

1 . Mapping and Managing Organization Objectives: A Case Study of the Alto Maipo
2 Hydroelectric Project in Chile
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5 Jeffrey P. Walters*^a, Hernán Alcayaga^b, Carolina Busco^c, Tamara Araya^d
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8 ^aAssistant Professor, George Fox University, Department of Civil Engineering, College of
9 Engineering, 414 N. Meridian ST, Newberg Oregon, 97132 USA
10

11 ^bAssociate Professor, Universidad Diego Portales, Department of Civil Engineering, College of
12 Engineering and Applied Science, Av. Ejército 441, Santiago, Chile
13

14 ^cAssistant Professor, Universidad Diego Portales, Department of Industrial Engineering, College of
15 Engineering and Applied Science, Av. Ejército 441, Santiago, Chile
16

17 ^dInternational Programs Executive, Zurich Insurance Company Ltd., Corporate Center, Austrasse 46,
18 8045 Zurich, Switzerland
19

20 *Corresponding Author, jwalters@georgefox.edu
21

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26 **ABSTRACT**
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28 This study presents a process that uses the method of alliances, conflicts, tactics, objectives and
29 recommendations (MACTOR) to inform integrated water resources management (IWRM) strategies
30 for complex, multi-organization hydroelectric projects. This process is applied to the Alto Maipo
31 Hydroelectric Project (AMHP) in Chile. The process enabled qualitative and quantitative insight on
32 the interconnected aspects of alignment and conflict between AMHP organizations by mapping the
33 ‘battlefield’ on which they converge or diverge based on their organizational objectives and relative
34 levels of influence. Study findings reveal environmental protection and water provision are the core
35 objectives around which conflicts center. Study findings also point to a nuanced power struggle
36 between state and local organizations that undermines project productivity. Project recommendations
37 focus on improving communication and collaboration between aligned yet siloed organizations and on
38 improving the mechanisms for information flow and advocacy for local community and governmental
39 organizations. These findings demonstrate the utility of the MACTOR approach – as it is applied
40 within the proposed process – as a way to inform IWRM strategies for multi-organization
41 hydroelectric projects from a systems perspective.

42 INTRODUCTION

43 It is becoming increasingly challenging to plan and manage water resources in light of water
44 scarcity, pollution, and a growing percentage of the population moving to urban centers (United
45 Nations et al. 2019). In the midst of these challenges, Integrated Water Resources Management
46 (IWRM) offers a means to address the complex and multidimensional linkages between the various
47 water resource stakeholder groups (Davis 2007; Gallego-Ayala and Juárez 2014; Suárez et al. 2014;
48 Hargrove and Heyman 2020). A core goal of IWRM is to thoughtfully consider and apply the
49 knowledge of a diverse range of stakeholder groups to optimize social and economic benefits while
50 not compromising resource sustainability (Hassing et al. 2009; Suárez et al. 2014; Davis 2007;
51 Werkheiser and Piso 2015).

52 Large hydroelectric projects provide a salient backdrop for the use of IWRM strategies,
53 especially related to conflict mitigation and the sustainable and equitable provision of both water and
54 energy resources (Jusi 2013). Hydroelectric projects often fall within the realm of ‘megaprojects’,
55 given their high cost and the impact they pose on society, the environment, and on the resources they
56 depend upon (Ansar et al. 2014; Flyvbjerg 2014; Sovacool and Bulan 2011). Like most megaprojects,
57 large hydroelectric projects involve multiple organizations from both public and private sectors. Here
58 we define an organization as any organized group of stakeholders that may affect or be affected by the
59 achievement of the purpose or purposes of a project (Freeman et al. 2010). Separate from an
60 unorganized group of individual stakeholders, such as water or energy consumers, organizations have
61 concrete objectives and a spokesperson who can represent the organization in an articulated manner.
62 As a result of the inherently complex organizational environment within which large hydropower
63 projects exist and operate, the true influence organizations can have on project development and
64 management is extremely variable (Bourne and Walker 2006).

65 Organizations integrate within a wide and complex network of competing interests and
66 objectives (Davis 2007). The process of management throughout and beyond the construction of
67 megaprojects have been widely discussed in the literature, with the chief objective of obtaining the
68 support of the many organizations involved (Ignatius Teye Buerthey 2016). Yet it remains challenging

69 to navigate the complex drivers of alignment or misalignment of organizations based on their
70 objectives and interests, often leading to conflict and suboptimal project outcomes and increased
71 project costs (Flyvbjerg et al. 2003; Ignatius Teye Buerthey 2016; Jergeas et al. 2000; Newcombe
72 2003; Yang and Shen 2015). There have been many past instances where hydroelectric projects were
73 not implemented due to their potential and perceived impacts on the environment and on local
74 communities. For example, in the Chilean Patagonia, the Alumysa Aluminum Reduction Plant project
75 (US \$ 2.75 billion) was discarded in 2006 (Dashwood 2012) and the HydroAysen hydroelectric
76 generation project (US \$ 3.2 billion) discarded in 2014 (Merino and Bello 2014), both as a result of
77 the strong demands of environmentalist and local community organizations. These examples, and
78 many others, show the participation, and perception, of relevant organizations in the development of a
79 megaproject in general, and a hydroelectric project in particular, can have a critical impact on project
80 success (Davis 2007). This highlights the impetus for IWRM strategies that undergird and support
81 productive communication and collaboration surrounding the economic, social and environmental
82 implications of large hydroelectric projects.

83 As a large hydropower project located within the fragile multi-use Río Maipo watershed, the
84 Alto Maipo Hydroelectric Project (AMHP) located 60km southeast of the capital city, Santiago
85 [population 7.1 million (INE 2018)], Chile, in the Cajón del Maipo, offers a compelling multi-
86 organization IWRM case study. Since its inception, many regional water supply utilities, rural potable
87 water organizations (APRs), citizen activist groups, farmers, and social organizations, including the
88 urban water service company Aguas Adinas, have vehemently opposed AMHP. They claim the
89 project threatens the security and supply of potable water to the seven million inhabitants in the
90 Santiago Metropolitan region, including farmers with 120,000 ha of irrigation and ten rural
91 communities where drinking water is supplied by APR systems. APRs, which are managed,
92 maintained and operated by the local community, have different regulation and performance
93 frameworks than urban water companies such as Aguas Adinas. Some predictable environmental
94 impacts from project construction include river sedimentation, area desertification, and significant
95 reduction in groundwater recharge rates (SEA 2018). In contrast, advocates purport AMHP will bring
96 much needed employment and innovation to the region, and bolster energy security in Chile (SEIA

97 2007). Despite these conflicting perspectives, a marked underestimation of implementation costs
98 (initially US\$700 million USD, now 3.05 billion) coupled with market challenges (Torrealba 2018), it
99 is estimated that the Alto Maipo project will begin injecting electricity to the Central Interconnected
100 System (SING) in late 2021 (Ministry of Energy 2012; El Mercurio 2020).

