in Uruguay is positioned in the face of a project to produce green hydrogen. We adopted transdisciplinary (Klein, 2013, 2014) and collaborative action research to explore the multidimensionality and complexity of this problem. Participatory action research perspective responds meaningfully to local demand for knowledge. The research group includes residents of the community that organize in two environmental groups (Agua es vida and EcoTambores), researchers from the national public university from different parts of the country, and from diverse disciplinary fields (i.e. communication, anthropology, political ecology, biochemistry, geology, development, agronomy, sociology, psychology, and environmental sciences), and undergraduate students. This collaborative research team (Darbellay, 2015), reflected in our long list of authors, also draws on a thematic interdisciplinary and critical tradition (Klein, 2014; Robinson, 2008) approaching the problem from a complex system, holistic and situated perspective.

The research design included mixed methods and long-term community engagement. We select data collection and analysis tools appropriate to our inquiries and informed by social, historical and environmental justice theories including political ecology. We deployed our collective skills and capacities in qualitative and quantitative methods as needed. Our main interest has been to document, problematize and intervene in the process to ensure the protection of the local community's human rights.

We began our field work in 2023 with participant observation, workshops and archival research. After noticing that many of the residents were not informed about the green hydrogen project in Tambores, in 2024, the community asked us to conduct a formal survey of their knowledge and stakeholder interests. In 2025, we continued with an analysis of national and local media coverage of green hydrogen, to describe the narratives that circulate in the public sphere, and we have begun participatory water monitoring to document underground water levels.

The topic is therefore of social interest and also contributes to the knowledge of how these state and global policies are translated into the lives of the people who live in the territories. I tis, as noted, underpinned by ascertaining what a fair energy transition with a rights perspective is, from a situated perspective. Our methods have tried to make visible the concerns and experiences of groups that are

usually not included in decision-making on major issues like green hydrogen projects in their territory.

The case of the Tambor project to produce green hydrogen in Tacuarembó

Tambores is a town with a population of 1,561, located in the north-central region of Uruguay (31°52′30″S 56°14′34″W) and is shared between the departments of Paysandú (to the west) and Tacuarembó (to the east). Like other towns in the country, its history is closely linked to the railway station (opened in 1891), which, in addition to connecting and transporting passengers, played an important role in transporting livestock for slaughter in the south of the country. The railway closed in 1987.

The proposed green hydrogen and methanol plant is located 2.7 km south of the town, next to the railway line and a local road. The area of influence of Tambores belongs to the Eco-Region known as Cuesta Basáltica, characterized by the presence of shallow soils, i.e., with lithic contact a few centimeters below the surface (Brazeiro, 2015). This characteristic determines a soil that, despite being fertile, has low capacity for root exploration and low water retention capacity, meaning significant limitations for agricultural production (grains and fodder) and plantations. The main productive activity is extensive livestock farming with cattle and sheep on natural pastures. This vegetation has enormous biodiversity, is adapted to the soil conditions of the region, and forms part of the Natural Grasslands of the Río de la Plata ecosystem (Bilenca & Miñarro, 2004). The soil characteristics mean a high risk of desiccation during water deficit, affecting fodder for livestock and small crop production, orchards, etc., as well as drinking water for humans and animals. Because the Green Hydrogen Production Project would use fresh water and groundwater (Barreiro 2023), it would compete with food production and human uses.

In June of 2022, residents first received news of the installation of a large-scale private venture in the vicinity of the town to produce green hydrogen (developed by the German company Enertrag, in partnership with the Chilean-Uruguayan company SEG Ingeniería). The "Tambor project" meant the installation of a wind farm, a solar energy farm, the extraction of fresh water from the aquifer, and the plant itself, which would be capable of producing 13,000 tons per year of green hydrogen, for the final production of 70,000 tons of methanol.[7] In a context of great uncertainty and lack of information about the possible environmental and social impacts, residents of Tambores and neighboring towns formed two groups: *Eco Tambores* and *Agua es Vida*. In February 2023, these groups filed an appeal of unconstitutionality before the Supreme Court of Justice against the re-categorization of the land from rural to industrial-suburban,[8] approved by the Tacuarembó Departmental Board in November 2022 (Decree 46/2022). At that time, the collectives contacted

