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Delayed and Approved: A Quantitative Study of Conflicts and the Environmental Impact Assessments of Energy Projects in Chile 2012–2017

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Abstract: The Sistema de Evaluación de Impacto Ambiental (Environmental Impact Assessment System—SEIA) evaluates all projects potentially harmful to human health and the environment in Chile. Since its establishment, many projects approved by the SEIA have been contested by organized communities, especially in the energy sector. The question guiding our research is whether socio-environmental conflicts affect the evaluation times and the approval rates of projects under assessment. Using a novel database comprising all energy projects assessed by the SEIA, we analyzed 380 energy projects that entered the SEIA review process between 2012 and 2017 and matched these projects with protest events. Using linear and logit regression, we find no association between the occurrence of protests aimed at specific projects and the probability of project approval. We do, however, find that projects associated with the occurrence of protest events experience significantly longer review times. To assess the robustness of this finding, we compare two run-of-river plants proposed in Mapuche territory in Chile's La Araucanía region. We discuss the broader implications of these findings for sustainable environmental decision making.

Keywords: environmental conflicts; environmental politics; environmental impact assessment; social movements; energy projects; Chilean politics; Latin American politics

1. Introduction

The Environmental Impact Assessment (EIA) is a common regulation around the world. By 2011, 191 of the 193 member states of the United Nations either had a national legislation or had “signed some form of international legal instrument that refers to the use of EIA” [1] (p. 6). The EIA process consists of evidence accumulation of the potential environmental, economic or social impacts of projects, comparing them to the baseline conditions of the area. EIA mechanisms have also been widely adopted by Latin American countries, with a considerable variation of their procedural quality [2]. With a medium degree of procedural effectiveness, transparency, consultation and technical capacity, the Chilean EIA (Sistema de Evaluación de Impacto Ambiental—SEIA) is a typical case in the Latin American context [2].

The Chilean model of development, far from being an “oasis”, also echoes many of the other trends in South America. This model is based on natural resource extraction and fits

in the wider universe of extractive countries, with abundant societal grievances, making sustainable development a difficult goal.

The SEIA systems play a substantial role in this scenario. In theory, EIA systems should allow economic development while protecting society and the environment from their harm. This ideal contradicts the fact that during the first two decades of the democratic transition (1990–2010), many projects approved by the SEIA were subject to the opposition [3].

Communities can take EIA verdicts to environmental courts, but in this matter, Chile lags behind. Compared to its Colombia counterpart, the Chilean EIA's litigation tends to favor enterprises and state interests [4]. For this reason, the SEIA is seen as a “market enabler” institution that favors business interest [5]. A recent analysis of the avocado producers in the Petorca Valley shows how state institutions are not responsive to grassroots demands for water availability when there are business interests controlling subnational and national environmental decision making [6].

Community reactions to energy projects are not a novel topic in the global literature. In comparing Japan and France, Daniel Aldrich found that the location of coal and nuclear plants is related to the absence of organized communities: “civil society, whether anticipated or encountered by the state, deeply conditions both the selection of sites for public bads and the state's response to opposition to such projects” [7] (p. 8). More recently, Doug McAdam and Hillary Boudet found that, in the USA, a mobilized community is a necessary, but not sufficient, condition for the withdrawal of energy projects [8].

Community reactions to unwanted energy projects have also received attention in the literature on Chile. A recent study about the Patagonia Without Dams movement shows how the concatenation of previous conflicts and a broad coalition of actors were able to block a mega-dam already approved by the SEIA [9]. Aware of this trend, Maillet and Albala [10] compared 26 energy projects that were facing opposition, finding that when a project exceeds 800 MW and the type of technology involved is polluting, such as coal, the opposition is more effective in blocking the projects.

Building on these previous studies, we expand the scope to small, medium and large-scale energy developments in Chile. Focusing on two specific variables related to the impact assessment process—time delays and approval rates—we show a statistical relation between opposition and the evaluation of energy projects. We find that projects facing organized opposition usually take longer to be evaluated by the SEIA. However, projects with opposition do not necessarily get rejected more often by the SEIA.

These results suggest that protests partially counterweight the lack of participatory channels. By establishing a statistical relationship between environmental assessment and societal struggles, we open a debate on the partial responsiveness of EIAs to energy conflicts in Latin America.