101 Past water resource experts have sought to promote IWRM strategies for basin management
102 in Chile (Donoso 2018). Despite these efforts, however, there are still no policies in Chile that
103 explicitly consider critical issues, such as social equity, environmental protection, environmental
104 management, coordination of different uses and conflict resolution, all key aspects of an IWRM plan
105 (Bauer 2009, 2015; Suárez et al. 2014). A history of neoliberal water management model undergirds
106 this outcome, which fundamentally favors large private corporations, especially hydropower projects
107 (Bauer 2015). Chile has a long history of water-related conflicts – initiated and promulgated by the
108 Chile 1981 Water Code, which officially established that water resources are national and public
109 goods. In this legal framework, water rights could be commercialized and transferred as a commodity
110 between private parties (Bauer 2009, 2015; Bitran et al. 2014; Correa-Parra et al. 2020). While the
111 1981 water code has since been modified in 2005, critics still point to this law as a key hindrance to
112 IWRM policy and practice in Chile (Bauer 2015; Bitran et al. 2014). When referring to larger
113 hydroelectric projects, the complexity and issues around IWRM are further confounded by the clout
114 and prominence of Chilean energy law, further privileging private access to water resources for
115 energy creation (Bauer 2009, 2015). Bauer (2015 p. 147) echoes these points, stating, “the critical
116 problem of the Chilean water model is the lack of institutional capacity for governance or integrated
117 water resources management, and the problem has worsened as water conflicts have become closely
118 linked to conflicts in the energy and environmental sectors.”

119 By virtue of the inherent interdependence of social, environmental, technical, political and
120 economic impacts of large hydropower projects, IWRM strategies requires a systems-lens through
121 which to manage the objectives of organizations in order to promote just and equitable distribution of
122 resources, and to mitigate conflict (Grigg 2016; Hassing et al. 2009; UNDP 2008). Past research has
123 focused on ways to visually and quantitatively analyze and interpret the systemic interaction between
124 organizations. One powerful approach is the ‘Stakeholder Circle’, developed by Bourne and Walker

125 (2005), that provides an effective means to visualize the set of organization in a project, and offers a
126 systematic way to represent the pattern of influences between these organizations. However, a
127 weakness of this approach is the lack of identification of organizational attitudes or positions, as it
128 does not reflect whether the organizations perceive the project positively or negatively Mok et al.
129 (2015). Other studies, such as Rowley (1997), point to the use of social network analysis (SNA) as a
130 way to understand the structural characteristics of the organizational network, wherein organizational
131 influence is limited by patterns of relationships with other organizations inside the network structure
132 (Wasserman and Galaskiewicz 1994). SNA is a useful method to examine the simultaneous influence
133 of multiple organizations, and to predict corresponding responses and organizational strategies
134 (Chinowsky et al. 2008; Rowley 1997). However, SNA does not allow for the explicit consideration
135 of competition and power dynamics between organizations.

136 Similar to these studies, we posit that informing a IWRM strategy for the Río Maipo
137 watershed following completion of the AMHP, as well as future water basin management strategies in
138 Chile, requires a systems perspective to expose and decipher the complex and nuanced
139 interconnections between organizations. Considering that the key sources of organizational alliances
140 or conflicts are rooted in the alignment or discord between enmeshed organizational interests and
141 objectives, we propose a multi-step stakeholder mapping process that uses the MACTOR (Matrix of
142 Alliances and Conflicts, Tactics, Objectives and Recommendations) method to quantify, map and
143 evaluate the balance of power between different organizations based on their converging or diverging
144 objectives (Arcade et al. 2009; Godet 1991, 1994). This process seeks to leverage the strengths of the
145 aforementioned approaches that map the patterns of influence between organizations with the explicit
146 framing of organizational competition and power-struggles that often lead to conflicts.

147 Outputs from MACTOR analyses take the form of influence maps and network diagrams that
148 represent scenarios for how organizations form alliances (convergences) or present conflicts
149 (divergences). These diagrams highlight organizations that have the greatest overall influence on the
150 other organizations as well as overall project outcomes, and reveal the project objectives that have the
151 most significant alignment or misalignment. The resulting analysis offers systems-level insight for
152 how to leverage and promote existing organizational alliances and minimize confounding conflicts

153 that negatively impacts an organization's objectives, operations or existence (Vivanco-Aranda et al.
154 2011). Given its strength to emerge systems-level insights for complex multi-organization projects,
155 the MACTOR approach has been applied within many contexts, including planning in development,
156 labor and employment (Bettencourt 2010), socio-economic development (de Figueiredo Porto et al.
157 2010), air transportation (Godet 1976), food supply-chains (Vivanco-Aranda et al. 2011), and photo-
158 voltaic technology innovation (Lo et al. 2013).

159 In the sections that follow, we present a replicable mixed-method data collection and analysis
160 process based on the MACTOR approach to address research questions (RQs) related to IWRM
161 strategies of the Río Maipo watershed in light of AMHP. We then conclude with a discussion of the
162 study findings and associated policy recommendations. The RQs that guided this study are:

163 RQ1: How do AMHP organizations align or misalign based on their objectives regarding the
164 use of the Río Maipo watershed?

165 RQ2: What appears to be the objectives or desires where conflict or alignment exists
166 between these organizations?

167 RQ3: What does this systems analysis reveal about the interaction between AMHP
168 organizations in particular, and inform for future pursuits of IWRM in Chile in
169 general?

170 **METHODS**

171 Below we outline the mixed-method process used to collect and analyze data on AMHP
172 organization objectives and influence culminating with the MACTOR method. With the intention of
173 promoting future replication of this process to other IWRM contexts, we detail the following steps
174 below: i) identification of key organizations through a thorough review of secondary data (e.g.,
175 documents and reports); ii) supplementary interviews with organization representatives, iii) coding of
176 challenges, objectives and organizational influence from the secondary data and complemented by
177 transcribed interviews, iv) MACTOR analysis, and v) Insights and recommendations. Data collection
178 and analysis rested heavily on secondary data sources to minimize the subjectivity that comes from
179 perception – using interviews to both corroborate with and add nuance to the challenges, objectives,

180 and organizational influences identified via the secondary data. Figure 1 summarizes each step of
181 this process below with an overview of methods and outputs for each step. As many steps were
182 complimentary and required outputs from the previous step to proceed to the next, we combine
183 selected study results from each step to facilitate the elaboration of the multi-step research process. In
184 the subsequent sections, we further detail, analyze, and discuss the study findings.

185 ***Step 1: Identification of Organizations***

186 A thorough review of secondary data covering topics of interaction and conflicts between
187 related AMHP organizations enabled the creation of an exhaustive list of organizations to participate
188 in the study. Secondary data sources included documents and reports, official web pages, social
189 media pages, press releases and the public environmental impact evaluation (SEIA 2007), all
190 representing the interests, vision, and objectives of the various organizations. Additional
191 organizations were identified through snowball sampling from the reviewed documents and from
192 study interviewees who were asked to indicate which organizations they interact with most (Palinkas
193 et al. 2015). Creators of the MACTOR approach recommend identifying between ten to 20 key
194 organizations to maximize the ability of the approach to characterize the complex interplay of these
195 organizations, while avoiding outputs that are overwhelming and uninterpretable (Godet 1994). In
196 total, eleven organizations were selected for this study. Table 1 provides a list of the organizations,
197 their organizational role, as well as the secondary data sources for each organization that were used
198 throughout the subsequent steps in the process.

199

200 ***Step 2: Interviews with Organizational Representatives***

201 We conducted semi-structured interviews with organizational representatives to identify their
202 positions, interests, motivations, limitations, and available resources to face conflicts with other
203 organizations, and to provide qualitative richness and cross-validation of findings from the secondary
204 data. Secondary data and interviews together provided the required inputs – objectives and inter-
205 organizational influence – for the MACTOR analyses.