[7] This information comes from the Ministry of Environment's web page where the company presented a document to request the environmental location approval needed to start the project. https://www.ambiente.gub.uy/bir/manifiestos/attachments/VAL_Planta_H2_Tambor_con_anexo_enero_2022.pdf

[8] The residents argued their right to protect the environment, and participation and access to water was guaranteed by article 47 of the Constitution. These rights were being infringed by the local government decision to allow the plant to proceed. On February 23, 2024, the Supreme Court of Justice (SCJ) issued its ruling on the appeal filed by residents against the Tambor Project. In its response, the appeal was dismissed because the contested departmental decree was considered to have no legal force in its jurisdiction. However the legitimacy of the residents' claim to their right to live in a healthy environment and to protect their fundamental rights, representing diffuse interests, was recognized.

researchers from the University of the Republic (Udelar),[9] asking for research support and participation in this campaign.

The survey

Based on our field experience and participation in different instances of public discussions about the megaproject, the university team agreed to carry out a survey in 2024 in response to the local request. The survey was titled *Green Hydrogen and Tambor Project, perception and information of the inhabitants of the area of influence,* and its purpose was to find out what local people knew, those that did not voluntarily attend the previous workshops and information sharing instances offered by the research team. It provided a more rigorous statistical survey of the opinions and interests of the population and neighboring areas regarding the possible industrial green hydrogen plant.

Systematic data collection on local perceptions also provided evidence of the fulfillment of human rights for individuals, social groups and communities. The megaproject's official communication with the Ministry of Environment seeking environmental authorization also guided the area targeted for our surveys (Figure 1). The communication was due to be followed with an environmental impact report, and finally a permission to begin operations.

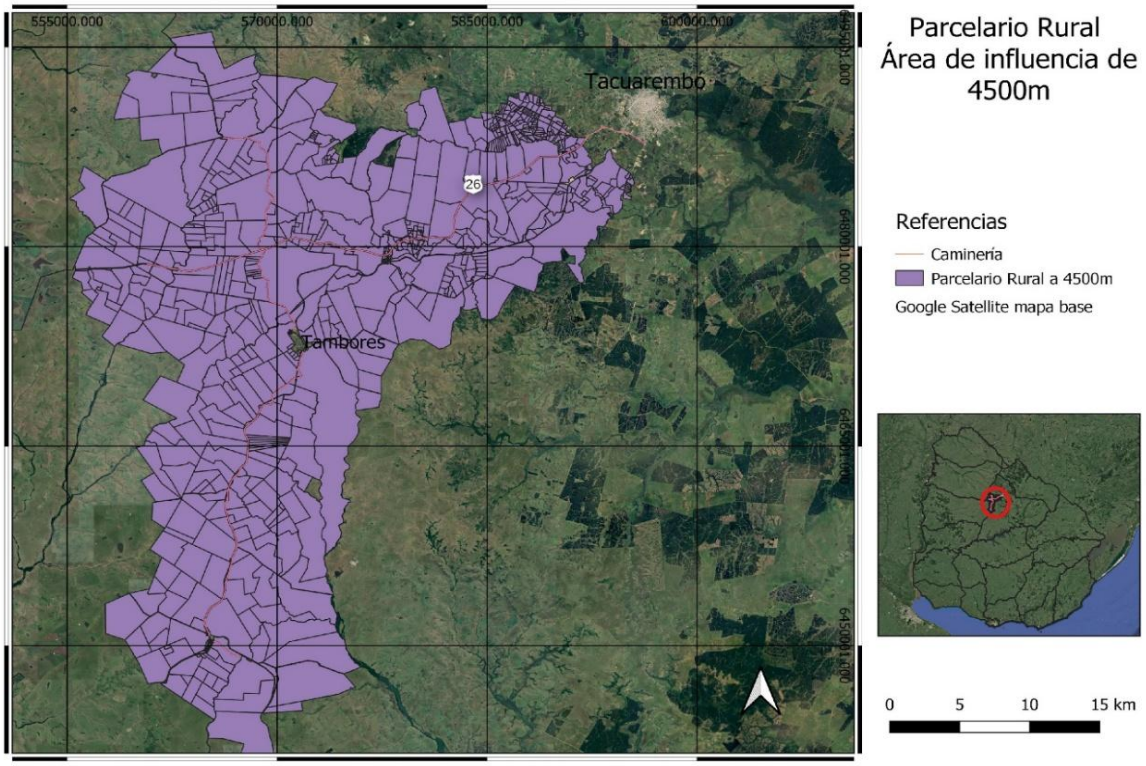

Figure 1: The sampled area.

