How do decision-making logics shape early venture trajectory in the context of informal institutional voids?

A Comparative Case Study of Green Hydrogen and E-fuel Ventures in Magallanes, Chile

Master's Thesis

By Benedict Young and Juan Pablo Ortiz

Date: 25/05/2026

Supervisors: Diamanto Politis

Final Seminar: 02/06/2026

Word Count: 16496

Contents

1. Introduction

1.1 Background and Context of the Study

The global transition toward sustainable energy systems represents one of the most complex socio-technical transformations of the twenty-first century. Sustainability transitions research conceptualises such transformations as systemic processes involving the interaction of technological innovations, institutional frameworks and societal actors. The renewable energy sector therefore offers a particularly rich setting for examining how firms interact with their institutional environments.

Institutional theory describes institutions as the "rules of the game" structuring social and economic interaction (North, 1990). These include formal institutions such as laws, regulations and administrative procedures, and informal institutions such as norms, cultural expectations and shared belief systems that influence perceptions of legitimacy and appropriate behaviour (Scott, 1995). Together, institutional structures reduce uncertainty and enable coordinated action (DiMaggio, 1988). Their role becomes particularly critical in capital-intensive sectors such as renewable energy, where projects require long investment horizons, regulatory predictability, infrastructural coordination and societal acceptance.

Institutional environments do not always provide stable conditions for economic activity. In many emerging or resource-rich regions, firms encounter institutional fragmentation, regulatory ambiguity or misalignment between formal frameworks and informal expectations. The literature on institutional voids describes such contexts as environments where market-supporting institutions are weak, incomplete or unreliable, increasing transaction costs and constraining entrepreneurial activity (Khanna & Palepu, 1997; 2006). More recent scholarship emphasises that institutional voids rarely reflect a complete absence of institutions; rather, they often involve inconsistencies across institutional layers or governance actors, generating uncertainty regarding how formal rules will be interpreted or enforced (Webb et al. 2020). Such dynamics are particularly visible in the development of emerging sustainability industries, where projects depend not only on technological feasibility and capital availability but also on institutional alignment across regulation, infrastructure, land governance and stakeholder coordination.

Within this context, entrepreneurial decision-making theory provides a useful analytical lens. Entrepreneurship research conceptualises entrepreneurship as the process of discovering, evaluating and exploiting opportunities in uncertain environments (Shane & Venkataraman, 2000). Sarasvathy (2001) distinguishes between two logics of entrepreneurial action: causation, which relies on predictive planning to achieve predetermined goals, and effectuation, which emphasises experimentation, stakeholder commitments and the iterative co-creation of opportunities under uncertainty. Effectual approaches may be more effective in contexts of institutional ambiguity, but the empirical record on this question remains incomplete, particularly in the context of large-scale capital-intensive ventures.

This dynamic is observable in southern Chile. The region of Magallanes has attracted global attention due to its exceptional wind resources and its potential to support large-scale production of green hydrogen, ammonia and synthetic fuels. Chile is widely regarded as one of Latin America's more stable investment environments and has actively promoted renewable energy development through ambitious climate and hydrogen strategies (Barrera-Verdugo et al. 2025; CMS, 2025). Nevertheless, the implementation of sustainable energy ventures in Magallanes has proven highly uneven. Highly Innovative Fuels (HIF) has obtained environmental approval for both its commercial wind farm and its associated e-fuels plant (Revista Electricidad, 2026; redimin.cl, 2025). While several developers associated with the H2V Magallanes ecosystem continue to face regulatory uncertainty and stakeholder opposition, with EDF cancelling its Energia Verde Austral project in December 2025 (Hydrogen Insight, 2025), TotalEnergies suspending its USD 16 billion permitting process the same year (Diario Financiero, 2025), and HNH Energy's permitting suspended after hundreds of technical observations (Fertilizer Daily, 2025). Given that these organisations operate in the same geographic region with comparable access to technology, capital and natural resource potential, their divergent trajectories raise questions regarding the role of informal institutional dynamics and actor decision-making.

1.2 Problem Statement and Research Gap

Institutional theory has long emphasised that economic behaviour is embedded within systems of formal rules and informal norms (North, 1990; Scott, 1995). When these structures function effectively, they reduce uncertainty and enable stable exchange. When they are fragmented, inconsistent or contested, organisations face significant challenges in coordinating with

stakeholders, securing legitimacy and mobilising resources (Leca et al. 2008; Webb et al. 2020). The concept of institutional voids provides a framework for understanding such conditions (Khanna & Palepu, 1997; 2006), and recent scholarship has refined the concept by distinguishing between formal institutional voids (where regulatory frameworks or enforcement capacity are insufficient) and informal institutional voids (where norms, shared beliefs and legitimacy structures fail to provide stable expectations for economic interaction) (Webb et al. 2020).

Much of the institutional voids research has focused on emerging markets and on macro-level firm adaptation strategies (Khanna & Palepu, 2006; Ahlstrom & Bruton, 2006). Comparatively less attention has been paid to the decision-making processes through which entrepreneurial actors interpret and respond to informal institutional voids in otherwise developed economies. A further limitation concerns the application of entrepreneurial decision-making theory: empirical studies of effectuation and causation have predominantly examined small firms and early-stage ventures (Arend, Sarooghi & Burkemper, 2015), with relatively little research on how these decision-making logics contribute to differentiated trajectories of advancement, constraint and recalibration in large-scale capital-intensive ventures operating under high uncertainty. The divergence between successful and stalled renewable energy ventures in Magallanes illustrates this gap. The variation cannot be explained solely by differences in resource endowment or technological capability; it suggests that the interaction between informal institutional conditions and entrepreneurial decision-making plays a decisive role in shaping trajectories.

1.3 Aim of the Study

The aim of this study is to examine how decision-makers in large-scale sustainable energy ventures use causal and effectual decision-making logics to enact institutional entrepreneurship, and how these practices shape early-stage venture trajectories under informal institutional voids. The study focuses on the early development phase, when ventures seek to establish legitimacy, secure stakeholder commitments, mobilise investment, and progress through permitting before commercial-scale operation.

1.4 Research Question

How do decision-making logics shape early venture trajectory in the context of informal institutional voids?

1.5 Scope and Delimitations

Empirically, the research focuses on organisations involved in emerging renewable energy industries (hydrogen, e-fuels and related technologies) operating within a resource-rich peripheral region (the Magallanes region of southern Chile). The temporal scope is delimited to the early development phase, encompassing ideation, investor mobilisation, environmental permitting and initial stakeholder coalition building. Long-term operational outcomes lie outside the scope. This delimitation is theoretically motivated: prior work on entrepreneurial decision-making suggests that the differentiating effects of causal versus effectual logics are most pronounced during phases of high uncertainty, before institutional and market structures stabilise (Sarasvathy, 2001; Read & Sarasvathy, 2005). It also reflects the empirical reality that neither case venture had reached commercial-scale operation at the time of data collection.

Sustainable entrepreneurship serves as the contextual framing of the case sector, but conclusions are not limited to sustainability ventures: insights are sought for any comparably capital-intensive and institutionally dependent projects. The study does not assess technical feasibility, engineering performance or detailed financial modelling; the analytical interest lies in the strategic and institutional processes that shape venture trajectory under uncertainty.

Venture trajectory is treated as a process construct: the evolving pattern of regulatory progress, stakeholder coalition development, legitimacy negotiation and commercial momentum across the early development phase of a venture.

1.6 Significance of the Study

The study makes three contributions. First, it extends the institutional voids literature by examining how organisations navigate informal voids within an otherwise formally functioning regulatory environment, responding to Webb et al.'s (2020) call for finer-grained analysis of informal-layer dynamics. Second, it identifies decision-making logic as a previously underspecified determinant of institutional entrepreneurship, complementing Battilana et al.'s (2009) emphasis on field conditions and actor position. Third, it extends effectuation research

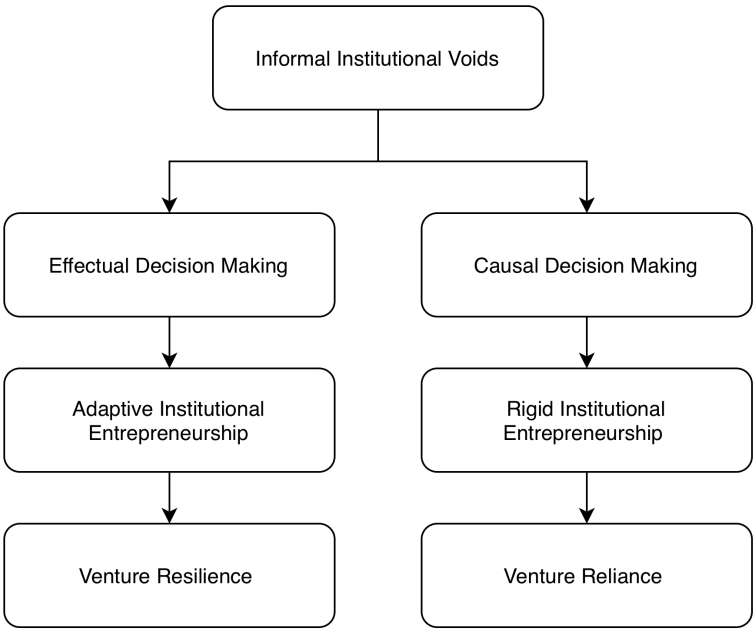
into capital-intensive sustainability ventures, examining whether the causal-effectual distinction continues to differentiate trajectories where stakes and institutional exposure are substantially higher than in the small-firm contexts that have dominated the literature. In doing so, it clarifies how the operational content of legitimacy is constructed within the venture when the wider institutional environment fails to supply it.