206 An interview protocol was discussed and validated by our research team and approved by the
207 Universidad Diego Portales Research Ethics Committee. The research team consisted of the four co-

208 authors of this paper, including two civil engineering academics with knowledge about the MACTOR
209 method and water resources management, an industrial engineering undergraduate student, and a
210 sociologist with specialization in stakeholder conflict. The interview instrument was applied in
211 person. Although the intention was to interview at least one individual from each organization,
212 organizations who did not participate in the interviews were: Aguas Andinas (AA), Maipo Canal
213 Society (SCM), National Forest Company (CONAF), and the Ministry of the Environment (MMA).
214 For these organizations, the necessary information on their objectives and interaction with other
215 organizations was inferred from the answers given by the interviewees and corroborated with the
216 secondary data sources show in Table 1.

217 The following five questions were asked for the organizations who participated in the
218 interviews:

- 219 1. *What is the vision of your organization regarding the Alto Maipo hydroelectric project?*
- 220 2. *What effects does the development of the Alto Maipo hydroelectric project have on your*
221 *organization?*
- 222 3. *What are your organization's objectives at a general level and in relation to the Alto Maipo*
223 *hydroelectric project? What are your challenges and goals in this regard?*
- 224 4. *What is the relation of influence and dependence that exists between your organization and*
225 *other organizations linked to the project?*

226 ***Step 3: Qualitative coding of secondary data and transcribed interviews***

227 Secondary data and transcribed organization interviews were qualitatively analyzed in
228 Spanish to retain contextual richness and nuance. Transcripts were deductively coded within an Excel
229 spreadsheet, with the purpose of extracting relevant information for the MACTOR analysis,
230 specifically: challenges, objectives, strategies, inference of influence strength (described in Step 4)
231 between organizations (Godet 1994). Table 2 presents the nine challenges and associated objectives
232 that emerged from qualitative coding.

233 ***Steps 4 & 5: MACTOR Analysis & Associated Recommendations***

234 Our research team met in four, five-hour sessions to discuss and evaluate the aforementioned
235 influences, challenges, and associated objectives of AMHP organizations emerging from the

236 secondary data and interview responses (Godet 1991, 1994). The aim of these sessions was to
237 systematically score organization influence and impact from project objectives. Subjectivity on
238 scoring was minimized through focused discussion and consensus between research team members
239 and supported using quotes from the organization's representative and supplemental documentation.
240 Influence strengths and impacts of organization objectives were housed within two matrices required
241 for the MACTOR analyses: the Matrix of Direct Influence (MDI) and the Matrix of Valued Positions
242 (2MAO).

243 The MDI is a square matrix that houses ordinal scoring on the level of organization influence
244 (impact of an organization's influence on the other organizations) and dependence (impact on an
245 organization by the influence from other organizations). The strength of influence between
246 organizations are classified on a scale of 0 to 4 according to the following criteria on the pair-wise
247 impact a particular organization has on the other organizations' processes, project, mission, or
248 existence:

- 249 — 0: No influence or dependency.
- 250 — 1: There is influence on the organization's processes; where a process is an everyday or minor
251 task or operation the organization undertakes in achieving its mission.
- 252 — 2: There is influence on the organization's projects; where a project is a major effort by the
253 organization to achieve its mission.
- 254 — 3: There is influence on the organization's mission; where the mission is an organization's
255 reason for existence.
- 256 — 4: There is influence on the organization's existence

257 The 2MAO is a square matrix that houses qualitative scoring on the impact achievement of
258 AMHP objectives have on the organization's processes, projects, mission, and existence. For each
259 organization, the valuation is classified against each objective on a scale of -4 to 4, where the sign
260 indicates how achieving said objective would result in a favorable (+) or undesirable (-) influence on
261 the organization. The analysis is performed based on the following criteria:

- 262 — 0: The organization is indifferent to the objective being met.
- 263 — 1: Achieving the objective influences the operative processes of the organization.

- 264 — 2: Achieving the objective influences the implementation of projects by the organization.
265 — 3: Achieving the objective influences the mission of the organization.
266 — 4: Achieving the objective jeopardizes the existence of the organization.

267 Analyses performed on the MDI and 2MAO offer insight into an organization's power of
268 influence and their alignment with other organizations, respectively. In particular, the mathematical
269 operation of these two matrices can be used to infer i.) the combined direct and indirect influence
270 between organizations, ii.) the relative level of power of each organization, iii.) the alignment
271 (convergence) between organizations, iv.) the conflict (divergence) between organizations, and v.)
272 major objectives or issues that drive alignment or conflict. All matrix manipulations were performed
273 using the Lipsor/EPITA MACTOR software (EPITA 2010), where the matrix mathematics are per the
274 MACTOR method outlined in Godet (2007) and presented in the Appendix.

275 Evaluation of the *combined direct and indirect influence between organizations* takes place
276 within the Matrix of Direct and Indirect Influences (MDII), which combines direct (i.e., Organization
277 A on Organization B) and indirect influence scores (Organization A on Organization B, through
278 interaction with Organization C).

279 Evaluation of an organization's relative *level of power* (R_i^*) entails systematically comparing
280 each organization's level of influence and dependence based on the MDII matrix. Values of $R_i^* >$
281 1.0 implies an organization has an above-average power or competition over other organizations,
282 while $R_i^* < 1.0$ implies a level of power less than the average and thus a disproportionate vulnerability
283 to other organizations within this battlefield.

284 Evaluation of an organization's *convergence* and *divergence* combines information from both
285 the MDI, 2MAO, MDII matrices to characterize the overall extent of an organization's alignment or
286 conflict on project objectives – considering an organization's power struggles as inferred by the level
287 of power score R_i^* . The resulting output is the weighted valued position matrix 3MAO, used to
288 calculate the weighted value matrix of convergences 2CAA (positive, alignment) or the weighted
289 value matrix of divergences 2DAA (negative, conflict) by multiplying the respective positive and
290 negative values contained in the 2MAO by their transpose. 3CAA is calculated as the average

291 intensity (weighted score) for organizations who hold the same position (whether positive or
292 negative), where 3DAA is the same calculation by for organizations who hold opposite positions (i.e.,
293 one positive and one negative). Results from 3CAA and 3DAA are presented as a network diagram
294 to highlight areas of strong alignment or conflict within the AMHP project battlefield.

295 Finally, evaluation of the major objectives where alignment or conflict culminate, entails
296 subtracting the valued convergence matrix (2CAA) from the valued divergence matrix (2DAA) to
297 create a new matrix (2MOO), and an associated graph of the net distance between objectives. A
298 smaller net distance between objectives indicates a higher level of alignment between stakeholders on
299 these objectives.

300 **RESULTS**

301 This section presents the findings from the MACTOR analysis of AMHP organizations. The
302 analysis begins by presenting results from the relationship between influence and power, followed by
303 the assessment of organizational convergence (alliances) and divergence (conflicts). It concludes with
304 an assessment of the overall level of organizational alignment or misalignment on project objectives.

305 *Organization Influence and Power (MDII Analysis)*

306 Analysis of an organization's direct and indirect influence uses the MDI created by the
307 research team. The complete MDI is presented in the Appendix Table A1. Calculation of indirect
308 interactions per equation 1 for creation of MDII, enabled creation of a factor influence map and
309 evaluation on the level of power (R_i^*), presented in Figure 2 below. An influence map provides a
310 two-dimensional analysis of the relative influence and dependence for each organization. In addition,
311 an influence map shows the relative power and vulnerability of each organization (Arcade et al.
312 2009), thereby providing supplemental insight into alignment and conflict and power struggles
313 surrounding project or program objectives (presented in the subsequent sections). High influence
314 scores indicate that an organization has the capacity to influence one or more organizations' mission
315 or existence.