[9] Uruguay has one large public university established in 1849, Universidad de la República, that produces 80% of the research and has over 80% of the students in tertiary level education, with locations all over the country. There is also a technical public university that was founded in 2012 and only has campuses in some regions outside the capital city area.

We used the 2011 Population and Housing Census zoning framework for localities recognized by the National Statistics Institute (INE). For all other localities, we used Google Earth was, and for rural areas, a combination of rural cadastral parcel data and Google Earth. With Google Earth, a visual inspection of potential dwellings was carried out, to eliminate suspected unoccupied dwellings. This characteristic was considered when sampling, mainly to define sample sizes.

Regions	Total
Tambores	57%
Rural	16%
Rincón de la Aldea	14%
Piedra Sola	10%
Valle Edén	3%
Grand Total	**100%**

Table 1: Surveyed areas within the sample.

The questionnaire, the sample and the survey implementation plan were prepared between September 2023 and April 2024 by an interdisciplinary group of researchers from the Universidad de la República. The sample design was done by researchers from the university's Statistics Institute. The stratification was defined based on the information available about each of the locations and resulted in 242 dwellings. The calculation of sample weights was carried out in accordance with the design used.[10] One person per household was surveyed, and the percentage of women was higher than in the population distribution. To correct this, a procedure was carried out to adjust the weighting of men and women in the localities of Tambores and Piedra Sola according to information from the 2011 Census. The expanded totals for men and women exactly reproduced the distribution of this variable according to the 2011 Census for these localities, which form the bulk of the respondents.

The survey questions focused on the most sensitive issues raised in previous interactions with communities. We inquired about access to information, encounters with the megaproject proposal, what issues interested respondents in relation to the project, and their positionality. Other questions, like water availability, employment prospects, local development, safety and social impacts were also asked. These issues had come up in questions from the audience in the two previous events conducted in the community.

Over 200 households were surveyed on April 20 and 21, 2024 by a team of 10 professors and 26 students from Udelar. Additional surveys were conducted for one day, ten days later. To safeguard the data, we retained the printed survey in paper format, consent forms, and transferred data to Qualtrics, with duplicates eradicated and data cleaned, which offers analytical capabilities (see the detailed description of the methodology in Appendix 8.1).

[10] Three types of adjustments were considered: for outdated sampling frames, for non-response, and finally, calibration by sex, to mitigate response biases.

Frequency data were analysed in SPSS. and cross-referenced with existing demographic data from national government records. Relationships between values, stance on the project, and level of information were also explored.

5. Survey results

We follow the topics covered by the survey in presenting the main findings (see survey in Appendix 8.2). The data analysis was conducted by a group of professors and students. Responses were tallied and cross-checked against demographic data. Interaction analysis between variables was then performed between scale-type questions. A 95% confidence interval was estimated for all calculations. We outline the demographic profile of the population, and their perceptions are identified in relation to their rights. We assess their interests, values and overall stance on the megaproject.

Population characteristics

We found that 57.2% of the surveyed population is in the town of Tambores, the most populated town in the project's area of influence. The rest includes the towns of Piedra Sola, Rincón de la Aldea, Valle Edén, Los Rosanos and rural areas of Tacuarembó and Paysandú. In terms of age, 48% are between 40 and 64 years old, 26.8% between 18 and 39, and 21.9% are over 65, with gender balance (Table 2).

Age by Gender	Female	Male	Total
18 to 39 years	15,33%	11,50%	26,83%
40 to 64 years	26,58%	21,37%	47,96%
65 years and older	6,41%	15,48%	21,89%
No answer	2,32%	1,00%	3,32%
Total	**50,64%**	**49,36%**	**100%**

Table 2: Population by age and gender identity.