In the next subsection, we analyze the most contemporary literature on EIA, social movements (SMs) and opposition to energy projects. In the Section 2, we describe the methods and the database used. We employ secondary data from the Center for Social Conflict and Cohesion Studies (COES) and using computational methods, match conflicts with energy projects entering the SEIA. In the Section 3, we analyze the sample using linear and logistic regression and, to complement the statistical analysis, we compare two cases and show that the absence of organized opposition is related to shorter approval time and a higher probability of approval. In the discussion and conclusion, we highlight the implications of these results for understanding the relationship between SMs and EIAs.

1.1. Analytical Framework

The SEIA is a typical case of an EIA in the Latin American context, with a medium degree of procedural effectiveness and transparency [2]. When Chile joined the OECD in 2010, it was asked to improve its environmental bureaucracy in several ways. Through this, new environmental laws and bureaucracies were created: the Ministry of the Environment, in charge of enacting environmental policies; the Superintendent of Environment, in charge of regulation; and three Environmental Courts. Notwithstanding these changes, Chile

missed the opportunity to build a more inclusive SEIA. The environmental reforms, while intended to improve the environmental framework, failed to implement more inclusive regulation. In this way, the Chilean case can be considered representative of the Andean Region, with environmental decision making being contested by SMs.

1.1.1. Environmental Bureaucracy and the SEIA

From a political perspective, the EIA is far from being mere procedures. EIAs are critical junctures during which a latent conflict can turn into a major struggle [11]. During the participatory moment, a community's initial technical claim can evolve to oppose the project altogether. EIAs are potentially subject to political pressures from "below" and from "above" in favor or in opposition of the projects under evaluation [12].

Widely adopted around the globe, EIA systems are designed to allow for sustainable development without questioning the development itself [12]. Without the influence of sustainable development goals, EIAs can only be of limited utility for achieving sustainability. One example of this is the limited capacity of EIA in urban planning in the coastal areas of Chile [13], where the proliferation of industries perpetuates the concentration of pollution in "sacrifice zones" [14].

The SEIA is an administrative "one-stop-shop" for evaluating projects with potential environmental and human impacts. All projects entering the SEIA pursue one of two review tracks, an Environmental Impact Statement (IS) or an Environmental Impact Assessment (IA). The latter process takes longer, as it requires an analysis of several impact variables considered by the regulatory framework. Barandiaran observes that the Chilean SEIA is the result of technocrats' vision for "how best to introduce environmental governance without threatening their priority: to safeguard political stability and economic growth" [15] (p. 1022). This creates participation mechanisms that have little influence over the design, location and viability of the projects. In other words, in many cases, citizen participation is merely window dressing.

Social participation in the SEIA is "proactive;" the public can raise objections to the proposed enterprises, but it is not allowed to determine the viability, size or location of the projects. Consequently, environmental conflicts have persisted in heavily polluted coastal cities such as Quintero-Puchuncaví, Coronel Bay and the Hualpén-Talcahuano Bay [14].

Several stages of the evaluation process can be the subject of controversy. One example of this is baseline studies, generally financed by the companies and carried out by hired professionals. Baselines studies usually create the illusion that all the possible impacts can be monitored and anticipated by the project proponents, creating positive result biases [16].

The grievance between communities and environmental decision making has deep historical roots. During Pinochet's dictatorship, social participation in environmental decision making was largely restricted to the lobbying influence of certain NGOs, such as the Center for Environmental Investigation and Planning (CIPMA). After the transition to democracy, the system gradually opened up to greater public participation in response to increasing community and NGO mobilization. Patricio Aylwin, the first democratically-elected president after Pinochet, enacted the first environmental law in Chilean history in 1994 and created the National Commission on the Environment (Comisión Nacional de Medioambiente—CONAMA). The CONAMA and the SEIA introduced better regulations, but the system remained largely controlled by powerful economic interests [17].

The status quo inherited from the dictatorship evolved slowly in adopting more citizen participation. Despite the first wave of reforms in the 1990s, a "top-down" approach to policy-making prevailed. The new environmental bureaucracy was a missed opportunity to promote environmental inclusion. The resulting assessment system remained hierarchical and centralized, excluding advocacy groups and scientific communities from the evaluation process.

1.1.2. Environmental and Energy Conflicts in Chile

Environmental conflicts have existed for centuries in Latin America. Conflicts over natural resource extraction span from oil drillings in the Amazonian region of Ecuador [18] to gold mines in Peru [11], large-scale soybean production in Argentina [19], energy developments in Brazil [20], just to mention a few. Chile echoes this trend. As a country with abundant natural wealth, the areas facing the most conflict are the mining industry and the energy sector [21]. Many mining projects have encountered organized opposition when they are perceived to be a risk to water and land use [22]. In general, such environmental movements have contested the validity of the EIA process.