316 Organizations that appear in the upper right quadrant of the influence map (Figure 2) are those
317 with both high influence and high dependence, and are therefore most likely to be the heart of either

318 virtuous or vicious project outcomes. It can be seen that AES-GEN (Ri* 1.09) has the largest
319 influence and dependence with other organizations – meaning they have a high potential for influence,
320 while also having a high vulnerability to the decisions and actions of the other organizations. NO-AM
321 (Ri* 0.95) also has a moderate level of influence and is yet vulnerable to outside organizations,
322 especially state agencies. It can be seen that the state agencies, such as CONAF (Ri* 1.45), MMA
323 (Ri* 2.02) and DGA (Ri* 1.70), all appear in the upper-left quadrant of the influence map, indicating
324 a high level of influence and low level of vulnerability to other organizations. This high level of
325 influence and low level of vulnerability is reflected by their high level of power scores (Ri*), where
326 we see the top three scores are for these three state agencies. This shows the important role of these
327 agencies in the context of water and land management in Chile. When asked about the dependence of
328 AES-GEN on DGA and MME, the AES-GEN interviewee highlights the Chilean law that undergirds
329 and gives power to these two agencies:

330 *“DGA has to give permission for a lot of our processes, so their authorization role as the*
331 *environmental institution is important in our process. Nowadays, when its*
332 *superintendency has to audit us, they invite all the other agencies, so they can all see if*
333 *you are complying with everything, therefore, with all of them, you have to have a super*
334 *close and dependent relationship”*

335 Similarly, regarding their dependence on the MMA, the AES-GEN interviewee indicated:

336 *“The MMA has been the most influential ministry for the project construction, because its*
337 *superintendency can prevent the project from being carried out. The ministry dictates the*
338 *general policies, processes bills, etc. But is the superintendency who supervises and*
339 *executes the sanctions and they can stop the project.”*

340 Additionally, these analyses show the highest scoring private company is AA (Ri* 1.16),
341 meaning their influence over AES-GEN is large. Interestingly, AA was initially included in the list of
342 opposing organizations, claiming that the AMHP threatened the security and continuity of Santiago's
343 drinking water service (SEIA 2008). However, in June 2011, AA signed a contract with AES-GEN, in
344 which they gave 2.5 m³/s of drinking water from Santiago to AES-GEN and, in addition, leased the
345 back-up infrastructure from the tariff system to the electric power generating company, and seeing an

346 economic benefit from pre-sedimentation by the hydro-plant turbines (CIPER 2011; INDH 2012). As
347 the AES-GEN interview corroborates:

348 *“AA were neutral at the beginning, but later on understood they had an opportunity,*
349 *because the project allowed them access to water, independently of climate or stationary*
350 *issues. On the other hand, the Andean water catchments are all downstream from the*
351 *project’s return point to the river, therefore they can use the water that passes through*
352 *the turbines without sediments, and their treatment process will be then much easier for*
353 *them.”*

354 Organizations with lesser influence and greater dependence on other organizations included
355 the local community organizations (COM, Ri^* 0.09; CTCM, Ri^* 0.39) and the local government
356 (MSJM, Ri^* 0.18). Indeed, local communities and governments are often the ones who are most
357 vulnerable and who experience the greatest impact from large hydro projects (Goodwin et al. 2006;
358 Latta 2007; Maher 2019). When asked about the engagement between AES-GEN and MSJM, the
359 AES-GEN interviewee indicated the importance of engaging the local municipality in discussion on
360 socio-economic and socio-environmental effects from the project. While they appreciated the way in
361 which the municipality aids in project operation, they mentioned the low level of power the
362 municipality has to impede project progress or existence.

363 *“The MSJM, as part of the community and the local council that allocates funds to local*
364 *projects, is a close partner for us. For example, when facing snow or floods during the*
365 *winter operation, we provide logistical support in order to allow fluid transit. We try to*
366 *keep a very close relationship. But as a good neighbor, we must have a good relationship*
367 *with the municipality – that is essential.”*

368 Similarly, rural municipalities, like MSJM, often lack the capacity to self-advocate and
369 influence the other organizations (Goodwin et al. 2006), as indicated by a low Ri^* score. This reality
370 was expanded upon by the MSJM representative:

371 *“The institutional role of the municipality is to represent each of its citizens against any*
372 *public-private venture. The [AMHP] divided this community 70% in favor 30% against*
373 *based on the data we have gathered. However, I feel that communities in Chile are not*
374 *prepared to challenge a project of this magnitude, be it mining, hydroelectric, etc. And*
375 *the municipalities are not professionally equipped to protect the community or local*
376 *surroundings, they do not have a technical team dedicated exclusively to evaluating*
377 *projects and present observations.”*

378 This emergent hierarchy of power agrees with the three scales of power for water rights in
379 Chile stated by Rojas Calderón (2014), from weak to strong: i.) communities, ii.) local organizations
380 and local government (e.g., COM, MSJM), grassroots organizations and associations (e.g., NO-AM),
381 iii.) and private surveillance boards composed of local agencies (SCM) and large private companies
382 (AA, AES-GEN). Coincidentally, this partnership of private companies represents the proposed
383 governing body of the upper basin of the Río de Maipo, where the primary control of water rights is
384 controlled by these organizations de facto (Borgias and Bauer 2018).

385 ***Alignment between Organizations (3CAA Analysis)***

386 Interpretation of organizational alignment is based on an analysis of third order convergence
387 scores within the 3CAA and is facilitated by creating a convergence map (Figure 3), which shows
388 interdependencies between aligning organizations. Overall, 3CAA scores – calculated by multiplying
389 indirect influence scores (MDII), level of power (R_i^*) and convergence scores on project objectives
390 (CAA, from the 2MAO developed by the research team, Appendix Table A2) – ranged from 2.1 to
391 22.5. Figure 3 graphically represents the strength of alignment, based on convergence scores,
392 between the various AMHP organizations. A thick red link signifies the strongest alignment (18.5 to
393 22.5), a thick blue link signifies a strong alignment (14.4 to 18.4), a thin blue link signifies a moderate
394 alignment (10.3 to 14.3), a thin grey link signifies a weak alignment (6.2 to 10.2), and a faint grey link
395 signifies a very weak alignment (2.1 to 6.1).

396 High convergence scores indicate a symbiotic alignment, where both influence and objectives
397 are favorable for an organization’s mission or existence. Figure 3 shows the strongest alignment
398 exists between MMA and NO-AM. Interestingly, NO-AM indicated they have had minimal contact

399 with MMA, and that they were not pleased with the ministry's capacity to handle the environmental
400 evaluation of AMHP:

401 *"The first time the country's highest political authority on the environment [MMA]*
402 *received us allowed for a brief conversation. We were then told that they can't do much*
403 *because they only have two inspectors for the metropolitan region, and the Alto Maipo*
404 *project is a giant project. But millions of dollars in public resources are wasted in*
405 *discussing tourist areas of interest, which will have been wasted if the Alto Maipo project*
406 *comes into operation."*

407 It is possible that the strong alignment between MMA and NO-AM emerged from a shared
408 focus on environmental concerns, mitigated through Chilean regulation, primarily Environmental Law
409 19.300 and Water code 1981. As NO-AM mentions: *"We asked them [MMA] to comply with the law*
410 *[for environmental regulation, law 19.300 of 1994], which, even if it was not sufficient, was the law."*

411 Figure 3 also shows that the strong alignment between MMA and NO-AM is complimented
412 by a strong convergence between MMA and CONAF. This is not surprising, as these three
413 organizations have the mission to support ecosystem health and management, where CONAF upholds
414 the protection and conservation of forests, NO-AM seeks protection of the rivers of the Cajón del
415 Maipo and its surroundings, and MMA, seeks a more general equilibrium of natural Chilean
416 ecosystems in Chile (Ministry of Environment 2020). Interestingly, these three organizations are not
417 formal allies, even though our findings show that they align on many AMHP project objectives. A
418 reason for this hidden alignment is perhaps because state institutions must typically remain neutral per
419 Chilean law and regulation – ruling in relation to the project only within their technical competences
420 (Silva 2010).