The national ethnic-racial identity of Uruguay is, according to the Observatorio de Territorio Uruguay of OPP, 4.8% Afro or black, 2.4% indigenous, 90.7% white, 0.2% Asian and 0.2% other. Tacuarembó department has a higher percentage of indigenous people (5.7%) and 6.4% Afro-descendant. Survey respondents identified themselves indigenous (29.5%) and Afro-descendant (20.4%) (Table 3). These high levels are explained by the organization of collectives of these historically excluded groups in this region (Cristiano, 2011; Padrón, 2011; Sans, 2022).

Ethno-racial identity	
European	45,9%
Indigenous	29,5%
African	20,4%
Other	3,8%
Total	100,0%

Table 3: Main ethnic-racial identity of the sample.

Some 17.8% are engaged in activities related to rural work, of which 9.7% are salaried and 8.1% are farmers. Some 28% are self-employed, while 22.3% are retired or pensioners and 19.1% perform unpaid household chores. In terms of educational level, a high percentage have not completed secondary school (41.1%), 6.7% have completed tertiary education and 2% have no formal education (Table 4).

Educational Level	Female	Male	Total
No education	0,83%	1,22%	2,04%
Incomplete primary	2,50%	3,66%	6,16%
Complete primary	13,25%	14,09%	27,33%
Incomplete secondary	22,40%	18,67%	41,07%
Complete secondary	4,99%	8,40%	13,40%
Incomplete tertiary	2,11%	1,22%	3,33%
Complete tertiary	4,58%	2,10%	6,67%
Total	**50,64%**	**49,36%**	**100%**

Table 4: Educational level by sex-gender identity in the survey.

We observe that the survey responses were from historically excluded groups likely to have low participation in the design, planning and decision-making activities in their territories. We know that these groups are impacted by extractive and development projects (REDESCA, Business & HRDs, 2019). Rights violations in terms of poverty, discrimination and other exclusionary practices need to be visible, given the numbers of women, indigenous and Afro-descendant communities.

Participation and information on land uses

A large number of respondents were aware of their rights to information and to participate in land use decisions. Almost 60% believed they had these. However, only 22.7% said they had participated in some instances or had been invited to think about the future of the region; that is, 77.3% had not. The right to participate is not being exercised.

Among those who did so, 4.6% participated in events or consultations arranged at national level, 9.3% locally, and 4.7% in opportunities self-managed by the community. There were calls from the Ministry of Livestock, Agriculture and Fishing on drought conditions or oil prospecting, and at local scale, participatory budgeting for municipalities and localities. For this, suggestions included building a picnic area or a secure place to hold neighborhood meetings.

The responses show the population has awareness of major proposals: 33.5% mentioned the green hydrogen plant. Other projects mentioned were related to the national energy company UTE (8.3%), the search for fossil oil (5.7%), the creation a general practice clinic (5.7%), and commercial forestry (2.1%).

Information and participation in relation to the Tambor Project

Despite this, the majority of respondents had no knowledge of the Tambor Project and the possible installation of a green hydrogen production plant in Tambores (45.2%) or only a little (34.6%). Information sources included the radio (21.5%), word of mouth – neighbors, friends, and relatives (18.9%), in a talk or meeting (13.5%), through social networks: Facebook, Instagram, internet (9.2%), television (7.4%), educational centers: high school, university (3.8%) or other media (1.2%).

The majority were not familiar with how a green hydrogen production plant works (68.1%). Regarding the Tambor Project, people considered that they were not adequately informed and that planning progressed with little public dialogue. Some 78.2% wanted to know where to get more information about the project, once they were made aware. There were also comments about the importance of having quality and reliable information, with no political bias.

Interests and information survey responders wanted to know

Water, and employment, were the topics of greatest interest to people. Most respondents wanted to know what type of jobs might be available for local people (88.1%). The open questions and comments revealed an interest in whether employment would be for the local population or for outsiders, and whether the project would help keep young people from leaving the locality.