Beyond its theoretical contributions, the study offers practical insights for entrepreneurs, investors and policymakers operating in or governing institutionally complex environments.

2. Theoretical Framework

This chapter develops a multilevel framework explaining how entrepreneurial organisations engage with informal institutional voids. Macro-level informal voids generate conditions of legitimacy contestation and unstable expectations. Meso-level institutional entrepreneurship is the mechanism through which ventures engage those conditions. Micro-level decision-making logic shapes the form of this institutional entrepreneurship. Venture trajectory emerges as the cumulative product of these interactions.

Figure 1. Theoretical Model



2.1 Institutional Theory

Economic activity is embedded in institutions that shape incentives, constrain action and confer legitimacy (North, 1990). Acemoglu and Robinson (2012) argue that development trajectories are significantly influenced by institutional arrangements and their effects on economic behaviour. Scott (1995) conceptualises institutions through three pillars: regulative elements (formal rules, monitoring and enforcement), normative elements (values and social obligations), and cognitive elements (shared cognitive frames and assumptions). Where favourable, institutions shape entrepreneurial activity by influencing access to resources, perceptions of legitimacy and coordination costs (Tracey & Phillips, 2011).

Applying institutional theory to entrepreneurial settings requires distinguishing between formal and informal institutions. Formal institutions are codified and enforceable governance mechanisms such as laws, regulations, permits and administrative procedures. Informal institutions are socially embedded norms, values and cultural-cognitive understandings that shape what is appropriate, credible and legitimate (North, 1990; Scott, 1995). Even when formal institutions appear present and supportive, ventures may face uncertainty if informal institutions produce contested interpretations of what sustainability means, whether development is acceptable, or whether actors can be trusted. Informal institutions therefore shape legitimacy judgments and stakeholder willingness to commit, often determining whether formal permissions translate into practical progress (Tracey & Phillips, 2011). This thesis foregrounds informal institutions for precisely this reason: they operate as the hidden coordination infrastructure of markets, and when weak or inconsistent, entrepreneurial action becomes difficult to sustain.

2.1.1 Institutional Voids

The concept of institutional voids characterises environments in which weak, fragmented or unreliable institutions create barriers to market exchange and entrepreneurial action (Khanna & Palepu, 1997; 2006). Originally developed to explain why diversified business groups persist in emerging economies, the construct identifies the absence of market-supporting institutions as a constraint firms must work around or replace through internal substitutes. The construct has been substantially refined since: Mair and Marti (2009) and Mair et al. (2012) treat voids not as static environmental conditions but as the field on which institutional work operates, showing that the

same conditions that can disable exchange can also enable the creation of new institutional arrangements through intermediary work.

Two further refinements are relevant here. Doh et al. (2017) distinguish formal institutional voids from informal institutional voids, arguing the two require different responses. “Operat[ing] through more implicit, culturally transmitted and socially constructed processes" (Doh et al. 2017, p. 297), informal voids can exist as failures to provide stable expectations even where formal rules operate. Webb et al. (2020) extend this distinction by demonstrating that informal voids can persist within otherwise developed regulatory environments, defining them as failure "to facilitate stable, efficient, and effective transactions" (Webb et al. 2020, p. 4) and decoupling any implicit equivalence between voids and emerging markets.

Bothello et al. (2019) argue that voids research has tended to compare emerging-market contexts against an idealised Western institutional baseline, producing a deficit framing that obscures the institutional richness of supposedly void contexts. The resulting deficit framing, they contend, obscures the institutional richness of contexts labelled as void, since the literature too often "characterizes settings by disorder primarily because it fails to recognize pre-existing, alternative orders" (Bothello et al. 2019, p. 4). Their critique does not refute the construct but calls for its careful application. The present thesis applies the construct specifically to the informal layer, where the empirical material evidences failures of shared expectations rather than measuring against a normative baseline.

The Chilean case illustrates the formal/informal distinction. Chile is among Latin America’s institutionally stronger economies, with a formally functioning Environmental Impact Assessment (SEIA) system, codified hydrogen-strategy commitments and stable property-rights protection. The informal layer governing sustainability development in Magallanes has nonetheless been characterised by regulatory volatility, fragmented expectations across levels of government, and contested legitimacy of large-scale industrial development.

2.1.2 Legitimacy and Social Licence

If informal institutional voids destabilise shared expectations, the operational content of what is destabilised is legitimacy. Suchman (1995, p. 574) defines legitimacy as “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within

some socially constructed system of norms, values, beliefs, and definitions." His framework distinguishes three forms: pragmatic legitimacy resting on the self-interested calculations of immediate audiences; moral legitimacy resting on normative evaluations of whether the activity is the right thing to do; and cognitive legitimacy resting on taken-for-granted comprehensibility within prevailing cultural-cognitive frames. The three are analytically separable but operationally interactive, with subsequent work emphasising that legitimacy is increasingly understood as a process of ongoing negotiation between an organisation and its evaluators rather than a stable state (Deephouse et al. 2017).

For ventures in emerging industries, cognitive legitimacy is particularly demanding. Aldrich and Fiol (1994) argue that new industries face a fundamental legitimacy challenge unlike that of established industries: no taken-for-granted category exists into which the new activity fits, and stakeholders cannot evaluate the venture against established reference points. New-industry ventures must therefore construct cognitive legitimacy through narrative and demonstration, often before they can claim pragmatic or moral legitimacy. This is directly relevant to green hydrogen and e-fuel ventures, since industrial-scale e-fuel production has limited taken-for-granted reference in the Chilean (and indeed global) institutional environment.

The concept of social licence provides a sector-specific articulation of legitimacy particularly apt for capital-intensive sustainability ventures. The concept originated in the mining industry in response to the recognition that formal regulatory permission is necessary but not sufficient for industrial operation (Prno & Slocombe, 2012). Boutilier (2014) defines social licence as the ongoing approval and acceptance of a company's operations by local stakeholders, noting that the concept is inherently relational, dynamic and renegotiable: it is sustained or withdrawn across the operating life of the venture rather than granted at a single moment. Gehman et al. (2017) make the theoretical connection between social licence and legitimacy theory explicit, arguing that social licence is a sector-specific application of legitimacy with three distinguishing features. It is specifically local in referent, concerning the legitimacy a venture maintains with communities most immediately affected. It is contingent on operational behaviour: it depends on what the venture actually does, not merely on what it formally promises or what regulators approve. It is informal in presentation: granted and withdrawn through community engagement, public protest and NGO mobilisation rather than through formal legal processes. These features make social licence a precise operationalisation of the informal legitimacy that informal voids

destabilise. Where voids weaken the informal infrastructure on which shared expectations depend, social licence becomes both more important, because formal permission cannot substitute for it, and more difficult to construct, because the institutional supports that normally help build it are themselves unreliable.

2.1.3 Institutional Entrepreneurship

If institutional voids destabilise legitimacy, how do entrepreneurial actors respond? DiMaggio (1988) introduced institutional entrepreneurship to explain how actors purposefully shape institutional arrangements rather than passively conforming to them. Maguire et al. (2004) define it as the "activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones" (p. 657). The construct highlights a long-standing paradox in institutional theory, namely how actors embedded in institutions can also act on them, which Garud et al. (2007) frames as the puzzle of embedded agency. Battilana et al. (2009) identify two explanatory conditions: field-level conditions including jolts or disruptive events, and the position of the actor at the periphery of fields or at the intersection of multiple fields. These operate to disengage the actor from the institutional context allowing transformative action.

Tracey and Phillips (2011) operationalise this institutional entrepreneurship through three strategic tenets directly relevant to the cases studied. Institutional brokering refers to the connection of fragmented stakeholders, reducing uncertainty and translating requirements between them, operationalised here as relational capital. Spanning institutional voids refers to the creation of substitute structures where formal supports are weak or missing, presented in this thesis as cognitive spanning, applying directly to our informal context. Bridging institutional distance refers to adapting practices from other contexts to local normative and cognitive expectations rather than attempting direct institutional transplantation. Operationalised here as legitimacy building. The three tenets correspond to patterns observed in the case material and allow institutional entrepreneurship to be analysed as a repertoire of specific moves whose enactment varies across ventures.

Opposing these tenets we introduce three counterpart concepts that describe how institutional work can take a reliance-based rather than construction-based form, producing the rigid trajectory pattern the analysis identifies. Aggregating connects to collective institutional

entrepreneurship research, which examines how multiple actors coordinate institutional change through formal coalition vehicles such as trade associations and policy alliances (Hardy & Maguire, 2008; Wijen & Ansari, 2007). This literature documents both the characteristic strength of such vehicles (aggregated voice, concession discipline, representational scale) and their characteristic vulnerability (dependence on formal-institutional responsiveness and on membership stability). Transplantation connects to the template-transfer and institutional isomorphism literatures (DiMaggio & Powell, 1983; Kostova, 1999; Sahlin & Wedlin, 2008), where Kostova's (1999) concept of institutional distance specifies why templates that travel within familiar contexts encounter friction when imported into structurally novel ones. Procedural legitimacy connects to legitimacy theory's distinction between formal and substantive forms of legitimacy: where Scott's (1995) regulative pillar specifies formal compliance with codified rules as one institutional support among three, and Suchman (1995) distinguishes pragmatic legitimacy from the moral and cognitive forms that rest on deeper bases, the social licence literature explicitly identifies the assumption that formal regulatory permission constitutes sufficient legitimacy as a characteristic failure mode of capital-intensive industrial development (Boutilier, 2014; Gehman et al. 2017). Procedural legitimacy is the institutional-work expression of that assumption: channeling legitimacy-construction activity through formal compliance processes without the parallel substantive engagement that constructs social licence as institutional infrastructure.