421 A similar alignment was found to exist between NO-AM, CTCM, and COM, as they share the
422 territorial and environmental consequences associated with the development of AMHP, leading them
423 to have common interests. It is also possible to see a triumvirate alignment between AA, GDW and
424 MMA, which could be expected, given their mission to protect and conserve water sources. AA and
425 DGA are organizations whose mission is based on water resources (drinking water supply, water
426 quality, and water rights management), and the MMA (water protection and conservation of water,

427 land and air), therefore, alignment is likely associated with a unified mission to care and protect in-
428 land water ecosystems.

429 While community - and municipal-level organizations show minimal alignment with the
430 larger private and state-level organizations, we see a moderate to strong connection between the SCM
431 and JVSM, and the other state organizations in charge of supporting environmental protection
432 (CONAF, MMA) and the Chilean Water Code (DGA). Despite having low-levels of power and high
433 levels of dependency on other organizations, MSJM and COM appear central in the alliance battle-
434 field.

435 It can be seen that AES-GEN has the weakest alignment with the rest of the organizations,
436 with all links being weak or very weak. The weakest of these alignments are from MSJM and COM,
437 indicating they have both a low level of influence on AES-GEN activities as well as a minimal
438 alignment on project objectives.

439 ***Conflict between Organizations (3DAA Analysis)***

440 Interpretation of the conflict between organizations is based on an analysis of third-order
441 divergence scores within the 3DAA and is facilitated by creating a divergence map, presented in
442 Figure 4, which shows interdependencies between conflicting organizations. Third order divergence
443 scores ranged from 0.8 to 13.2, with a max divergence score about two times less than the top third
444 order convergence score (22.5). A thick red link signifies the strongest misalignment (10.8 to 13.2), a
445 thick blue link signifies a strong misalignment (8.3 to 10.7), a thin blue link signifies a moderate
446 misalignment (5.8 to 8.2), a thin grey link signifies a weak misalignment (3.3 to 5.7), and a faint grey
447 link signifies a very weak misalignment (0.8 to 3.2).

448 This analysis shows a clear focal point of conflict on AES-GEN, in particular between
449 CONAF (10.2), MMA (10.7) and NO-AM (13.2). With a mission to halt construction of the AMHP,
450 and a moderate R_i^* , it is expected that NO-AM would have the strongest divergence score (13.2) with
451 AES-GEN. However, it is MMA and CONAF that pose the most detrimental conflict for AES-GEN,
452 given their collective mission of environmental protection and stewardship along with the power to
453 derail the company's mission. Similarly, from analysis of indirect organizational influences, MMA
454 had the largest level of power and lowest dependence on the other organizations, while AES-GEN had

455 the largest dependence on the other organizations, as evidenced by their centrality in the conflict
456 network (Figure 4). Finally, we see that SCM and JVSM have low levels of conflict, both with AES-
457 GEN as well as the other environmentally-focused organizations, despite having relatively high-
458 power level scores R_i^* (Figure 2).

459

460 *Net Distances between Objectives*

461 The graph of net distances between objectives, presented in Figure 5, offers insight on the
462 relationship between objectives where organizations take the same position, whether for or against,
463 based on their interconnectivity and strength of alignment or opposition. This analysis reveals groups
464 of objectives between which there is strongest alignment (objectives with low net distances) or
465 conflict (objectives with large net distances) (Godet 1994). This graph reveals the objectives for
466 which organizations are most divergent relate to aspects of environmental protection, provision of
467 water and energy services and community prosperity. This shows how AMHP potentially imposes a
468 tension between the needs and benefits of providing energy and overall community prosperity, with
469 the potentially detrimental effects on water availability and quality and environmental degradation.
470 Conversely, the objectives with smaller net distances and thus greater alignment are those related to
471 the social approval and financing of the project, together with social cohesion. This implies that social
472 issues are less likely to drive conflict or alignment between organizations, and that the key
473 battleground surrounds the impact on environment, water availability and water quality, which comes
474 with a host of indirect societal, economic and environmental consequences. These results show the
475 interconnected battlefield between organizational objectives, and how these objectives do not exist in
476 isolation and thus must be managed thoughtfully to minimize conflict.

477

478 **DISCUSSION**

479 Findings from this study offer systems-level insights regarding organization power dynamics,
480 the presence of alliances and conflicts between organizations (addressing RQ1), whether perceived or
481 unperceived, and the objectives on which organizations align or misalign (addressing RQ2). This

482 enables us to discuss core aspects of collaboration, communication, alignment and conflict mitigation
483 towards productive management of AMHP and the Río Maipo watershed (addressing RQ3).

484 Regarding RQ1 (alliance, conflicts, power dynamics), we see that the most powerful
485 stakeholder organizations are state agencies. However, despite state agencies having the greatest
486 influence on other organizations, whereby the management of water resources in Chile is the
487 responsibility of many institutions (i.e., Directorate of Hydraulic Works (DOH), CONAF, and the
488 Ministry of Agriculture), the previously mentioned studies on Chilean Water law and water
489 governance highlight weaknesses in institutional capacity to administer water law and manage multi-
490 organization interests and conflicts, in particular the DGA's power to monitor and enforce water
491 rights transactions (Bauer 2015; Bitran et al. 2014; Budds 2004; Roose and Panez 2020). The DGA
492 representative reinforced this point:

493 *“Firstly, our unit has to approve all the projects throughout Chile and this activity is*
494 *done at our headquarters where we have only 5 people working. You see that the permit*
495 *fee that they require is more than the installed capacity and there are also a lot more*
496 *conditions ... There are emblematic cases that are more time consuming. The Law*
497 *establishes that the DGA while it does not have all the antecedents cannot respond, that*
498 *to the extent that you have a long line of reviews you go out of one and you get into*
499 *another the main problem from the point of view of In view of time, it is the*
500 *environmental evaluation ... if it does not have a favorable environmental evaluation, all*
501 *permits are prohibited ... and when the environmental evaluation is finished they come to*
502 *us.”*

503 In contrast to the state agencies and larger private companies, we see that local grassroots
504 organizations, such as MSJM (Ri* 0.18) or COM (0.09) are less able to promote their objectives.
505 Local organizations generally lack the necessary maturity or capacity to negotiate before large
506 companies or institutions (Goodwin et al. 2006), despite an enthusiastic social-environmental dynamic
507 that arise with the support of social network media (Twitter, Facebook, Instagram, etc.). This
508 immaturity limits their ability to advocate for their interests, and undermines a true IWRM program
509 (Donoso 2018; Hassing et al. 2009; Jusi 2013; Suárez et al. 2014; UNDP 2008). The 2005 Chilean

510 Water Law also lacks support mechanisms and modalities through which to protect and support local
511 communities and organizations in response to their demands (Roose and Panez 2020).