The “green wave” of ecological struggle was inaugurated by the Ralco Dam project, the first “high profile” environmental conflict in Chile [23]. The Ralco project was a 570 MW dam approved in 1998 for construction in indigenous lands. President Eduardo Frei circumvented SEIA officials, approving the project contrary to their advice. The project entailed the forced relocation of hundreds of Pehuenche families from their ancestral lands in Alto Bio Bio. Nowadays, the Ralco Dam represents an “egregious distributive inequity” [24] (p. 27) to the Mapuche people and has been a landmark for subsequent environmental movements.

In 2004, a new milestone in environmental conflict was marked by industrial effluent from the largest pulp mill in Chile. Located in the basin of the Rio Cruces, near the city of Valdivia, the effluent from the mill affected a protected wetland and caused the death of many endangered black-necked swans [25]. Action for the Swans, a grassroots organization from Valdivia, led the opposition against the wood products company CELCO. Although Action for the Swans did not succeed in stopping the operation of the pulp mill, CELCO had their environmental licenses reviewed by environmental authorities and their operations were suspended for a month.

On the forefront of recent SMs, arguably the most iconic has been Patagonia Without Dams, the largest environmental movement in the history of Chile [26]. HidroAysén sought to build a five-dam complex in the Region of Aysén, located on the Baker River in Chilean Patagonia. The project was approved by the SEIA in Coyhaique. After several years of campaigns, the movement succeeded in revoking the environmental permit of HidroAysén. Achieving a similar outcome, No to Pascua Lama was the first major SM in the north of Chile [27], opposing a gold mine and defending the water and glaciers, and they succeeded in placing glacier law on the political agenda [28].

It should be noted that one of the main gaps in the social movement literature is the selection of “successful movements”, leading to a bias of positive results [29]. The SM literature usually chooses high-profile conflicts with considerable impacts. In our study, we expand the focus to less visible conflicts and small-scale projects, offering a more nuanced perspective on the role of EMs on the EIA.

2. Materials and Methods

Do conflicts relate to longer processing times and lower approval rates by the Chilean EIA? Our study compares a large number of projects ($n = 380$) undergoing EIAs, not limited to large-scale projects and “successful” movements. By choosing projects of different sizes, we circumvent the bias of positive results present in the bulk of case studies on the Latin American movement, ultimately acquiring a more balanced assessment of their environmental decision making.

To capture the relation between SMs and Environmental Impact Assessments, we employ a mixed-methods empirical strategy to combine the leverage of large-N statistical analysis with the depth of case study comparisons [30]. Using quantitative methods, we find statistical associations between protest events and project assessments, and we complement this finding with a qualitative comparison of two “most similar” cases. Our study covers a wide variety of sizes in proposed projects and state-related behaviors in the evaluation of energy projects opposed by local communities.

The case selection for the comparative assessment was performed using a clustering algorithm for mixed categorical and quantitative data and grouped data. The results of this comparison strategy support the claim that, with all other factors fixed, the presence of an organized opposition is a necessary condition for delayed processing and/or rejection by the SEIA.

Data

Following recent recommendations in how to employ computational methods in the analysis of socio-environmental conflicts [31], we obtained our sample using a series of structured and unstructured data sources. In 2019, we scraped the SEIA website [32], which yielded an original dataset of 25,536 projects that entered the Chilean EIA review process between 2006 and 2019. We filtered these projects, keeping only the energy-production enterprises ($n = 380$) that began the SEIA review process between 2012 and 2017 and that were either approved or rejected within this same timeframe. SEIA provides several project outcome classifications. For simplicity, however, we used in our analysis only those projects classified as “approved” or “rejected.” Table 1 describes the data contained in the analysis.

Table 1. Groupwise statistical comparison of energy projects in the dataset ^a.

	N	Mean Investment (MUSD)	Impact Assessment Rate	Conflict Rate	Time Delay (Avg. Days)	Approval Rate
Impact Statements (IS)	323	177.09 ^b		0.01	286.04	0.97
Impact Assessments (IA)	57	283.4		0.14	647.49	0.93
Rejected	13	579.85	0.31	0.15	700.92	
Approved	367	179.33	0.14	0.02	327.49	
No conflict	370	189.22	0.13		328.38	0.97
With conflict	10	334.1	0.8		780	0.8

^a Data is grouped by type of review (IS or IA), outcome (rejected or approved), and presence or absence of organized opposition. Proportions were calculated using the rows in the N column as denominators. ^b Numbers in bold are those for which the difference between a pair of group means or proportions is statistically significant ($p < 0.05$) using a Welch two-sample t-test.