Empirical studies of institutional entrepreneurship in comparatively stable formal environments remain limited (Leca et al. 2008), motivating research that examines how it functions where formal institutions may be present but informal legitimacy conditions remain contested. The present thesis contributes to this gap by examining institutional entrepreneurship in a setting where formal architecture is functionally present but informal voids destabilise the legitimacy conditions on which venture progress depends.

The framework therefore distinguishes two processual trajectory patterns. Venture resilience refers to a trajectory in which the venture constructs legitimacy assets, stakeholder commitments and tangible anchors that allow continued adaptation under institutional volatility. Venture reliance refers to a trajectory in which the venture remains dependent on external institutional predictability and becomes vulnerable when formal procedures, market signals or stakeholder

expectations fail to stabilise. These are not terminal outcomes, but trajectory patterns observed during early-stage venture development.

2.2 Entrepreneurial Decision-Making

The institutional and legitimacy mechanisms examined above operate at the meso level of the venture's engagement with its environment. This section turns to the micro level of decision-making logic that underpins this engagement. The fundamental theoretical issue concerns the limits of predictive rationality under uncertainty.

The distinction between risk and uncertainty is foundational. Knight (1921) introduced the analytical separation between situations in which probability distributions over outcomes are known (risk) and situations in which they cannot meaningfully be assigned (uncertainty). McMullen and Shepherd (2006) develop this distinction for entrepreneurship theory, arguing that entrepreneurial action takes place under Knightian uncertainty, where outcomes cannot be known in advance and the choice to act is itself a judgment under that uncertainty. Informal institutional voids produce a form of uncertainty that is not reducible to risk: when shared expectations cannot stabilise, the probability distributions over institutional outcomes cannot be assigned at all, and the decision-making logic the venture employs must therefore operate without them.

Two contrasting logics for action under such conditions have been developed in the entrepreneurship literature. In causal models, action is framed as an optimisation problem in which decision-makers begin with a predetermined goal and select efficient means (Gregoire & Cherchem, 2020). This logic assumes that planning and analysis can mitigate uncertainty in sufficiently predictable environments; where the environment is structurally unpredictable, the planning assumptions on which goal-directed action rests cannot be reliably anchored. Effectuation offers a contrasting logic suited to institutional-void conditions. Sarasvathy (2001) defines effectuation as a basis for action in environments where the future is unknowable in principle. Read and Sarasvathy (2005, p. 50) describe it as a "straight inversion" of rational choice theory: rather than selecting means to reach a given goal, entrepreneurs begin with available means and co-create possible ends through interaction with stakeholders. Effectuation is operationalised through five core heuristics (Sarasvathy, 2001). Bird-in-hand directs ventures to start from existing means and iteratively shape a viable path rather than relying on a fixed

plan. Affordable loss directs ventures to stage commitments so potential downside remains manageable while learning accumulates. Crazy quilt directs ventures to assemble a coalition of committed stakeholders whose precommitments stabilise legitimacy and coordination. Lemonade directs ventures to treat surprises as inputs for adaptation rather than as failures of plan execution. Pilot-in-the-plane directs ventures to treat outcomes as actively shaped by agency rather than determined by environment.

In this study, causal decision-making is operationalised through three patterns: predictive planning (decisions based on assumptions that regulatory, market or stakeholder conditions can be forecast with sufficient reliability), goal-directed commitment (maintaining a predefined project configuration or scale despite emerging uncertainty), and expected-return reasoning (evaluating continued commitment through projected future payoff rather than through affordable-loss exposure or incremental legitimacy-building). These indicators do not imply that causal reasoning is inherently ineffective; they specify the form it takes empirically in this study and allow comparison with more effectual patterns of staged commitment, stakeholder co-creation and adaptive recalibration.

2.3 Integrative Synthesis

The framework specifies a multilevel explanation integrating three causally connected levels.

At the macro level, institutions shape incentives, coordination costs and legitimacy conditions (North, 1990; Scott, 1995). Where informal institutions fail to provide stable shared expectations, entrepreneurs face heightened uncertainty (Webb et al. 2020). The macro level provides the contextual condition the venture operates within: it does not act mechanically on the venture but determines what kinds of institutional work are necessary for progress.

At the meso level, ventures respond through institutional entrepreneurship (DiMaggio, 1988; Maguire et al. 2004; Battilana et al. 2009) and institutional work (Lawrence & Suddaby, 2006). The three tenets articulated by Tracey and Phillips (2011), institutional brokering, spanning institutional voids and bridging institutional distance, specify the practices through which ventures construct the legitimacy and stakeholder commitments necessary for progress. Institutional entrepreneurship is the channel through which decision-making logic is translated into concrete institutional effects. What is at stake is operationally manifested as legitimacy

(Suchman, 1995), expressed in the sector-specific form of social licence to operate (Boutilier, 2014; Gehman et al. 2017). Under informal institutional voids, legitimacy and social licence cannot be assumed and must be actively constructed. To operationalise where legitimacy and social licence are taken as given rather than constructed, we include three opposing tenets. Aggregating draws on collective institutional entrepreneurship (Hardy & Maguire, 2008; Wijen & Ansari, 2007), where formal coalition vehicles confer aggregated voice but depend on formal-institutional responsiveness. Transplantation draws on template-transfer and isomorphism (DiMaggio & Powell, 1983; Kostova, 1999), where templates fail when imported across institutional distance. Procedural legitimacy draws on Scott's (1995) regulative pillar and the social licence literature (Boutilier, 2014; Gehman et al. 2017), where formal regulatory permission is treated as the sufficient form of legitimacy work, displacing the substantive engagement that constructs social licence under conditions where formal permission cannot substitute for it.

At the micro level, effectuation and causation represent decision-making logics through which entrepreneurs enact institutional work under uncertainty (Sarasvathy, 2001; Read & Sarasvathy, 2005; McMullen & Shepherd, 2006). Decision-making logic is not a separate parallel construct but the cognitive-strategic orientation that shapes the form and effectiveness of meso-level institutional work.

Venture trajectory emerges from the interaction of these levels. The argument the empirical chapters develop is that effectual decision logic, under conditions of informal institutional voids, produces institutional entrepreneurship that constructs legitimacy and social licence. Causal decision logic, under the same conditions, produces institutional entrepreneurship that depends on the predictability of formal institutions and is therefore vulnerable to precisely the conditions an informal institutional void creates.

3. Method

3.1 Approach and Epistemology

This study adopts a qualitative, processual research strategy suited to tracing sequences of decisions, interactions and legitimacy contests over time (Van de Ven, 2007). The research

design is a comparative multiple-case study (Eisenhardt, 1989; Yin, 2003) within the Magallanes region, combining within-case process reconstruction (Langley, 1999) with cross-case comparison. The approach is abductive, moving iteratively between empirical observations and theoretical constructs (Bell et al. 2019).

The study adopts an interpretivist epistemological position. Informal institutional voids are not directly observable phenomena; participants do not articulate their experiences using the term or its theoretical synonyms. The construct is therefore operationalised indirectly, through observable indicators participants discuss in their own language: shifting regulatory expectations, gaps between high-level endorsement and intermediate-level practice, contested legitimacy claims, fragmented stakeholder signalling and breakdowns in shared expectations among coordinating actors. The researcher's role is to interpret these accounts through the theoretical lens of Chapter 2, identifying responses to informal voids in the patterns participants describe.

This interpretive reading is one possible reconstruction. Alternative readings (regulatory dysfunction or unfavourable global market conditions rather than informal voids) are plausible. The analytical contribution rests on the productive value of the chosen lens for illuminating the relationship between decision-making logic and venture trajectory, rather than on a claim that the informal-void interpretation is uniquely correct. The appropriateness of the lens is itself part of the analytical contribution.

3.2 Research Design

A comparative case study design (Eisenhardt, 1989; Yin, 2003) is adopted within the chosen locality, supported by within-case process reconstruction (Langley, 1999; Van de Ven, 2007). This is a qualitative comparison in which the regional institutional environment is held analytically constant as a contextual condition, allowing the variation of analytical interest, namely how each venture interprets and responds to that environment, to be brought into focus. The two cases were selected through theoretical sampling: both ventures operate in Magallanes; both are sustainability-oriented capital-intensive ventures dependent on the same formal regulatory architecture; both were exposed to comparable informal institutional dynamics; but they have followed visibly divergent trajectories. This combination of similarity in context and

divergence in trajectory makes the comparison theoretically informative for the research question.

The two cases were not exposed to identical regulatory situations: HIF's pilot facility benefited from a streamlined permitting pathway available below a certain project size threshold, whereas the larger H2V-associated projects entered the standard SEIA system at full commercial scale. This is itself part of the analytical interest: the choice of project scale, and therefore the regulatory regime entered, is treated as part of the venture's decision-making and institutional engagement. The analysis is framed as a comparison of how each venture engaged the same broad institutional environment, including their differing strategic choices about scale and sequencing, rather than as a comparison under identical procedural conditions.