512 Despite a formal regulatory framework to engage interests of local organizations, past
513 grassroots citizen action groups in Chile have had enormous impact on hydroelectric programs. For
514 example, the campaign “Rio Pueblo Sin Torres” (Rio Pueblo without Towers), was a highly
515 successful communication initiative that promoted awareness of the conflict between the community
516 of Cochamó and the company Mediterráneo. Their Facebook page has over 53,000 followers (the
517 town only has a population of 4,000) showing the significant diffusion and reach a local organization
518 can have (Velásquez 2018). Another example is the organization ‘Patagonia Sin Represas’ (PSR -
519 Chilean Patagonia without Dams). PSR also used social networks as a tool to amass support, power
520 and legitimacy with a structural change of the power, upscaling until the highest political levels in the
521 country take notice (Romero Toledo 2014). Nevertheless, the strengthening of user organizations
522 strongly depends on the existence of a legal framework that enables a diverse range of organizational
523 participation in decision-making.

524 Regarding RQ2 (the objectives on which organizations align or misalign), our results show
525 that the most powerful organizations are those who also align most on environmental objectives.
526 Private and community-based organizations who align with aspects of environmental protection find a
527 favorable relationship with these organizations. As previously mentioned, our results revealed a
528 general non-existence of ‘alliance clusters’; that is, aligned organizations appeared, through analysis
529 of secondary data and the interviews, to advocate for their mission separately with little to no
530 cooperation to face opposing organizations. The only organizations that confirmed formal alliance
531 were NO-AM and CTCM, where the other aligning organizations, such as DGA, SCM, AA, and
532 JVSM, appear to act in isolation, maintaining a neutral or regulatory role based on the legal confines
533 of the Chilean Water Code (BCN 2018).

534 Combining the literature on Chilean Water law with the results from this study on specific
535 organization alignment, conflict, and influence, we address RQ3 (overall study implications) with
536 three overarching findings: i.) state agencies (MMA, DGA, CONAF) have the greatest power to
537 realize their organizational objectives, yet they often work in isolation and are limited in their power

538 and capacity by the 2005 Chilean Water Law (that reformed a part of the 1981 Chilean Water Law) to
539 promote a true IWRM structure, ii.) large private companies have a greater capacity to achieve their
540 objectives than local community and grass-roots organizations, and iii.) the source of greatest conflict
541 centers around environmental objectives.

542

543 ***Recommendations for IWRM Policy and Practice in Chile***

544 Based on the study findings, we propose facilitating positive synergies among aligned
545 organizations by promoting collaboration between CONAF and NO-AM to do joint work with the
546 ME to leverage their power within the Chilean Water Law to uphold environmental standards and
547 impacts on water resource availability. This outcome could be achieved through an adjustment of
548 regulatory standards and communication protocols in Chile for megaprojects to better consider the
549 environmental demands of all organizations, defining the control and regulation processes together
550 with the increase in resources available for these types of environmental conflicts. Conjointly, it will
551 be important to seek to minimize conflicts between organizations, in this case, between AES-GEN
552 and the local community and governmental organizations affected by the project, through increased
553 public and user participation and discussion (Borgias and Bauer 2018; Retamal et al. 2013; Larrain
554 2010).

555 The early formation of relationships and dialogue is key in minimizing conflicts between
556 organizations. Past studies have shown that early alliances have more productive collaboration,
557 establish more credibility in the local community, and are more effective at balancing collaborative
558 initiatives against competitive interests (Hearld et al. 2012; Derakhshan, Turner and Mancini 2018;
559 Baharuddin et al. 2017). Indeed, numerous examples help us understand that an organization's
560 management, co-governance and social legitimacy are relevant concepts to consider in the success of
561 future hydroelectric projects in Chile and beyond (e.g., Birnbaum 2015; Marrewijk 2005; Sandström,
562 Crona and Bodin 2013). Similar to what we find in our study, this past work shows that in countries
563 like Chile, power is concentrated on government agencies, leaving a legal deficit in local
564 organizations to defend themselves against the impacts of megaprojects. NO-AM is an interesting
565 exception, given that they are a community organization established by local stakeholders who have

566 economic resources as well as the professional and the international connections needed to engage in
567 this territorial defense. In other words, NO-AM has been able to privatize local defense, which is not
568 always possible for local community organizations. This is consistent with findings established by
569 Aliste and Stamm (2016), who state that in Chile the main social-environmental conflicts are
570 concentrated in wealthier socioeconomic sectors, raising concerns about the exclusion of proper
571 defense of rural and impoverished sectors of society. This lack of public support could be ameliorated
572 with the help of international non-governmental organizations (iNGOs) that have expertise regarding
573 international law (e.g., World Wildlife Fund and International union for Conservation of Nature)
574 (Eliantonio 2018; Barnes and van Laerhoven 2014), helping educate local organizations on best
575 practices to self-advocate and build their organization's legitimacy. It is important to understand that
576 external organizational legitimacy (Drori and Honig 2013) or social legitimacy (Suchman 1995) is a
577 perception or assumption developed by the observer, but it is always socially constructed, depending
578 on what each group expects from the entity. Indeed, our study shows that social approval and
579 alignment goes beyond legal requirements and authorizations, and are better understood from a
580 systemic perspective, where local organizations that interact and are affected by the project have a
581 voice and an agency to impact project outcomes. Overall, the mitigation of future water use conflicts
582 between organizations, and improved program planning, implementation and management in
583 subsequent hydroelectric projects in Chile, requires a refined legal framework and protocol for
584 information exchange and capacity building. (Ricart and Clarimont 2015).

585 ***Study Limitations & Future Research***

586 There were some unavoidable issues with validity and generalizability resulting from the data
587 collection and analysis activities.. Obtaining a rigorous representation of objectives and levels of
588 influence between relevant AHMP organization was challenging, as it was not possible to interview
589 organizational representatives from AA, MMA, SCM, and CONAF. We sought to circumvent this
590 issue with the responses from the other interviewees in conjunction with information extracted from
591 the secondary data sources, which included official information channels of each organization and the
592 publicly available environmental impact evaluation. However, we recognize that a true representation
593 of organizational influence on hydroelectric project success also requires consideration of individual

594 stakeholders, such as electricity and water consumers, a task that is more difficult to accomplish and
595 evaluate with a MACTOR analysis. Excluding these types of stakeholder groups in this study
596 potentially resulted in an incomplete assessment of stakeholder impact on IWRM strategies for
597 AMHP.

598 Another study limitation relates to the transparency of information provided by the
599 interviewed organizations, a common problem in both qualitative and quantitative studies. It is
600 possible that the organizational representatives interviewed neglected to openly reveal their plans,
601 strategies and objectives, as well as the type of relationship they may have with respect to the other
602 organizations. In addition, there is a risk that the information delivered is not completely true or that
603 the same organizations have a different vision with respect to the topics consulted. As mentioned
604 previously, the research team sought to mitigate errors from false information by comparing data
605 across interviewees and secondary data sources.

606 A final limitation relates to subjectivity imposed within MACTOR analyses conducted by the
607 researcher team. Although our analysis was carried out with a multidisciplinary team composed of
608 professionals with different backgrounds, degrees, and perspectives, there is an invariable potential
609 for subjectivity, whereby the various forms of information used to perform the MACTOR analysis
610 could have been interpreted differently. The research team sought to minimize subjectivity by
611 gathering and contrasting various forms of secondary data, as well as the interview transcriptions to
612 cross-validate the MACTOR outputs

613 Despite these limitations, we believe the MACTOR approach, as applied within the multi-step
614 process presented here, provided useful insight into the interdependencies and associated alliances and
615 conflicts between key project organizations of complex and large hydropower projects in general and
616 AMHP in particular. This process could be improved upon in future studies to limit subjectivity, and
617 improve insight on the interactions between organizations and individual stakeholders and their
618 impact on IWRM strategies and hydroelectric project success. Such improvements to the
619 methodology could include: i) Further engagement and discourse between organizations to modify
620 MACTOR inputs and collaboratively evaluate outputs throughout the various stages of project
621 planning, implementation and management, ii) Following-up this study in five to ten years to

622 compare and contrast findings with any landmark project outcomes related to AMHP management
623 and coordination between organizations, and iii) complimenting MACTOR insights from other
624 systems analyses, such as social network analysis (SNA), to gain a deeper understanding on alignment
625 and conflict based on the flow of communication and knowledge between organizations and
626 individual stakeholders.