The unit of analysis is the projects under evaluation by the SEIA. When entering the SEIA, projects can take two different review tracks, an Impact Statement (IS) or an Impact Assessment (IA). ISs and IAs differ in the degree of complexity; IAs involve larger investments and, thus, require more exhaustive feasibility studies. IAs usually take longer to be evaluated and are more expensive because presenters may be required to provide a baseline study that records the preexisting economic, ecological and social conditions of a given territory. In both the IA and IS, citizen consultations are compulsory. The last two columns in Table 1 are the two outcome variables. The first column captures the temporal variation, i.e., how long a project took to be either approved or rejected, and the second is a binary variable that takes the value “1” when a project is approved.

As shown in Table 1, our sample contains 323 ISs and 57 IAs. There are clear differences among these two types of review: an IS takes, on average, 286 days to be evaluated, while an IA takes 647 days on average, a difference that is significant at $p < 0.05$. Additionally, ISs are less controversial as only 1% are associated with conflicts, while 14% of IAs are associated with conflicts, a difference that is also significant at $p < 0.05$. Finally, ISs have a slightly higher approval rate (97%) than IAs (93%); however, this difference is not statistically significant.

Notable differences are found when grouping the dataset by review outcome. While only 3% (13 out of 380) of the projects in our dataset were rejected, the average monetary value of the rejected projects is almost three times greater than the average monetary value of approved projects, a difference that, despite its large absolute size, is not statistically significant. The evaluation time of rejected projects was, on average, more than twice as

long as the evaluation time of approved projects, and this difference is significant ($p < 0.05$). Rejected projects are almost seven times more likely to have encountered citizen opposition, although this difference is not statistically significant.

There are 10 energy-related conflicts in our dataset. We find that compared to projects that faced no citizen opposition, these controversial projects tend to have a larger monetary value (334 MUSD vs. 189.22 MUSD), but this difference is not statistically significant. Controversial energy projects submitted to the IA review track took 780 days, on average, to be either rejected or approved, while noncontroversial projects took an average of 328 days, a difference that is statistically significant ($p < 0.05$). Finally, 80% of these controversial energy projects were approved despite the organized opposition to them, while 97% of those not facing opposition were approved. This difference in proportions is not statistically significant.

The opposition to energy projects was coded using a secondary source, the protest events datasets from COES, which is publicly available on the Harvard Dataverse [33]. In the COES dataset, an event is counted as a conflict when a social movement publicly expresses a collective grievance by articulating demands to and applying pressure against public or private actors. To identify instances of conflict, the COES Observatory systematically reviews digital and printed media. To avoid selection bias, the authors reviewed a wide selection of news sources. Only protest events clearly linked to projects submitted to the SEIA were considered. Using automatic and manual classification, we matched protest events and energy projects. As shown in Table 2, this yielded a total of ten protest events directly linked to energy projects submitted to the SEIA. Because we are interested in the statistical effect of these conflicts on project review time and approval outcome, we retained protests that occurred after a given project had entered into the SEIA and before the date of the project's final approval decision.

Table 2. Energy projects in the database that faced organized opposition, 2012–2017.

Project Name	Technology Employed	Region	Investment (MUSD)	Status	Days in SEIA	Year
Central a Gas Natural Las Arcillas	Natural Gas	XVI	400	Approved	567	2016
Central de Respaldo Doña Carmen	Diesel	V	43	Rejected	436	2015
Adecuaciones Operacionales Cogeneradora Aconcagua, ENAP	Natural Gas	VI	200	Approved	424	2017
Optimización Central Termoeléctrica Bocamina-segunda unidad	Thermoelectric	VIII	184	Approved	478	2013
Central de Ciclo Combinado Los Rulos	Natural Gas	V	594	Approved	763	2015
Central El Campesino	Natural Gas	XVI	804	Approved	644	2014
Plan de Expansión Cardones -Polpaico	Transmission Line	Interregional	1000	Approved	645	2014
Central hidroeléctrica de pasada El Rincón	Hydroelectric	IX	24	Rejected	1514	2013
Proyecto Hidroeléctrico de pasada Agua Viva	Hydroelectric	Interregional	70	Approved	1364	2013
Central Hidroeléctrica Añihuerraqui	Hydroelectric	IX	22	Approved	965	2012

SEIA—Sistema de Evaluación de Impacto Ambiental (Environmental Impact Assessment System).