A structural asymmetry in the two cases warrants explicit acknowledgement as a design feature rather than a limitation. HIF is studied as a single venture, with multiple senior internal informants providing actor-level accounts of decision-making across the development trajectory. The H2V Magallanes developer ecosystem is studied at a higher level of aggregation: given the dissolution or significant reduction of personnel across member organisations prior to data collection, the primary informants are actors who operated within or adjacent to the ecosystem rather than its internal decision-makers. This asymmetry is intended to mitigate survivor-bias risk arising from the divergent venture trajectories. Trajectories are observed through markers such as progress through regulatory stages, permitting milestones and implementation movement; Chapter 4 is organised around these markers.

3.3 Data Collection

3.3.1 Triangulation Strategy

The study applies data triangulation (Yin, 2003; Bell et al. 2019), enhancing credibility by enabling cross-validation across different types of data. Reliance on retrospective interview data alone would risk biases of memory and post-hoc rationalisation. Two primary data streams are used: (i) semi-structured interviews providing insight into how actors interpret institutional conditions, make decisions and engage with stakeholders, and (ii) documentary and archival sources providing evidence of formal processes, regulatory timelines and publicly articulated positions.

3.3.2 Primary Data: Semi-Structured Interviews

The primary data source is a set of semi-structured interviews with senior actors directly involved in the development of the two case ventures. The coded dataset comprises eleven interview sessions with seven coded participants (P2 to P8 in Table 1), supplemented by a single exploratory pilot interview (P1, not coded). Participants are anonymised throughout using role-based descriptors and the named organisations are publicly identifiable.

Table 1. Interview corpus.

Code	Role-based descriptor	Organisation	Duration	Status in study
P1	CEO and Founder	HIF Global	60 min	Pilot; exploratory; not coded
P2	Chief Technology Officer	HIF Global	60 + 60 min	Coded; current CTO
P3	Former CTO	HIF Global / AME	60 min	Coded; founding-period actor
P4	CEO Chile	HIF Global	60 + 60 min	Coded; Chilean lead
P5	Chief Environmental and Sustainability Officer	HIF Global	60 min	Coded; permitting and stakeholder lead
P6	Director	H2V Magallanes	60 + 60 min	Coded; exploratory and follow-up
P7	Former Project Director	HNH Energy / CIP	60 + 60 min	Coded; large H2V project lead
P8	Former President	H2 Chile (former EDF, Engie)	60 min	Coded; national / ecosystem coordinator

Participants were selected through purposive sampling based on their direct involvement in the strategic, regulatory and stakeholder-facing decisions central to the study, with initial access through a personal professional connection and subsequent participants recruited via snowball sampling. Since H2V Magallanes operated with only two staff prior to its dissolution, additional informants were drawn from the wider hydrogen developer ecosystem to provide project-level operational detail (P7) and system-level perspective (P8). The corpus covers distinct vantage points: for HIF, three operational roles and one environmental lead role; for H2V Magallanes, one trade-association role, one project-level technical role, and one national coordination role.

Coded interviews were conducted in English or Spanish over video call, recorded with informed consent and transcribed verbatim. The interview guide (Appendix A) emphasised concrete decision episodes, regulatory and stakeholder interactions, and reflective accounts of strategy. In line with Gioia et al. (2013), the design prioritised respondents' own language. Because informal institutional voids are not directly articulable, questions were designed not to ask about voids per se but to elicit concrete experiences ("How did the permitting process unfold over time?", "How did expectations about regulatory requirements change?", "How did you decide whether to commit to the next stage?"), from which void-related dynamics could be reconstructed. Follow-up interview guides were based on prior transcripts to avoid repetition.

3.3.3 Secondary Data: Documentary and Archival Sources

Documentary and archival material is used to construct an independent event-level timeline of each case, to corroborate or contest interview accounts of specific named events, and to characterise formal institutional positions. The secondary-source corpus consists of approximately twenty distinct sources collected over the period January 2025 to April 2026 and grouped into five categories (Table 2).

Table 2. Secondary sources.

Source category	Examples in the corpus
Regulatory filings and state communications	SEIA records for Faro del Sur, Cabo Negro and H2 Magallanes EIA processes; Ministry of Environment regulatory notifications; SEA Magallanes suspension grants (La Prensa Austral, 2025).

Company press releases and corporate communications	HIF Global (2025a) on the Porsche-Shell tripartite agreement; Porsche Newsroom (2022a, 2022b) on the USD 75m investment and Haru Oni opening; Energy Capital Houston (2024) on the Idemitsu-led round; TotalEnergies H2 (2024); Renewables Now (2021).
Chilean financial and regional press	Diario Financiero (2023, 2025) on project filings and the suspension; La Tercera (2023) on Faro del Sur withdrawal; La Prensa Austral (2025); Radio Polar (2026) on *the gremio* pause; redimin.cl (2025); Revista Electricidad (2026) on Faro del Sur approval.
English-language sector press	Hydrogen Insight (2025) on EDF cancellation; Fuel Cells Works (2025) on Ignis pause; Fertilizer Daily (2025) on HNH suspension; Strategic Energy Europe (2026); Renewables Now (2021).
Industry-association and international policy-body publications	H2V Magallanes (2024) on gremio membership composition; Environmental Defense Fund (2025) and Ammonia Energy Association (2025) on the IMO Net-Zero Framework postponement.

Source identification followed a replicable search protocol with three primary clusters: venture-name searches (organisational and project names), thematic searches (regional green-hydrogen and e-fuel terms in English and Spanish), and event-specific searches conducted after interviews to verify named milestones (the IMO Net-Zero Framework postponement, Indian and Omani green-ammonia tenders, US IRA hydrogen subsidy changes, the Atome Uruguay FID). Where multiple sources reported the same event with discrepant detail, the original primary source was preferred. Where contested interpretations existed, both were retained in the data and the contestation itself was treated as analytically significant material rather than as something to resolve.

Three caveats apply. First, press sources are not neutral observers: specialist hydrogen-sector press has commercial relationships with the firms it reports on, and Chilean regional press

operates within local political-economy dynamics. The analysis weights primary regulatory and corporate sources more heavily than press accounts of the same event. Second, the temporal cutoff for secondary-source collection is April 2026; events subsequent to that date are not captured. Third, the public visibility of events is unevenly distributed across the two cases: HIF's milestones are more documented in international press than those of H2V or any single ecosystem developer, which itself influences what can be independently triangulated.

3.4 Data Analysis

The analysis combines thematic analysis with elements of process tracing to examine how decisions and institutional interactions unfold over time. Thematic analysis enables the identification of recurring patterns, themes and concepts across the data (Bell, Bryman & Harley, 2019), while process tracing supports the reconstruction of causal sequences linking specific actions to observed outcomes (Yin, 2003). The combination is suited to explaining how venture trajectories emerge through sequences of decisions and interactions.

3.4.1 Within-Case Process Reconstruction

The first stage of analysis is within-case process reconstruction (Langley, 1999). For each case, a structured chronological narrative was developed tracing key decision episodes, stakeholder interactions, regulatory processes and shifts in trajectory. Interview data and documentary sources were integrated into a single timeline per case, with each sub-chapter heading indicating a specific temporal marker.

3.4.2 Multi-Stage Coding

A multi-stage coding process was then applied to the interview transcripts, following the Gioia methodology (Gioia, Corley & Hamilton, 2013). At the first-order stage, transcripts were coded inductively staying close to the respondents' own language. At the second-order stage, first-order concepts were grouped into theoretically informed themes that captured patterns across multiple informants and episodes. Second-order themes were then synthesised into case-specific aggregate dimensions. The macro-level dimension of informal institutional voids, which is shared across both cases, is presented separately as a cross-case context structure (Appendix D).

Tables 3 and 4 present one aggregate dimension per case, with illustrative quotations, as a demonstration of the coding methodology; the full data structures appear as Appendices B (HIF) and C (H2V). Themes and quotations that bear solely on the macro-level informal institutional voids dimension are presented separately as the cross-case context structure (Appendix D).

Table 3. Example coding structure for the HIF case.

1st-Order Concepts	2nd-Order Themes	Aggregate Dimensions
"We tried everything. We started with the [idea] to interconnect Chile with Magallanes, with a submarine transmission line. We also worked in interconnection with Argentina, but all alternatives were very difficult." (P4) "We were like more than half a year talking to some aluminium industry… but there was a huge problem… they needed this kind of bricks, like the 24/7 supply of energy." *(P4)* "Liquid energy carriers, like oil, liquid gas, are transported around the world." (P2)	A1. Iterative technology-pathway	**A. Construction of the venture's shape**
"It was quite clear in the beginning that we would need to demonstrate that this is possible." (P2) "It was imperative to move from a PowerPoint solution to a real solution." (P4) "It's a mix between an industrial plant and a museum." (P4)	A2. Pilot plant as proof	

“We realised in all these years that we cannot develop gigawatt projects... you could, but you have to make them in stages, small stages.” (P4) “It was also one of our, also my, mistake. I started the development from the technical perspective and said, we have to go to the commercial size directly.” (P3)	A3. Disciplined right-sizing	
“Wind and PV was very expensive 20 years ago... factor of 10 or 20 more expensive than fossil generated electricity.” (P2) “Costs will go down only with executed projects.” (P3) “We need that scale up. We need several proto-type installations to reduce the cost.” (P2)	A4. Small-scale justification	

Table 4. Example coding structure for H2V Magallanes.