627 **CONCLUSIONS**

628 This study used a mixed-method process culminating with the MACTOR approach to identify
629 and evaluate the interconnected drivers of alignment and conflict between 11 key organizations
630 connected with the Alto Maipo Hydroelectric Project in Chile. Findings from this analysis revealed
631 underutilized synergies between siloed state organizations, and the centering of conflicts or alignment
632 around environmental protection and resource use. It was also seen that while state agencies have the
633 greatest power to realize their organizational objectives with the Rio Maipo watershed, they remain
634 limited in their power and capacity to realize these objectives by existing legal frameworks. Finally,
635 the study revealed a substantial power gap between state agencies and local organizations. These
636 findings point to the need for the development or refinement of policies and legal frameworks that
637 foster connection and collaboration between aligned, yet currently, hermetic organizations to uphold
638 environmental standards and impacts on water resource availability. Capacity building by local non-
639 profits or iNGOs for local community and governmental organizations could help narrow the power
640 gap with state agencies by promoting community-level advocacy for more productive negotiation and
641 increased organizational legitimacy.

642 The MACTOR approach, as applied within the multi-step process presented here, provided a
643 powerful way to visualize and evaluate the interconnected drivers of alignment or conflict between
644 organizations involved with or affected by hydroelectric projects. However, future studies would
645 benefit from a more iterative and reflective engagement of organizational representatives in the
646 process throughout the implementation and early stages of project management. Future hydroelectric
647 projects in Chile, and beyond, could benefit from the early application of this process as a way to

648 engage relevant organizations in a thoughtful discussion of managing objectives to mitigate conflict
649 and promote alignment towards a common agenda for sustainable water resource management..

650 **DATA AVAILABILITY STATEMENT**

651 Some or all data, models, or code that support the findings of this study are available from the
652 corresponding author upon reasonable request. This includes:

- 653 • A coarse summary of qualitative analysis of secondary data and interview transcripts
- 654 • The complete MACTOR analyses within a LIPSOR MACTOR software file (xml format)

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832 **TABLES**

833

834 **Table 1.** A summary of the organizations included in this study and the secondary data used to

835 represent these organizations. Organization names are abbreviated in parenthesis for later use in data

836 visualization (Figures 2 through 4). Where appropriate, we use the Spanish abbreviations used in

837 Chile, with full names translated to English. More information on the secondary data sources for

838 each organization can be found in the Appendix using the provided source numbers.

839

Organization	Role	Org. Type	Secondary Data Sources
AES-GENER (AES-GEN)	Chilean electric power company in charge of implementing and managing the AMHP.	Private	13, 14, 15
Aguas Andinas (AA)	Chilean company of sanitary services.	Private	1, 2
General Directorate of Water (DGA)	State Agency that is responsible for promoting the management and administration of water resources.	National Government	10, 11, 12
Ministry of the Environment (MMA)	Ministry in charge of collaborating in the design and application of policies, plans and programs in environmental matters.	Regional Government	7, 8, 9
National Forest Corporation (CONAF)	Dependent entity of the Ministry of Agriculture, in charge of administering Chile's forest policy and promoting the development of the sector.	Regional Government	5, 6
Communal Union of the Neighborhood Board of San José de Maipo (COM)	Community organization maintained by the Neighborhood Boards of San José de Maipo	Local Organization	No published secondary data available
No Alto Maipo (NO-AM)	Organization that oversees the protection of the valleys and rivers of the Cajón del Maipo watershed	Social-environmental NGO	18, 19
Maipo Canal Society (SCM)	Non-profit organization of private law, responsible for the extraction and distribution of water from the Maipo River.	Irrigation Organization	3, 4
Maipo Surveillance Board (JVSM)	Non-profit entity of private law, which exercises the action granted by the Chilean Water Code. Administers and distributes water to those who have their associated rights.	River organization	No published secondary data available

Municipality of San José de Maipo (MSJM)	Autonomous corporation, in charge of the administration of the San José de Maipo commune.	Municipal government	16, 17
Chamber of Tourism of the Cajón del Maipo (CTCM)	Trade association, responsible for the promotion of tourism in the region of Cajón del Maipo.	Local Organization	20, 21

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842

Table 2. Challenges and associated objectives from coded interview transcriptions, with parenthetical objective abbreviations used in analyses shown in Figure 5.

Challenge	Objective	Definition of Objective
Potential for high environmental impact	Protect the Environment (Pro. Env.)	Strengthen protection and mitigation measures for impacts on the environment
Social division	Social Cohesion (Soc. Coh.)	Maintain the interconnection and communication of neighbors and communities
Issues with energy availability	Increasing the Supply of Renewable Energy (Ren. Ene.)	Growth in the supply of renewable energy
Issues with water availability	Availability of Water Resources (Wat. Ava.)	Ensure the availability, correct use and distribution of water resources
Detrimental effects on water quality	River Water Quality (Wat. Qual.)	Strengthen the monitoring of water status.
Impacts on tourism	Protection of Tourist Areas (Pro. Tour.)	Protection and conservation of areas for sustainable tourism, ensuring the non-intervention of tourist areas.
Detrimental impacts on the quality of community life	Local Community Prosperity (Com. Pro.)	Promote the economic prosperity and success of near-by communities.
Initial Capital Investment of Project	Financing of Project (Pro. Fin.)	Ensure investment partners for the financing and development of the project.
Potential for social upheaval	Social Approval (Soc. App.)	Obtain the approval of the communities and society for the development and operation of the project.

843
844

845 **FIGURE CAPTIONS**

846

847 **Figure 1.** Overview of research activities, methods and outputs

848

849 **Figure 2.** Influence map for MDII, with R_i^* presented in table to the right. Direct and Indirect

850 influence scores normalized with max 90 (MMA), min 15 (COM). Dependence normalized with max

851 90 (AES-GEN) and min 36 (MMA).

852

853 **Figure 3.** Third-order convergence graph, showing the level of alignment between the various AMHP

854 organizations; thick red link: strongest (18.5 to 22.5), thick blue link: strong (14.4 to 18.4), thin blue

855 link: moderate influence (10.3 to 14.3), thin grey link: weak (6.2 to 10.2), faint grey link: very weak

856 (2.1 to 6.1). Score ranges (i.e., strongest or weak) are designated by the equal division of the total

857 range of scores.

858

859 **Figure 4.** Third-order graph of divergence, showing the level of misalignment or conflict between the

860 various AMHP organizations; thick red link: strongest (10.8 to 13.2), thick blue link: strong (8.3 to

861 10.7), thin blue link: moderate influence (5.8 to 8.2), thin grey link: weak (3.3 to 5.7), faint grey link:

862 very weak (0.8 to 3.2). Score ranges (i.e., strongest or weak) are designated by the equal division of

863 the total range of scores.