3. Results

Using our sample of energy projects ($n = 380$), covering a period from 2012 to 2017, we built two statistical models with conflict as the main independent variable. Table 3 shows two statistical models, the first one is a year fixed effects ordinary linear regression (OLS) capturing the statistical effect of protest events on delay times. The second model is a logistic regression capturing the statistical effect of protest events on the approval rate. To complement these statistical findings, we conducted a “most similar” comparison of two cases.

Table 3. Statistical models: ordinary least squares and logistic regression on processing time and approval rates.

	DV: Number of Days	DV: Approval Rate
	OLS ^a (1)	Logistic ^b (2)
D: Conflict	238.826 ** (110.656)	−1.688 * (0.985)
Investment	0.035 (0.024)	−0.001 *** (0.0004)
D: EIA	319.677 *** (40.308)	−0.597 (0.732)
D: Bachelet	92.479 (72.415)	−0.588 (0.637)
Intercept	192.662 *** (13.403)	4.271 *** (0.586)
N	380	380
R ²	0.373	
Adjusted R ²	0.357	
Log Likelihood		−50.686
Akaike Inf. Crit.		111.372
Residual Std. Error	188.820 (df = 370)	
F Statistic	24.418 *** (df = 9; 370)	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. ^a OLS model: year fixed effects and robust standard errors in parenthesis. ^b Logit model: coefficients represent log odds. N = Sample size.

The first model is a linear regression with year fixed effects and robust standard errors for heteroscedasticity. We included a series of control variables to reduce the potential noise in the estimation of the standard errors and the magnitude of the coefficients. Because IAs are usually more expensive and potentially more invasive projects, a dummy variable to control for the type of reviewing process, IS or IA, was included. We also controlled for the monetary value of the project and included a dummy variable capturing whether the project entered the SEIA review process during the second government of Michelle Bachelet (2014–2018), a center-left government coalition viewed as more responsive to environmental demands [27].

Do projects facing organized citizen opposition take longer to evaluate in the SEIA review process? Model 1 shows that the presence of environmental conflicts is statistically associated with longer processing times. Holding all other variables constant, the effect of environmental protests on evaluation times is significant at $p < 0.05$. Compared to projects that citizens did not protest, projects facing organized opposition took 238 days longer, on average, to be either approved or rejected by SEIA ($p < 0.05$). Additionally, projects entering the SEIA review process on the IA track took, on average, 320 days longer than projects submitted to the IS track ($p < 0.01$). The effect of a project's monetary value is not statistically significant and, similarly, the dummy variable capturing whether a given project entered the SEIA review process during the presidency of Michele Bachelet has no statistically significant effect on processing times.

Are projects that face opposition more likely to be rejected? The logistic regression coefficient in Model 2 falls just short of statistical significance ($p < 0.1$). Logistic regression coefficients do not offer as straightforward an interpretation as an OLS analysis; in logistic regression, the coefficients are log odds, so one must convert the coefficients into odds ratios or percent changes [34]. Categorical-dependent-variable models fit the parameters using a logistic link function. To convert the parameters into interpretable odds ratios, therefore, one must exponentiate the parameters [35]. The odds ratio value of the conflict dummy variable is $\exp(-1.69) = 0.18$, meaning that a one-unit increase in the conflict dummy variable decreases the odds of approval by 0.18, holding all other variables constant. Put differently, the percent change in the odds of approval associated with a one-unit increase in the dummy variable conflict equals $100 * (\exp(-1.69)-1) = -81.5\%$, holding all other variables constant. However, the simplest alternative is to compute the coefficient of predicted probabilities; holding all other variables constant, the presence of conflict explains a -10% change in the predicted probability that a project will be approved ($p < 0.1$).

In sum, the OLS model provides evidence that the occurrence of protests is significantly associated with longer review times. Projects that face organized opposition take, on average, 239 days longer to be reviewed by the SEIA, a result that is significant at $p < 0.05$. The logistic regression provided weaker evidence that the approval rate for projects that elicit organized opposition differs from those that do not elicit such opposition ($p < 0.1$).