1st-Order Concepts	**2nd-Order Themes**	**Aggregate Dimensions**
“We are sort of forced to go to this scale because you had to pay for the infrastructure.” (P7) “If we were to go for only phase one, 580,000 tons per year, that was not enough to pay for the cost of the infrastructure.” (P7)	A1. Scale-driven logic	**A. Strategic Architecture Decisions**

“Trying to develop an industry that would go from nothing, from zero to an industry that represented 18% of the fuel consumption of the world in 15 years.” (P7)		
“When we start working on Chile, we thought that the project will be ready to decide on investment, say, after two or two and a half years, no more than that.” (P7) “We expected a significant drop in electrolyser prices around [the early 2020s], but that didn’t happen.” (P8)	A2. Prediction-based investment logic	
“The projects had to develop inexistent infrastructure, such as port... the cost of bringing labour in... started going up significantly.” (P7) “There was the need to develop a port, expand the highway... expand the airport.” (P7)	A3. Capex-amortisation as design constraint	
“Hydrogen projects are industrial projects; they are not generation projects, even though they have a generation component.” (P8) “Utilities’ knowledge is more limited to the power-generation side, and believing that would be enough for a hydrogen project has proven not to be the case.” (P8)	A4. Power-generation logic for an industrial venture	

Coding was conducted iteratively. After initial first-order coding of the first transcripts, candidate second-order themes were proposed, and subsequent transcripts were coded with reference to

that emerging structure while remaining open to new themes. After all transcripts had been coded, the second-order themes were re-examined for consistency and consolidation.

3.4.3 Cross-Case Comparison

Cross-case comparison was conducted following within-case analysis, focusing on differences between the advancing venture (HIF) and the constrained ventures (H2V Magallanes and the broader ecosystem) in their dominant decision-making logics, forms of institutional entrepreneurship and responses to similar institutional conditions. By treating the broader regional and sectoral environment as a shared contextual condition, the analysis isolates variation in decision-making behaviour as the potential explanation for divergent trajectories. The analysis iterates between empirical observations and theoretical constructs to develop a coherent explanation, leading to the grounded model and propositions presented in Chapter 5.

3.5 Trustworthiness, Ethics and Limitations

Research quality is established through credibility, construct validity and transparent inference. Credibility is strengthened via sustained contextual immersion in the Magallanes case and systematic documentary review, enabling informed interpretation of technical and political dynamics. Claims are triangulated across semi-structured interviews, corporate communications, sector press and policy-body publications, as detailed in Section 3.3.3. Construct validity is addressed by defining informal institutional voids explicitly (Chapter 2), specifying observable indicators (Section 3.1), and designing interviews that can be corroborated externally. Transparent inference is supported by the public presentation of the coding structure (Tables 3 and 4; Appendices B to D).

Because the topic involves politically and commercially sensitive disputes, the study prioritises confidentiality. In addition to anonymising participants, contextual detail is moderated to reduce disclosure risk. Interview recordings, transcripts and sensitive materials are stored securely. The two case ventures are referred to by their publicly known organisational names (HIF and H2V Magallanes), since both operate within publicly documented processes.

The study is subject to access and survivor bias, partially mitigated by inclusion of constrained cases and by documentary triangulation. The single-locality, single-sector focus strengthens

internal explanatory leverage but limits transferability. The reconstructed longitudinal design relies partly on retrospective accounts; recall risks are mitigated through event-sequencing against documented dates and through follow-up interviews with P2, P6 and P7. The secondary-source corpus is unevenly distributed across the cases: HIF's milestones are more publicly documented than those of individual H2V developers, which affects what can be cross-checked. The appropriateness of the theoretical lens to the specific empirical material is discussed in Chapter 6.

4. Empirical Findings

This chapter presents the empirical material from 11 coded interview sessions with seven informants, supplemented by documentary sources. Each case is presented processually, following the approach developed in Chapter 3, and traces the trajectory from initial venture design through to resilience or retreat. The objective is descriptive: to present what happened, how participants interpreted their circumstances, and how their accounts trace the unfolding of the decision-making logic each venture employed. Analytical interpretation linking these findings to the theoretical framework is developed in Chapter 5.

4.1 Case One: Highly Innovative Fuels (HIF)

4.1.1 Means-driven Design

HIF originated not from a strategic plan to enter the e-fuels market but from personal observation of the wind conditions in southern Chile. The founders identified the opportunity through informal exposure to the region, and rather than treating Magallanes's grid isolation as a constraint, reframed it as a problem of energy conversion. The ideation process that followed was iterative rather than directed, exploring multiple potential applications before converging on synthetic fuels:

> We thought about different options, like aluminium production, for example, or production of glass. And then I studied a project in Germany, Power to Gas... first methane, then methanol and Fischer-Tropsch products (P3, former CTO HIF).

The CEO of HIF Chile (P4) corroborated the breadth of the exploratory phase, which included submarine transmission to Puerto Montt, interconnection with Argentina, and prolonged conversations with the aluminium industry before the e-fuels pathway was selected. The choice of methanol and synthetic gasoline reflected technological maturity, regulatory tailwinds in aviation and maritime fuels, and the maturation of a partnership with Porsche whose origins predated the e-fuels venture by several years (see Section 4.1.3).

The most consequential design decision at this phase was the rejection of commercial scale as a starting point. The CTO identified his early recognition:

> It was quite clear in the beginning that we would need to demonstrate that this is possible. And therefore also from the beginning, it was planned to install a demonstration plant, a pilot plant, directly down in these wind conditions (Chief Technology Officer, P2).

The CEO of HIF Chile articulated the same principle as continuing design discipline: “we are very clear on the size that we need to start... it’s not a monster project like a gigawatt break” (P4). HIF was formally incorporated in 2019 to 2020 (Renewables Now, 2021), with conceptual groundwork developing within the parent organisation AME for several years prior.

4.1.2 Proof Commitment

The most consequential single decision in HIF’s early development was the construction of the Haru Oni demonstration plant near Punta Arenas before any commercial-scale project had been permitted. Every coded HIF interviewee described the plant as central to the company’s subsequent ability to engage investors, regulators and the public. The current CTO framed it as a deliberate step from concept to operational reality: “we have to show to the world that it is possible” (P2). The CEO of HIF Chile characterised the plant as deliberately occupying a hybrid purpose: “It’s a mix between an industrial plant and a museum” (P4).

The plant has received over a thousand visitors annually since opening (P4) and was attended at its December 2022 opening by Chilean Energy Minister Diego Pardow and two Porsche executive board members (Porsche Newsroom, 2022b). The Chief Environmental and Sustainability Officer (P5) described arrangements operationalised around the plant's by-products: off-gas transfer to Chilean gas distributor Gasco for LPG mixing experiments, salt recovered from desalination offered for de-icing Magallanes's streets, and a formal supply agreement with national oil and gas distributor ENAP. The plant was deliberately framed as "made in Magallanes" rather than as an extractive foreign investment, addressing an early legitimacy challenge in which community feedback frequently questioned why fuel destined for Germany should be produced in Magallanes (P3, P5).

4.1.3 Relational Capital

The Porsche relationship is the most fully documented instance of HIF's coalition-building approach. It did not begin with the e-fuels venture: it originated in five to six years of prior R&D collaboration during earlier projects, including patent work on photovoltaics and a joint study on electric bus deployment in Santiago. The former CTO emphasised that the e-fuels concept could not have been introduced cold:

> We had already five years, six years of work together [with Porsche]... if a genuine company is coming to Porsche and want to propose co-development, you know in which world we are living. But we had already five years, six years of work together (P3).

When the e-fuels concept was first presented at senior level, the response was unambiguous rejection. The team did not abandon the relationship; they re-entered through Porsche's automotive engineering division. The engagement that followed was incremental: Porsche first agreed to participate in the pilot plant only as a demonstration partner, explicitly stating it would not become an infrastructure investor. Over time this position evolved through repeated interaction with the operating plant, eventually reaching the CEO level (P3). The trajectory is independently documented. Porsche's formal investment of USD 75 million in HIF Global LLC

was announced in April 2022, with total Porsche commitment to e-fuels development exceeding USD 100 million (Porsche Newsroom, 2022a). By May 2025, the relationship had deepened into a tripartite supply agreement involving HIF, Porsche and Shell for fuel from Haru Oni (HIF Global, 2025a).

The former President of H2 Chile identified the commercial strategy as HIF's most distinguishing factor: "they had a very good international pitch and were able to raise capital from partners like Porsche…[HIF] has known how to scale it properly" (P8). A second investment round led by Idemitsu (USD 114 million of a USD 164 million round) followed in 2024 as the project portfolio expanded internationally to the United States, Australia and Uruguay (Energy Capital Houston, 2024). Partners were selected for patience as much as capital, with pre-existing trust networks making that selection feasible (P2).

4.1.4 Adaptive Institutional Work

HIF's experience with environmental permitting differed across project scales. The Haru Oni demonstration plant qualified for a streamlined regulatory pathway and was approved relatively rapidly; the commercial-scale wind farm and chemical plant projects entered the standard SEIA system and encountered substantially greater complexity. The former CTO identified a pattern in which high-level government endorsement of green energy did not translate into corresponding behaviour by intermediate-level officials: "on the top level, if you speak to the government, everything, oh yes, green energy, it's fine. But on the intermediate level, the people are unsecure" (P3).

Public consultation surfaced a significant legitimacy challenge regarding the destination of the project's output, with community feedback frequently questioning why a fuel destined for Germany should be produced in Magallanes (P3). The Chief Environmental and Sustainability Officer described the company's response to organised opposition with particular specificity. Conservation NGOs, particularly those concerned with bird populations, raised substantive concerns about collision risk from large wind farms. Rather than positioning these groups as opponents to be defeated through legal process, HIF engaged them as substantive collaborators in early environmental study work:

> We actually contacted some of the specialists, people that ended up being against the large-scale wind farms. But these people were the ones that did the first studies down on our projects where we determined that there was no big red flags (P5, Chief Environmental and Sustainability Officer).