How much water would be used by the green hydrogen production plant was also a source of concern for 80.8% of respondents, and where the water would be taken from (80.7%). Some 82% wanted to know how the availability of water for other uses would be impacted. There were also comments related to impacts on water quality, environmental contamination, and where people would source their water if local supplies were used.

In addition, the survey showed there was interest in the social consequences of the project (73.2%) and knowing the benefits it will bring to the community (81.1%). Other issues that stood out were the possible risks and accidents that could be caused by having a plant of this type in the area.

Perceptions of the Tambor project and position on the H2V plant

When questioned about their stance on the Tambor project, 43.7% of respondents did not yet have a definite opinion, mainly because of lack of information. Some 24.5% were in favor, 15.2% were against and 15.4% preferred not to answer. Some 54.4% of women had no opinion, while 32.6% of the men had not taken a position. Men were more favorable to the implementation of the plant (36.2%) compared to women (12.9%). However, the survey revealed there were expectations and ideas about what the project would mean for the community. The vast majority thought it would help solve job problems (77.7%) and lead to road improvements (77.4%). The effects they believe the plant would have include generating jobs (63.4%) and producing energy for export (66.4%). Other expected impacts mentioned were the production of less polluting fuel (52.3%) and the modification of the landscape (49.5%).

In addition, the opinion scales showed that the inhabitants value prioritizing the use of water for human consumption and food production over the production of green hydrogen. They considered that water not suitable for human consumption should be used to produce green hydrogen and that the company should pay for the water it consumes. Water conservation is a value shared by the population. These statements of broad consensus in the locality and surrounding areas reflect positions that were endorsed by the Uruguayan population in 2004 in a plebiscite for constitutional reform, which recognized the human right to water, its public management, and citizen participation. Uruguay was the first country in the world to recognize the human right to water in its constitution.

As a result, there is a high level of awareness of the importance of water as a common good essential for life and dignity.

6. Discussion

In recent years, international organizations, governments and corporations have been promoting an energy transition as a response to the climate crisis, and to a decrease in energy availability and lack of economic growth. Using critical perspectives and political ecology thinking, it is important to question what type of energy transition is promoted, for whom, how, and where (Rátiva Gaona *et al.*, 2023). Thinking about policy directions includes considering how social problems are identified and how capable the people affected are, contributing their knowledge in pursuit of transformative change aimed at equity (Sutz, 2024). The power asymmetries of different actors are manifested in what problems are identified, and in the agendas and in the strategies that are deployed to solve them.

The Tambor Project clearly shows how these imbalances in power play out on the ground. A German renewable energy company, Enertrag, with interest in expanding its extraction frontiers has been using a colonial logic that reproduces unequal economic relations in this new market (for example, the company has investments in Namibia, a former German colony, where it is also proposing a green hydrogen hub). This type of project receives indirect public funding by using public water sources, public energy infrastructure and tax exceptions, while local business and residents struggle to make ends meet. The construction of science, technology and innovation (STI) policies that should incorporate the interests and needs of historically excluded actors or vulnerable groups can be aided by researchers, to "unearth problems" make them visible and "translate them" (Sutz, 2024, p. 429) into scholarly terms so that they can be incorporated into a research and technology development agenda that responds to local needs.

We will discuss the main results of the survey as researchers from a public university funded by state monies, and with a commitment to producing knowledge that serves public interests and defends human rights. Our interpretations also draw on a critical perspective recognizing human rights as processes that open spaces for the struggle to achieve lives worth living. Rights are simultaneously legal obligations that bind states and companies to guarantee basic needs as stipulated in national and international jurisprudence.

The main findings were that the population around the area of influence of the green hydrogen project reported not having information about the project, and that they have not benefited from 'effective and real' participation. Uruguay has relevant norms and legislation (among others Art. 47 of the Constitution, the Law of Land Management and Sustainable Development, the Law of National Water Policy, 18.610 and Law 19.773 Escazú Agreement) in which the inclusion of citizens in the planning and decision of land uses is promoted. However, as the results of the survey attest, this right has not been actively realized in the case of the Tambor Green Hydrogen Project. The potential impacts of the project on the availability and quality of water in the area were also identified as issues of interest and concern for the population of the area.