3.1. Case Selection and Comparative Analysis

A mixed-methods strategy allows us to combine the strength of large-N statistical analysis with the depth of case comparisons. Having found statistically significant associations between protest events and the EIA outcomes, we now turn to a qualitative comparison of two “most similar” cases, a strategy that enables us to show how variation in one key variable (conflict) is related to changes in other variables (delay times/approval rates). To avoid selection bias, we grouped similar observations for comparison using a K-means clustering algorithm with the Gower distance for mixed categorical and numerical features. To visualize the clustering, Figure 1 presents the K-means algorithm compressed into a two-dimensional space using a Barnes–Hut implementation of the t-Distributed Stochastic Neighbor Embedding package for R.

Table 4 details the cluster number 4 that contains only small hydroelectric projects; it also includes the most extreme case in the dataset, the Hydroelectric Central El Rincón, a small-scale run-in-river plant in the Araucanía. In sharp contrast to El Rincón, the Hydroelectric Central Pasada Condor did not face any organized opposition in La Araucanía. We chose this cluster because the cases are similar, but there is variation in the degree of environmental conflict.

Table 4. Cluster 4 projects based on the project value, type of assessment, region and year of submission to the SEIA.

Name	Value (MUSD)	Conflict	Days in SEIA	Approval	Impact Assessment
Run-of-river plant El Rincón	24	Yes	1514	No	Yes
Modification of the run-of-river Carilafquén-Malalcahuello	28	No	228	Yes	No
Run-of-river plant Condor	17	No	827	Yes	No
Hydroelectric power plant Añihuerraqui	22	Yes	965	Yes	Yes
Hydroelectric power plant Las Nieves	19	No	183	Yes	No

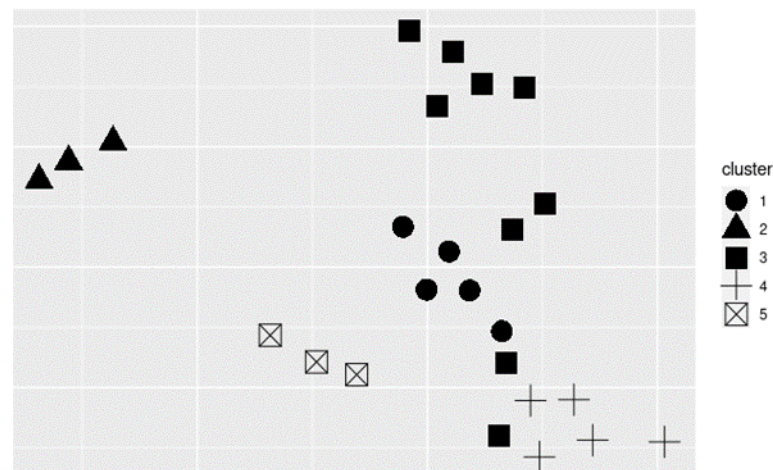


Figure 1. Hydroelectric projects clustered by investment size, Impact Assessment, region and year of submission to the SEIA review system using the Barnes–Hut implementation of the t -Distributed Stochastic Neighbor Embedding. Cluster 1 contains the hydroelectric projects Ancoa, hydroelectric central Colorado River, run-of-river plant Cumpeo and the hydroelectric central Los Hierros II; cluster 2 contains the run-of-river plant Aillín and Las Juntas, hydroelectric dam Nido de Águilas and the run-of-river plant Cipresillos; cluster 3 includes the run-of-river plant Cumbres, the run-of-river plant Cumbres Chanleufu, the optimization of hydroelectric La Mina, the operational continuity of the main camp at the Chacayes hydroelectric power plant, the expansion of La Arena run-of-river hydropower plant, the run-of-river plant Huenteleuf, the modification of the Huasco River hydroelectric power plant project and the hydroelectric power plant El Médano; cluster 4 includes the hydroelectric power plant Las Nieves, the run-of-river plant El Rincón, the run-of-river plant Halcones, the modification of the run-of-river plant Carilafquén-Malalcahuello, the run-of-river plant Condor and the hydroelectric power plant Añihuerraqui; cluster 5 includes the run-of-river plant Agua Viva, the hydroelectric power Rucalhue and the run-of-river plant Perquilauquén.