Project design adaptations followed. First, sites were selected in landscapes already significantly altered by 150 years of cattle farming and 80 years of oil and gas exploration, avoiding pristine areas near Torres del Paine National Park (P4, P5). Secondly, the Faro del Sur wind farm site includes the first underground high-voltage transmission line for a wind farm in Chile (Strategic Energy Europe, 2026) and the facility at Cabo Negro was designed to take seawater from the Magellan Strait and fully recycle it (P5). Finally, rotor heights were adjusted to clear local bird species' flight altitudes (P4) and bird-monitoring radar and camera systems were integrated so individual turbines could stop spinning if specific species crossed collision corridors (P4, P5).

The permitting trajectory itself evidenced this iterative orientation. Faro del Sur initially entered the SEIA in August 2022, was strategically withdrawn in October 2022 for additional fieldwork following regulator observations the firm regarded as exceeding the usual standard, and was resubmitted in late 2023 with revised design (La Tercera, 2023). Cabo Negro received unanimous environmental approval in October 2025 (redimin.cl, 2025); Faro del Sur received unanimous approval in late January 2026 (Revista Electricidad, 2026).

4.1.5 Staged Scaling and Resilience

Despite its regulatory progress in Magallanes, HIF faces substantial market-side uncertainty. The CEO of HIF Chile described the impact of an unexpected setback in October 2025, when the International Maritime Organization postponed adoption of its Net-Zero Framework by one year (Environmental Defense Fund, 2025; Ammonia Energy Association, 2025), invalidating the demand-side trigger HIF had expected to drive offtake commitments: "something that we were expecting would trigger the closing of offtakers probably didn't happen. So that showed us that we need to focus on probably other kinds of customers" (P4). HIF's response differed materially from those across the H2V developer ecosystem: rather than freezing positions, HIF maintained

its operating plant, sustained its Porsche offtake agreement, and continued progressing its international project portfolio while reassessing customer-side options.

When Chilean permitting fell behind during the early development period, HIF redirected development capacity to the United States and Uruguay; when the US project subsequently stalled due to political and regulatory risk after the 2024 election, the company recalibrated toward Uruguay rather than committing further (P2). The Uruguay project advanced toward Final Investment Decision under the same partnering model: a smaller project with a German offtaker for 100,000 tons per year of e-fuel, made viable by a pulp-and-paper plant across the fence supplying biogenic CO2 (P8). The structural significance of this multi-jurisdictional posture is taken up in the cross-case comparison (Section 4.3).

4.2 Case Two: H2V Magallanes and the Broader Developer Ecosystem

This case draws on three informants whose roles in the Magallanes hydrogen ecosystem differed substantially. The Director of H2V Magallanes (P6, two interview sessions) provided a sector-level perspective from inside the trade association coordinating the major developer firms. The former Project Director of HNH Energy (P7, two interview sessions) provided a granular operational account of the largest single project in the ecosystem. The former President of H2 Chile (P8) provided a system-level perspective from a position external to any single developer but with intimate knowledge of all of them, having held prior senior hydrogen positions at EDF Chile and Engie.

4.2.1 Goal-First Design

International developers including TotalEnergies, EDF, Acciona, RWE, AES, Ignis and HNH Energy pursued large-scale green hydrogen or ammonia projects in Magallanes, drawn by the region's wind resource and Chile's reputation as a stable investment environment. In contrast to the iterative product search and right-sizing decisions of Section 4.1.1, the H2V developers designed their projects around a fixed forward goal anchored in predictive assumptions about market timing. The former Project Director articulated the planning horizon: "when we start working on Chile, we thought that the project will be ready to decide on investment, say, after two or two and a half years, no more than that" (P7). He described HNH's project in terms illustrating the scale ambition prevailing across the ecosystem:

> The purpose of the project was to develop a 1.3 million tons per year green ammonia facility in two phases... 1.4 gigawatts of wind power and one gigawatt of electrolysers in total (P7).

The former President of H2 Chile identified the underlying decision-making pattern that produced this scale of ambition. The developer firms were almost all utilities or large-scale power generators by origin, and they imported a cognitive frame from that domain into a novel industrial context where it proved poorly suited:

> Many companies entered thinking that because they were power generators, doing hydrogen was just continuing the same energy business, and that's not the case. Hydrogen projects are industrial projects; they are not generation projects, even though they have a generation component that represents 70 per cent of the levelised cost of hydrogen. Utilities' knowledge is more limited to the power-generation side, and believing that would be enough for a hydrogen project has proven not to be the case (P8, former President H2 Chile).

The Director of H2V Magallanes characterised the resulting design profile as systemically over-scaled:

> projects too big, okay, too ambitious... but this is also the main problem, because we have to build everything. We don't have roads, electrical systems. We have nothing currently compatible with that kind of project (P6).

The mismatch between project ambition and infrastructural capacity was knowable in advance but the projects believed these challenges were surmountable.

To represent the developers' collective interests before government and regulators, the firms established a trade association (H2V Magallanes) in March 2023 (Diario Financiero, 2023). The original founding membership of five firms included HIF Global, with HIF's VP of Strategic Development serving as the first President. H2V Magallanes expanded to six members with the addition of HNH Energy in 2024 (H2V Magallanes, 2024). By late 2024 HIF had departed, citing differences in product orientation (e-fuels versus ammonia) and project scale (P7), and leadership had transferred to the larger developer firms (TotalEnergies H2, 2024). The strategic significance of this departure is examined in Section 4.3.

4.2.2 Commitment Lock-In

The decisions taken at the goal-setting phase produced a sequence of irreversible early commitments that locked the developers into cost positions escalating as planning horizons extended. The first concerned land: Chilean permitting obliged developers to secure land-lease agreements before they could enter the formal SEIA system, a requirement the former Project Director described as unusual: "it's the first time I've seen that you pay the lease in the development phase when you don't have a project" (P7). Competitive land acquisition drove price inflation, with the Spanish firm Ignis Energy offering USD 29 per hectare against an industry-common rate of USD 4. Ultimately, with the vast majority being for wind turbines only, HNH had to secure 64,000 hectares to develop a project that would exclusively use only 1,600 (P7).

The second commitment category concerned infrastructure. Because the region lacked ports, road capacity, expanded airport facilities and a skilled labour pool of the required size, developers committed to build or expand all of this themselves. The former Project Director described envisioned construction-phase logistics of "about 4,000 workers during the construction period for a span of about four years... about 10 flights per week that would have to come in with workers on charter planes" (P7). The infrastructure commitment had to be sized to a single project's needs because the gigascale design did not permit gradual incremental development.

The third commitment category concerned technology. The developers planned around an assumed electrolyser cost-and-availability curve that did not materialise:

> The largest electrolyser … commercially available in the world, was about 20 megawatts capacity. We were planning to install one gigawatt of these electrolysers in HNH. So that meant at that scale, you had to install 500 electrolysers in place. So no way. I mean, it's totally illogical (P7, former Project Director HNH Energy).

The expected price decline did not arrive on the planned timeline: "a significant drop in electrolyser prices was expected... but that didn't happen... this growth curve moved out in time; we're no longer talking about 2030 but about 2035, 2040, 2050" (P8). The resulting position was a chicken-and-egg trap in which the pause in project development further suppressed the demand needed to bring technology costs down (P7).

4.2.3 Permitting Spiral

The defining structural obstacle in the H2V account is not the absence of regulation but its instability. The Director described an environment in which the rules of the permitting game changed continuously:

> The environmental ministry issued a very high volume of new regulations over a short period... almost every week, or every two weeks, you have a new regulation regarding bird, soil, water, whatever. A real mess (P6)

The planning horizon against which decisions had been made was repeatedly invalidated. The former Project Director detailed the consequence in cost terms: the first round of formal observations on the environmental impact study produced approximately 1,500 questions, with response costs exceeding USD 3 million; the second round produced approximately 1,400 substantive questions and a further USD 4 million in technical study costs (P7). The cost-of-permitting figure across the ecosystem reached, by the former President of H2 Chile's estimate, "in the range of 10 to 50 million dollars" per project (P8); some single projects spent in

excess of USD 30 million on permitting alone with no permit ultimately issued (P6). A complementary capacity constraint operated on the regulator side: the Magallanes regional environmental office had only two assessors at the outset and had to bring in junior engineers from other regions, none of whom had "a full and complete understanding of the industry" (P7).

The Director described significant fragmentation between levels of government. While the regional government of Magallanes was broadly supportive, the Ministry of Environment in Santiago pursued an obstructive approach during the previous administration: "on the top level... green energy, it's fine. The former government, in their speech... did support the investment. But the reality was different" (P6). TotalEnergies H2 formally requested suspension of its USD 16 billion H2 Magallanes EIA in September 2025 to address 817 observations (Diario Financiero, 2025); the SEA Magallanes granted the suspension until 7 December 2026 (La Prensa Austral, 2025). Even the Regional Government of Magallanes, described in interview as broadly supportive, issued an unfavourable EIA assessment for H2 Magallanes (La Prensa Austral, 2025), evidence that institutional fragmentation cuts within nominally supportive levels of government.