Employment was mentioned as a potential benefit linked to the implementation of this green hydrogen project. The population does not have a defined position on this, or prefers not to express an opinion. Community values and interests are to safeguard a common good, water, and to improve local living conditions, which means demanding work associated with the project. Protecting the rights of populations in territories when such commercial activities are proposed is vital.

The report "Business and Human Rights: Inter-American Standards" by the Inter-American Commission on Human Rights (2019) highlights the importance of ensuring effective mechanisms

for transparency and access to information around commercial activities, placing human dignity and people's autonomy centrally. Key conclusions of that report which inform our analysis of the survey results from a rights perspective are:

- Companies must provide timely, accessible and complete information to counteract the imbalance between them and communities.
- Ensure effective mechanisms for community participation in state and company decision-making, essential to ensure that corporate decisions respect human rights.
- It is important to protect the rights of vulnerable populations, including the rights of indigenous peoples and Afro-descendants.
- Development must be sustainable, prioritizing well-being and human rights over economic success. It is essential to remember that the right to development implies a process in which all human rights and fundamental freedoms are fully guaranteed.

There are significant discrepancies between these standards and the implementation of the Tambor Project. The results of the survey make visible the experience of those who live in its area of influence. Some of the central findings of our analysis include:

- Although 59.4% of the population of the study area considers that they can participate in project planning, only 22.7% expressed having participated or been called to do so. There is a gap between the recognition of the right to participate and implementing those rights.
- Almost 30% of the population in the study area self-identifies as indigenous and 20.4% as Afro-descendant. An inclusive approach that respects and promotes their rights is imperative, ensuring that their voices are heard, and their needs are addressed within the Tambor project. The high representation of these groups and their low participation in decision-making contrasts with the OAS focus on the need to empower and protect them in the context of commercial activities.
- Some 45.2% of people know nothing about the Tambor Project, and 68.1% do not know what a green hydrogen production plant is. The main sources of information are radio, word of mouth and talks/meetings, indicating a lack of formal communication mechanisms. This lack of information hinders informed decision making and effective community participation.
- The issues of greatest interest to the study area population are the impact of the project on local employment and water use, areas that, if violated, threaten sustainability, quality of life and rural activity. Most believe that the project will help solve employment problems (77.7%) and improve roads (77.4%). However, there are also concerns about environmental impacts from the plant, whether it will serve to prevent young people from leaving the locality, and possible risks and accidents. It is crucial to address these concerns by ensuring that the benefits of the project are distributed equitably and respect the environment.
- According to previous studies we know that the impacts of this type of mega-project are multidimensional, complex and unequal. We recognize this study is a first step. It can include and record the intersections between territorial, gender and ethno-racial identities, and this requires documenting the impacts that affect groups with special human rights protections.

The survey identified the main community interests, some of which are about the availability of water. This interest is related to the way in which green hydrogen is produced through an electrolysis process. In the case of the Tambor Project, and although this aspect has not been fully clarified, the primary source of green hydrogen would be underground water, initially from the Arapey aquifer, without ruling out the Guarani Aquifer System (SAG). In addition, the company is exploring the possibility of surface water supply (as stated in the company's EIA). The initial prospective wells in the Arapey aquifer were dry or had very low flow rates.[11] In the area where the project would be located, the depth of the SAG is currently unknown. If water is extracted from the subterranean system, we would be dealing with the use of a non-renewable strategic resource, with the danger of depletion or contamination (Álvarez, 1997). In a regional context marked by recent drought and climate change, the hydrological cycle will be affected, and extreme climatic events could impact access to water for human use in the area and compete with other productive activities already in place. The productive use of water in the area is mainly in the livestock sector. Extreme events such as drought cause forage and water shortages that affect livestock. As observed in the recent water crisis in the country in 2023, one of the great challenges is to guarantee access to water for human consumption as stipulated in Article 47 of the Uruguayan Constitution.