864

865 **Figure 5.** Graph of net distances between objectives; thick red link: Largest net distance (23 to 26),

866 thick blue link: Large net distance (17.5 to 23), thin blue link: mod (6 to 17.5), thin grey link: weak (0

867 to 5.5), faint grey link: Shortest net distance (-8.5 to 0)

868

869 **APPENDIX**

870

871 **MACTOR Mathematics**

872

873 Equations 1 – 4 present mathematical operations used in evaluation of an organization’s power (eq 1),
874 competition (eq 2), convergence and divergence (eq 3), and net distance of objectives (eq 4)

875

876 **Matrix of Direct and Indirect Influences (MDII):**

877

$$878 \quad [MDII]_{ij} = [MDI]_{ij} + \Sigma Min ([MDI]_{ij}, [MDI]_{ik})$$

879 Where,

880 $[MDII]_{ij}$ is the combined direct and indirect influence organization i has on
881 organization j .

882 $[MDI]_{ij}$ is the direct influence organization i has on organization j from the MDI

883 $\Sigma Min ([MDI]_{ij}, [MDI]_{ik})$ is the sum of all indirect influences actor i exerts on
884 actor j , and which flow through an intermediary actor k ; where this indirect
885 interaction is kept ‘second order’ – that is, flowing only with one intermediary
886 actor at a time (Godet 1991)

887 **Evaluation of relative organizations’ level of power (Ri^*):**

888

$$889 \quad Ri = [(Ii - [MDII]_{ii}) / S] * [Ii / (Ii + Di)]$$

890

$$891 \quad Ri^* = n * Ri / \Sigma Ri$$

892

893 Where,

894 Ri is an organization’s competitiveness score

895 Ri^* is the normalized power score for each organization

896 $(Ii - [MDII]_{ii})$ is the organization’s ‘maneuver range, in other words its net direct
897 and indirect influence (Ii) minus its retroaction or vulnerability from actions they
898 take indirectly feeding back to influence them ($MDII$)_{ii}

899 $S = \Sigma Ii = \Sigma Di$ factor for normalizing the maneuver range

900 $Ii / (Ii + Di)$ allowing a relative integration of organizations’ influence and dependence in the
901 equation.

902 ΣRi is the sum of competitive scores

903 n is the number of organizations

904

905 **Third order evaluation of convergence (3CAA) and divergence (3DAA):**

906

907 $If ([3MOA]_{ik} * [3MOA]_{jk}) > 0$ (for 3CAA) or < 0 (for 3DAA)

908

909 $Then [3CAA or 3DAA]_{ij} = 1/2 x (| [3MOA]_{ik} | + | [3MOA]_{jk} |)$

910

911 $Else [3CAA or 3DAA]_{ij} = 0$

912 Where:

$$913 \quad [3MOA] = Ri^* * [2MOA]_{ij}$$

914

915 **Distance on objectives:**

916
 917
$$If (([2MOA]_{ik} * [2MOA]_{jk}) > 0 (for 3CAA) or < 0 (for 3DAA)$$

918
 919
$$Then [2CAA or 2DAA]_{ij} = 1/2 * (| [2MOA]_{ik} | + | [2MOA]_{jk} |)$$

920
 921
$$Else [2CAA or 2DAA]_{ij} = 0$$

922
 923
$$[2MOO]_{ij} = [2CAA]_{ij} - [2DAA]_{ij}$$

924
 925
 926 **Secondary Data Sources (from Table 1)**

- 927
 928 1. <https://www.aguasandinasinversionistas.cl/es/quienes-somos/nuestro-proposito>
 929 2. <https://www.aguasandinasinversionistas.cl/~media/Files/A/Aguas-IR-v2/annual-reports/es/190626-reporte-integrado-aa2018.pdf>
 930 3. <https://www.scmaipo.cl/canalistas/>
 931 4. https://www.scmaipo.cl/canalistas/wp-content/uploads/2019/04/Boletin_Gota-a-gota_N1.pdf
 932 5. <https://www.conaf.cl>
 933 6. <https://www.conaf.cl/cms/editorweb/institucional/CUENTA-PUBLICA-CONAF2018-CON-APORTES-COSOC.pdf>
 934 7. <https://mma.gob.cl>
 935 8. https://mma.gob.cl/wp-content/uploads/2018/03/Estrategia_Nac_Biodiv_2017_30.pdf
 936 9. <https://mma.gob.cl/wp-content/uploads/2018/03/Informe-Final-Encuesta-Nacional-de-Medio-Ambiente-2018.pdf>
 937 10. <https://dga.mop.gob.cl/Paginas/default.aspx>
 938 11. https://dga.mop.gob.cl/legislacionynormas/Legislacin%20y%20Normas/LEY-21064_27-ENE-2018.pdf
 939 12. https://dga.mop.gob.cl/acercadeladga/informesgestion/Informes%20de%20gestin/BGI_DGA_2017.pdf
 940 13. <https://www.aesgener.cl/#hello>
 941 14. <https://conocealtomaipo.cl>
 942 15. https://www.aesgener.cl/wp-content/themes/aes_gener/pdfs/Politica-de-Vinculacion-y-Relacionamiento-con-comunidades.pdf
 943 16. <https://www.sanjosedemaipo.cl>
 944 17. <https://www.sanjosedemaipo.cl/gestion/direccion-de-desarrollo-comunitario/>
 945 18. <http://www.chilesustentable.net/tag/no-alto-maipo/>
 946 19. <https://www.facebook.com/NoAlProyectoAltoMaipo/>
 947 20. <https://cajondelmaipochile.cl>
 948 21. <https://www.facebook.com/cctsjm/>

955 **Table A1.** Matrix of Direct Influence (MDI) between AMHP organizations, defined by research team

956

	AES-GEN	AA	SCM	DGA	MMA	CONAF	CTCM	NO-AM	MSJM	COM	JVSM
AES-GEN	0	1	1	1	1	1	3	3	2	2	2
AA	3	0	2	1	0	0	1	1	3	0	2
SCM	2	3	0	1	0	0	0	1	1	0	2
DGA	3	1	1	0	1	1	1	3	1	1	1
MMA	2	1	1	1	0	1	3	3	2	1	1
CONAF	2	1	1	0	1	0	2	3	1	1	0
CTCM	2	0	0	0	0	1	0	3	2	0	0
NO-AM	2	1	1	1	1	1	3	0	1	0	1

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959

MSJM	1	0	0	0	0	0	1	1	2	4	0
COM	1	0	0	0	0	0	0	0	2	0	0
JVSM	2	2	2	1	1	0	0	1	0	0	0

Table A2. Matrix of AMHP organization position within the battlefield of objectives (2MAO), as defined by the research team

	Pro. Evn.	Soc. Coh.	Ren. Ene.	Wat. Ava.	Wat. Qual.	Pro. Tour.	Com. Pro.	Pro. Fin.	Soc. App
AES-GEN	0	1	1	1	1	1	3	3	2
AA	3	0	2	1	0	0	1	1	3
SCM	2	3	0	1	0	0	0	1	1
DGA	3	1	1	0	1	1	1	3	1
MMA	2	1	1	1	0	1	3	3	2
CONAF	2	1	1	0	1	0	2	3	1
CTCM	2	0	0	0	0	1	0	3	2
NO-AM	2	1	1	1	1	1	3	0	1
MSJM	1	0	0	0	0	0	1	1	2
COM	1	0	0	0	0	0	0	0	2
JVSM	2	2	2	1	1	0	0	1	0

Pro. Env.: Protect the Environment; Soc. Coh.: Promote Social Cohesion; Ren. Ene.: Increase the Supply of Renewable Energy; Wat. Ava.: Ensure the Sustainable Availability of Water Resources; Wat. Qual.: Maintain River Water Quality; Pro. Tour.: Protect Tourist Activities; Com. Pro.: Promote Local Community Prosperity; Pro. Fin.: Ongoing Project Financing; Soc. App.: Encourage Social Approval

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