4.2.4 Market Non-Materialisation

Compounding the regulatory difficulties, the global market for green hydrogen and ammonia softened during the period in which H2V developers were attempting to navigate permitting. The former Project Director described a series of compounding shocks beginning in early 2025:

> first half of 2025... that's when we started hearing the drums in the jungle were not bringing not so good news... Trump erasing all subsidies; India and Oman coming up with huge volumes of green ammonia at low prices; and the IMO postponing the vote and postponing the decision of adopting ammonia, or any other e-fuel, into the industry" (P7).

The competitive pricing position became untenable. India and Oman entered the market offering green ammonia at USD 570 to 650 per ton against Magallanes's best-case USD 1,000 (P7). Korean and Japanese power-sector buyers, the most plausible large-volume offtakers, were positioned to accept blue or grey ammonia as well as green, treating decarbonisation as the

priority and eco-quality colour as secondary. The former President of H2 Chile confirmed the system-level position: “green ammonia prices remain well above, almost double, on average, the gray alternative... except for HIF, no project has a contract yet” (P8). The IMO’s October 2025 postponement of the carbon-tariff vote (Environmental Defense Fund, 2025) was “the last shot to kill the initiatives” for ammonia-exporting projects (P7).

4.2.5 Strategic Retreat

The compounding effect of these conditions produced a sequence of retreat decisions across the H2V developer ecosystem. The Director articulated the situation as a missed market window, attributing the failure not principally to market conditions but to country-level institutional performance:

> We feel we missed a huge opportunity. Chile wasn’t able to secure the investment it needed, not because of the market, because of our fault. If we had worked as, say, normal countries work, we would have the environmental permits granted after three years... with the investment decision already taken three years ago, when the market was completely different (P6, Director H2V Magallanes).

The Director drew the comparison with HIF directly:

> HIF already started the investment... you have something. With H2 projects, none of the projects has nothing. They haven’t invested, actually, they just spent money, but they have nothing to offer, because they don’t even have a paper that says you have the environmental permit granted (P6, Director H2V Magallanes).

The retreat decisions across the ecosystem were documented in both interview and external sources. EDF cancelled its 785 MW Energia Verde Austral project at Cabo Negro in December 2025 (Hydrogen Insight, 2025); RWE froze its project; AES’s Ena project was cancelled and the company’s hydrogen team disbanded; Engie cancelled its hydrogen projects (P8). The national

H2 Chile project map declined from approximately 81 identified projects at the start of 2025 to approximately 63 to 64 by late 2025 (P8). TotalEnergies remained in the system but reduced personnel substantially (P6). The trade association announced a pause of activities citing “the inexistence of a consolidated market for green hydrogen and its derivatives” (Radio Polar, 2026), with the four remaining member firms (Consorcio Austral, ACCIONA & Nordex Green Hydrogen, TEG Chile and TotalEnergies H2) continuing project-level work. The Director and the former Project Director identified tentative strategic reframings under duress, but none had materialised in commercial commitments by the time of the interviews (P6, P7).

4.3 Cross-Case Comparison

Across the two cases, several structural contrasts emerge that warrant emphasis prior to the analysis. They are presented here descriptively without interpretation.

First, HIF and the H2V developer ecosystem operated in the same regional institutional environment but pursued fundamentally different scale strategies from the outset. HIF committed to a small demonstration plant as its first physical investment, with a manageable 386 MW first commercial step thereafter; H2V-associated developers designed projects at gigawatt scale before any permitting had been secured or local infrastructure assessed. The scale difference was not principally a matter of capital availability; the H2V developer firms had access to capital commensurate with their ambition (P6, P7, P8). The difference lay in the design logic that determined how much capital should be committed before regulatory certainty existed.

Second, HIF’s engagement with investors, partners and regulators was characterised by progressive, relationship-driven commitment building, originating in pre-existing connections and expanding scope incrementally. By contrast, the H2V developer ecosystem represented large-scale external investment without comparable prior relationship development, and channelled its principal institutional engagement through the association. HIF also demonstrated a consistent pattern of adapting project design substantively in response to stakeholder concerns; H2V-associated developers, in the accounts of P6 and P7, struggled to gain comparable traction with communities and regulatory authorities, and engagement was driven by concession discipline rather than cooperation.

Third, HIF had completed the Haru Oni pilot plant and obtained both required commercial permits by early 2026; all H2V-associated projects remained without permits after five or more years, and most developers had reduced their commitment to a minimum holding position. Most analytically significant, HIF possessed a tangible asset (the operating Haru Oni plant) that anchored continued development even when commercial offtake conditions worsened, while the H2V developer ecosystem had no equivalent anchor and could only retrench. The Director's framing of this contrast, "they don't even have a paper that says you have the environmental permit granted" (P6), was independently corroborated by the former President of H2 Chile (P8) as the most decisive factor differentiating HIF's trajectory.

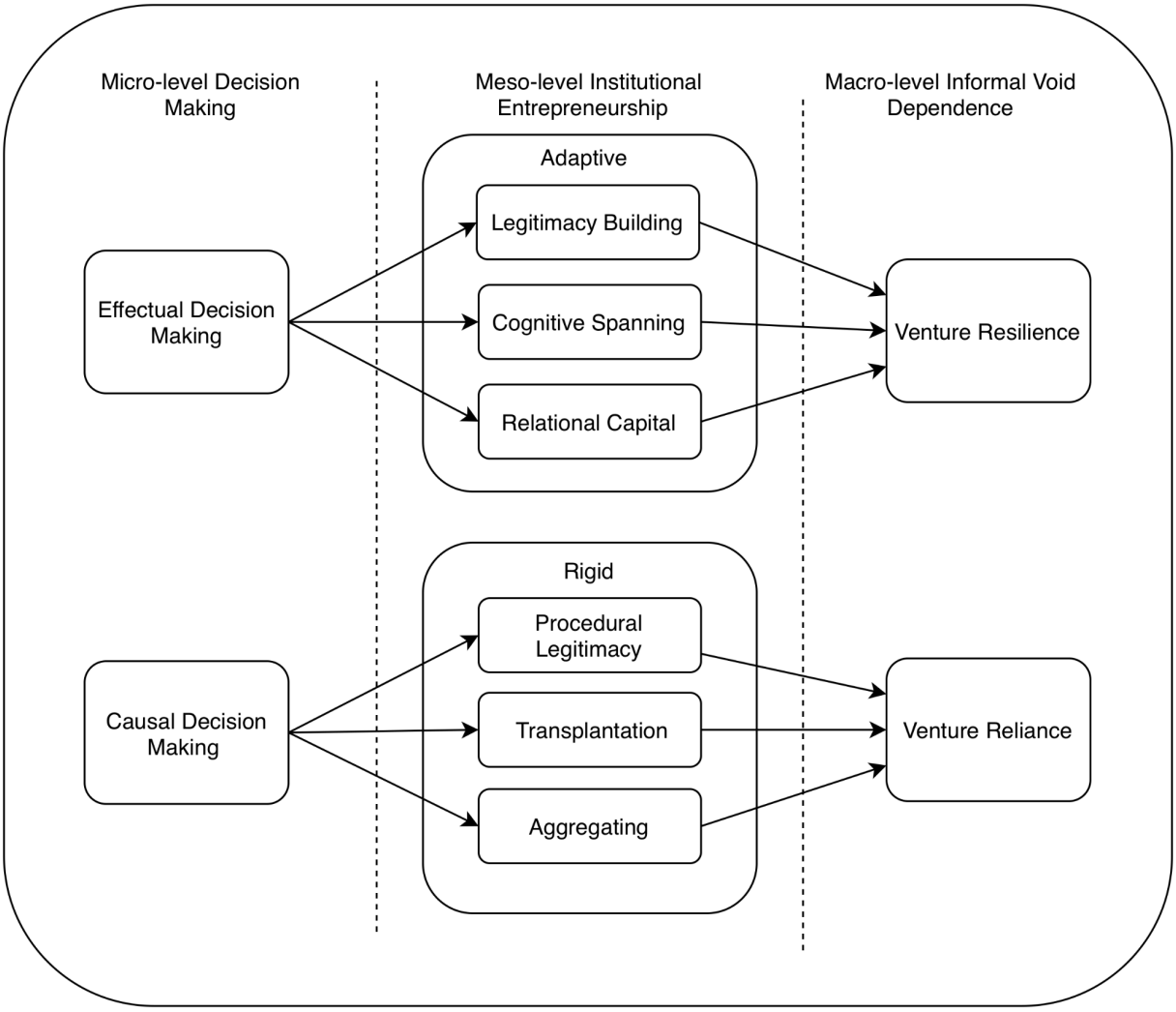
A finding from the documentary record warrants particular note. HIF was originally a founding member of H2V Magallanes, with its VP of Strategic Development serving as the first President (Diario Financiero, 2023); the company departed during the course of 2024 (TotalEnergies H2, 2024). The departure is itself evidence that the institutional separation between HIF and the H2V developer ecosystem was the product of HIF's deliberate choice to distance itself from the formal-lobbying modality of H2V Magallanes. The former Project Director described the departure in terms of fundamental business-model incompatibility: "HIF was not planned to produce ammonia... different challenges, different issues... not always aligned with the interest of the association" (P7).

5. Analysis

This chapter develops the analytical interpretation of the empirical material presented in Chapter 4 by reading it through the multilevel framework of Chapter 2. The argument is that the divergent trajectories of Highly Innovative Fuels (HIF) and the H2V Magallanes developer ecosystem cannot be explained by differences in resource endowment, capital availability or technological capability alone, since both ventures operated in substantially the same Magallanes institutional environment. The divergence reflects a difference in how each venture engaged that environment, and that difference is traceable to the underlying decision-making logic the venture employed. The chapter moves from the micro level to the meso and then the macro level, tracking the causal direction of the argument: decision logic shapes the form of institutional

entrepreneurship enacted, and that institutional entrepreneurship determines how the venture engages the shared macro environment, producing the trajectory observed.