3.1.1. Case 1: El Rincón Run-of-River Plant

The run-of-river plant project El Rincón comprised a 24 MUSD investment to generate 11 MW in the Trifultruful River in La Araucanía, located around 900 km south of Santiago. The project entered the SEIA review process in 2013. Although the proposed project was less invasive than most other large dam projects, it would set a precedent for subsequent industrial developments in the heart of Mapuche lands. Opposition to the project was motivated to protect the Trifultruful and to prevent more construction of run-of-river plants in the region [36].

Anticipating the adverse environmental and cultural impact of the project, members of the Melipeuco community tried to block this development from the outset. Several other Mapuche organizations were concerned by previous run-of-river plants that had been constructed in Collipulli, Vilcún and Pitruquén. Opponents feared that the project would harm tourism, interfering with popular outdoor activities, such as rafting and kayaking. The SM coordinated with a dense network of actors beyond the Mapuche territory. They found support from Red de Defensa de los Territorios (Territories Defense Network) and established NGOs, such as the Latin American Observatory for Environmental Conflicts (OLCA).

Since Chile's return to democracy, Mapuche communities have struggled to obtain support from the country's party system, channeling their land rights claims against large-scale hydroelectric and forestry projects via grassroots organizing and NGOs [24]. As a result, the Mapuche people have built a network of associations, and these associated groups participated in the Trifultruful River conflict. A dense network of actors opposed the project and was able to delay the review process for more than 1500 days in the SEIA of the Araucanía Region.

Opposition to the project took various forms, from active participation in the citizen consultation process to demonstrations in the regional and national offices of the Ministry

of Energy. International supporters sent letters to the investors with signatures from indigenous communities across the world. The conflict was also supported by the local authorities, especially by the mayor of Melipeuco, Juan Carlos Espinoza. After a long review process, the project was rejected by the environmental authorities in 2018. The IS, which began the SEIA review process in 2013, received an unfavorable verdict in February 2018 after spending almost five years under review.

3.1.2. Case 2: Condor Run-of-River Plant

In sharp contrast, the project Condor, a 5.4 MW run-of-river enterprise in the Trueno River, in the communes of Lautaro and Vilcún located in the same region of Araucanía, faced no conflict. The project entered the impact evaluation process in SEIA in 2013 and, after a relatively long review time of 827 days, it was approved by the SEIA of La Araucanía. During the evaluation process, there were consultations with members of the indigenous communities, and no advocacy groups nor grassroots activists opposed the enterprise, nor did the local authorities in Lautaro and Vilcún. Additionally, a search of the main news sources and databases of environmental conflicts in Chile yielded no records of protests or contentious actions related to the Condor project. A similar pattern was seen for the hydroelectric project Las Nieves, a six MW run-of-river plant to be located in the Melipeuco commune with a total investment of 19 MUSD. The Las Nieves project faced no opposition, and the environmental authorities issued the approval in 183 days. As with Condor, a search of the main news sources and databases of environmental conflicts in Chile yielded no records of protests or contentious actions regarding the Las Nieves project.

In conclusion, the “most similar” comparison shows how variation in one key variable (conflict) is associated with two key outcomes, delay times and approval rates. The comparison of two almost identical run-of-river projects shows that social licensing, or social approval, plays a significant role in the fate of hydroelectric energy projects.

4. Discussion

Do conflicts matter for the environmental assessment of energy projects? Using a novel dataset of 380 energy projects that entered the SEIA between 2012 and 2017, the analysis shows a statistically significant positive relationship between the occurrence of protest events and proposal review duration. Using an OLS regression, the study found that, compared to projects that encountered no protest, projects facing organized opposition took on average 238.8 days longer to be either approved or rejected by the SEIA. More substantially, delays in evaluation times of energy projects can have a considerable impact on the provision of energy for communities and businesses alike. Although statistical association does not equal causation, this observed relationship shows that environmental bureaucracies are partially responsive to social pressure “from below”.

On the other hand, the logistic regression model gives weaker support for the claim that protest events affect the likelihood of a project being approved. Holding all other variables constant, the presence of conflict is associated with a ten percent decrease in the predicted probability of a project being approved, a difference that falls just short of statistical significance ($p < 0.1$). Our model does not allow us to claim that protests significantly affect the approval rates of projects under revision by the SEIA.

Environmental movements are complex social phenomena generally investigated using in-depth case methodologies. Using a large-N study, we show that protests have a statistically significant association with one specific outcome of the SEIA process in Chile: time delays. While these statistical associations do not prove a causal relation, the comparison of two almost identical run-of-river projects shows that social licensing plays a significant role in successfully locating energy enterprises. Because of the limitations of our data, we complemented the quantitative analysis with a “most similar” case comparison between hydroelectric projects in the Mapuche territory in Chile’s La Araucanía region. The case studies support the claim that the presence of organized opposition is associated with a longer duration of the environmental impact review.