This project promises jobs and infrastructure development in the region, both of which are in short supply. According to the Tambor Project company's description, the green hydrogen hub would involve the installation of a wind farm (about 30 wind turbines), a 500 hectare photovoltaic solar farm, and a chemical industrial plant close to the town of Tambores. None of these facilities are yet in place. According to the Observatorio Territorio Uruguay of Uruguay's Office of Planning and Budget (Oficina de Planamiento y Presupuesto, or OPP) Tacuarembó has lower unemployment than average, Although it is still high at 48.4% (based on data from 2021). Some 8% of households live in poverty (in 2021 according to the Continuous Household Survey) and 45.2% of people have at least one unsatisfied basic need.[12] Tacuarembó is quite rural, which means the promise of job creation and social services would be a welcome response to structural problems. However, the figures provided by the company (1,900 direct jobs, including technical personnel and day laborers during the construction phase) do not reveal what profiles are required, how long these jobs will last, or what working conditions those who take them will have.

According to the survey, a large part of the population in the project's area of influence has not completed high school, so it would be necessary to specify what guarantees exist that the advertised jobs will go to locals. Employment promises should also consider the social, environmental, and territorial impact of activities that affect livelihoods: will the incipient ecological tourism industry be displaced, along with progressive agroecological producers? How will the commercial and production sectors be affected? What plans are there for the conversion and transformation of skills to improve the labor market for local inhabitants? What impact will the project have on the sexual division of labor and gender gaps? What changes will it cause to modes of living and the landscape?

7. Conclusions

In Uruguay, the advances of a productive model that has favored the development of mega-enterprises based on the exploitation and export of natural resources has already resulted in an increase in environmental conflicts and in the organization of collectives with an environmental

[11] This information comes from the environmental report presented in the Ministry of Environment. https://www.ambiente.gub.uy/oan/proyectos/proyecto-tambor-planta-de-produccion-de-e-metanol-a-partir-de-h2verde

[12] https://www.opp.gub.uy/es/observatorio-territorio-uruguay https://www.opp.gub.uy/es/taxonomy/term/92

agenda (Bidegain, Freigedo & Puntigliano, 2021; Santandreu & Gudynas, 1999; Santos, 2019). Therefore, the repertoires of action of the environmental movement and civil society when large-scale projects are proposed for their territories demonstrate their capacity to articulate a diversity of interests and actors who know their rights. and make concrete demands to defend them. In this sense, we observed through our fieldwork and through the survey that this population has responded quickly to the project when it was made public through mobilization, organization and by demanding judicial mechanisms, as well as requesting outside support.

From our position in a public university we have been able to contribute to the study of problems of general interest, contributing to public understanding, and defending the principles of justice, social welfare, human rights and democratic forms of government (Art. 2, Organic Law of the University of the Republic). Our work implies an ethical positioning that makes visible and responds to the demands of civil society, particularly those of socially disadvantaged groups. The recognition of the new 'rights agenda' obliges us to consider how historically excluded groups and knowledge, not usually recognized, are integrated in the production of knowledge and in the design of public policies. At the same time, this type of work in collaboration with civil society leads to lines of research that respond to problems of social interest, and not only to the needs of those in power. This approach also offers the possibility of providing opportunities for university students to learn by applying theoretical training to concrete problems.

Our survey is a small example of how university research groups can contribute to the understanding of complex problems such as those posed by energy transition policies. We hope to unearth and make visible the concerns of those who inhabit the territory, and problematize the way in which energy transition public policies and productive models are implemented in a democratic society. The findings point to the extreme vulnerability of the people inhabiting this region in terms of their basic rights: unemployment, limited access to education and historically discriminated groups. This megaproject creates conditions where this social vulnerability is exacerbated.

As regards the regional debate on energy transition, this case study research presents evidence of how the corporate energy transition narrative (Bertinat & Chemes, 2022; Chemes, 2023) operates in the territory. We observed how this conceptualization of the energy transition does not consider the effects on territories, and reproduces a logic of accumulation, concentration and commodification, prioritizing the economic aspects of projects over the needs and concerns of the community where the megaproject is implemented. In this context, the energy transition pathway promoted by the green hydrogen roadmap policy in Uruguay is a state policy favoring green extractivism and energy colonialism.

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Appendices as separate files on article page: Methodology documents

8.1 Sample design

8.2 Survey

8.3 Information booklet