Our findings imply that SMs have limited effects on the fate of energy development projects. We view our study as a contribution to the literature of SMs and their interaction with institutional frameworks. Specifically, we hold that new advances in the literature should account for successful and unsuccessful movements, explaining under what conditions environmental conflicts lead—or do not lead—to sustainable changes.

5. Conclusions

Our research pursued the ambitious task of using quantitative reasoning to analyze a large data set of energy projects in EIA. To our knowledge, it is the first published quantification of time delays and approval rates related to social protests against energy projects in Chile and Latin America. Our data set included data from the SEIA and COES of projects with different sizes entering the SEIA between 2012 and 2017. Using OLS and logit regressions, we found that projects which were opposed by social protests took on average 238.8 days more to be reviewed ($p < 0.05$) but were not rejected more often ($p < 0.1$). This partially confirms a pattern found in previous studies that social movements hinder energy developments. Avoiding the selection bias present in many case studies and using quantitative analysis, we found that while SMs affected the timeline, they did not stop energy projects from being approved.

Our study contributes to the rich abundance of SM literature on successful and unsuccessful mobilizations. While protests considerably delayed energy investments, SMs did not succeed in blocking the majority of controversial projects. This counterintuitive pattern was found by bypassing the selection bias in previous research, which had been generally based on case studies and highly publicized social movements against mega-projects.

In terms of research agendas, our study aligns with a renewed interest in Latin American social movements opposing large-scale projects [37]. From this perspective, we make two interrelated recommendations for future research. The first is looking into the determinants of social receptivity to energy projects. In China, for example, on-shore windfarms receive less public acceptance when affected communities do not receive compensations [38]. In Chile, mining projects can avoid social confrontation if they are not perceived as a threat to water availability [22], in other words, if they are perceived as sustainable.

A second avenue is to analyze the determinants of successful and unsuccessful SMs. Chilean energy projects tend to be successfully opposed when projects use polluting technologies [10], but there is still a lot to learn about the mechanisms employed by SMs to stop or modify projects. SMs have a wide range of strategies for contesting unwanted developments: they can take them to the judicial system and demand the auditing of environmental impact studies, they can also mobilize authorities and technocrats to influence the impact evaluation process, among many other strategies.

In addition, we also encourage researchers to go further and expand the analysis to other technological domains. Energy and mining sectors are strategic sectors in Latin America, and there is still a gap in the knowledge of the social response to sustainable projects. A comparison between the societal reactions to sustainable and non-sustainable projects can yield interesting advances in the sustainability transitions literature.

Our findings lead us to consider the role of institutional design for achieving sustainability goals. Restricted EIA procedures can make citizen participation irrelevant, leading to anger and distrust. When Chile joined the OECD in 2010, it was asked to improve its environmental bureaucracy, and a new environmental law and ministry were created. Despite these changes, Chile missed the opportunity to build a more inclusive SEIA. If community stakeholders feel that EIA procedures are irrelevant, they may engage in contentious politics to counter the top-down scheme of environmental decision making. Distrust of institutions and of decision-makers can escalate in episodes such as Chile's Social Outburst—the mass mobilizations that took place during October and November of 2019. A possible way to overcome this cycle of citizen distrust is enhancing participatory mechanisms and direct democracy in strategic developments.

The main recommendation for policy-makers is to include citizen participation in key stages of the energy projects, especially at the beginning of the process. By understanding citizens' concerns about future developments, planners and investors can avoid and manage potential social confrontations. Assuming that time delays usually translate into financial costs, it is imperative to consider the social acceptance of the projects. Another ethical recommendation to include environmental justice criteria in EIA, with a special focus on inequality, to avoid disadvantaged areas becoming the preferred destination of polluting enterprises.

There is consensus within policy circles that sustainable development must consider citizen participation in decision making. In this regard, the Chilean landscape is troublesome as many projects are approved by the EIA despite being opposed by local communities. The SEIA is an institution that allows development but does not question its necessity. This poses the risk of perpetuating the tensions between citizens and environmental decision making. Social participation can potentially regenerate the modes of communication between citizens, authorities and business leaders. For a sustainable future in developing countries, the logic of decision making must shift from being "top-down" to socially inclusive in a substantive way.

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