Figure 2. Grounded Model



5.1 Micro Level: Decision-Making Logic

The two cases exhibit systematically different patterns of decision-making logic. The HIF patterns identified (Appendix B), map closely onto Sarasvathy's (2001) effectuation principles, and the H2V patterns (Appendix C) map closely onto their causal counterparts. This thesis treats effectuation as a collection of related reasoning patterns rather than as a closed set of five

heuristics, consistent with the mode-of-action perspective recent scholarship has developed (Gregoire & Cherchem, 2020; Welter et al. 2016).

5.1.1 The Effectual Pattern in HIF

The HIF data structure evidences four broader patterns consistent with effectual reasoning (Sarasvathy, 2001). The first is means-driven construction of the venture, corresponding to the bird-in-hand principle. The iterative search across multiple potential applications (Appendix B, A1), including aluminium production, glass, methane, methanol and Fischer-Tropsch products before convergence on synthetic fuels, derived possible ends from available means (the wind resource, the parent organisation's engineering expertise) rather than selecting means for a predetermined goal.

The second is staged commitment under acknowledged uncertainty, corresponding to the affordable-loss principle. The pilot plant (A2), continuing right-sizing discipline (A3) and explicit learning-curve reasoning (A4) together evidence a learned discipline of small-scale commitment. The former CTO's retrospective is unusually direct: "I started the development from the technical perspective and said, we have to go to the commercial size directly. That was a mistake. You have to start smaller, because otherwise you cannot pay the contingencies" (P3).

The third is coalition formation through accumulated precommitments, corresponding to the crazy-quilt principle. Each stakeholder commitment reduced the uncertainty faced by the next: Porsche's evolution from demonstration partner to investor (Appendix B, B2) occurred due to five to six years of prior collaboration (B1) and the successful pilot; Japanese investors (B4) entered an already-established portfolio.

The fourth is adaptive recalibration in response to setbacks, corresponding to the lemonade principle. The IMO postponement was reframed as a customer-mix shift (E2); Chilean permitting delays redirected resources to the United States and Uruguay (E1); the subsequent US political shift triggered further recalibration toward Uruguay, where the project advanced toward Final Investment Decision.

5.1.2 The Causal Pattern in H2V Magallanes

The H2V data structure evidences a contrasting pattern. The first is goal-first design anchored in predictive assumptions. Scale-driven logic (Appendix C, A1) followed from the predicted necessity of financing self-built infrastructure across a sufficiently large output base. Prediction-based investment logic (A2) is the most explicit instance. Predicted electrolyser cost reductions, expected IMO regulatory adoption, and anticipated Korean and Japanese ammonia demand formed the base on which all subsequent commitments rested. The technology assumption was particularly consequential: "The expectation was that by 2025, we would have available electrolyzers of at least 100 megawatts capacity at a very low cost. Neither one happened" (P7).

The second is sustained commitment to invalidated plans. When the predictions on which design choices were based began to fail, the response was not redesign but retrenchment: holding (Appendix C, D1), lease renegotiation (D2) and divergent firm responses (D3). The available response repertoire when predictions failed was retreat, not recalibration.

The third is retrospective sensemaking through reframing rather than ongoing institutional adaptation. The missed-window narrative attributes failure to country-level institutional performance: "we missed a huge opportunity, huge market opportunity... not because of the market, because of our fault" (P6). This framing is itself analytically informative. It reflects a causal interpretation after planning assumptions have been invalidated: the explanation is located primarily in institutional underperformance, rather than in the venture's mode of engaging that environment.

5.2 Meso Level: Institutional Entrepreneurship

The decision-making logics identified do not act on venture trajectory directly. They act through the institutional entrepreneurship they produce at the meso level, which in turn determines how the venture engages the macro environment. Drawing on the Tracey and Phillips (2011) typology and the analytical counterpart developed in Ch. 2.1.3, this section identifies three adaptive modalities in HIF's case and three rigid modalities in H2V's case. Each adaptive modality is constituted of themes that evidence an effectual disposition operating at venture scale, and builds a new institutional resource during the venture. Each rigid modality evidences a causal

disposition operating at venture scale, and relies on an existing institutional resource that the macro environment may or may not continue to support. The asymmetry is the structural reason for the trajectory divergence the macro-level analysis returns to, producing the divergent trajectory patterns the framework proposes: venture resilience and venture reliance.

5.2.1 HIF: Adaptive Institutional Entrepreneurship

Legitimacy building.

The legitimacy-building modality has the clearest empirical representation in the HIF coding: pre-EIA stakeholder feedback loops (Appendix B, C1), stakeholder concerns translated into engineering specifications (C2), avoiding sensitive areas in site selection (C3), tactical permitting pivots (C4), the made-in-Magallanes identity (D1), operational presence as credibility (D2) and shared local value from project outputs (D3). The pattern these themes describe, treating stakeholder concerns not as obstacles to be managed around the permitting process but as inputs from which substantive design is iteratively constructed, expresses the lemonade and bird-in-hand heuristics operating jointly in the legitimacy domain.

The Chief Environmental and Sustainability Officer's account of the NGO design collaboration carries the effectual disposition explicitly: "if there are concerns, [we look] sort of how can they be adjusted in either location or design, or the studies that we need to do" (P5). Opposition becomes the means from which a viable design is co-created. The concrete design adaptations that followed under C2, adjusted rotor heights, integrated bird-collision radar, the first underground high-voltage transmission line for a wind farm in Chile (Strategic Energy Europe, 2026), full internal water recycling, are the engineering record of that disposition. At the spatial scale, rather than imposing a predetermined siting profile on the territory, HIF started from the territory's already-disturbed condition and built outward (C3). The local-value cluster under D1 to D3, the made-in-Magallanes identity, the operational presence sustained between commercial milestones, and the shared-value agreements with Gasco, ENAP and the Chilean Navy, extends the same logic into the political-economic frame. The means available locally include the region's underserved waste infrastructure and naval presence, and legitimacy was constructed by integrating those means into the project rather than around them.

The adaptations are the material construction of social licence as institutional infrastructure (Boutilier, 2014; Gehman et al. 2017). Where informal voids destabilise the institutional supports on which social licence ordinarily depends, HIF constructs that licence, achieving the unanimous environmental approval of both Faro del Sur and Cabo Negro (Revista Electricidad, 2026). The legitimacy asset built through this work is the most consequential of the three modalities for resilience: it is the institutional resource that informal voids most directly destabilise, and the one whose absence in the H2V case most directly explains the trajectory divergence.

Cognitive spanning.

The cognitive-spanning modality is constituted of three empirical themes: pilot plant as proof (Appendix B, A2), disciplined right-sizing (A3) and small-scale justification (A4). Together they describe a pattern in which HIF committed physical capital at deliberately sub-commercial scale, before any commercial-scale project had been permitted, and treated that commitment simultaneously as technical demonstration, public reference object and learning-curve investment. These decisions reflect closely onto the effectual principle of affordable loss (Sarasvathy, 2001). The plant constituted a manageable risk exposure whose institutional contribution lay in the industry familiarisation it generated.

The former CTO of HIF articulated the decision logic directly:

> for all kind of stakeholders, the local stakeholders, also banks and for all the governments that are involved in making decisions about this, it has been pretty important to see that this can be done (P3).

His retrospective on his initial instinct traces the discipline that produced the move:

> I started the development from the technical perspective and said, we have to go to the commercial size directly. That was a mistake. You have to start smaller, because otherwise you cannot pay the contingencies (P3).

The learning-curve reasoning under A4, “you have a learning curve: double installed capacity, you have like 22 to 23% reduction in cost of the infrastructure” (P3), specifies the rationale under which sub-commercial commitment compounded.

The plant’s hybrid identity (“industrial plant and museum”, P4) addresses the cognitive legitimacy challenge Aldrich and Fiol (1994) identify for new industries, where no taken-for-granted category exists into which the new activity fits. The legitimacy generated locally then compounds across jurisdictions as demonstrated by the subsequent EU RFNBO certification (Offshore Energy, 2025), the first awarded outside the European Union.

Relational capital.

The relational-capital modality is constituted by four empirical themes from the HIF coding: pre-existing relationships (Appendix B, B1), customer-investor convergence (B2), recruitment as relationship work (B3) and patient capital (B4). The pattern these themes describe, in which the venture’s most consequential resource commitments emerged from relationships that predated the e-fuels venture itself and in which the boundaries between customer, investor and partner were allowed to evolve through accumulated interaction, expresses effectual heuristics operating at venture scale.

The former CTO’s account of the Porsche relationship reflects this: "There was already some connection. There was a conference. There was a respect” (P3). Porsche moved from technical demonstration partner to direct equity investor of USD 75 million (Porsche Newsroom, 2022a), and eventually to a tripartite supply agreement with Shell (HIF Global, 2025a) in which Porsche’s role as offtaker, investor and brand sponsor became indistinguishable. The Idemitsu-led 2024 round (Energy Capital Houston, 2024) followed the same logic, capital entered against an already-established portfolio. The recruitment logic under B3 extends the pattern into the labour market. Senior hires came in through pre-existing personal relationships rather than through formal executive search, with the former CTO noting that the company’s value resides principally in its “people” (P3).

Tracey and Phillips (2011) depict this as institutional brokering, or the substitution of relational capital for formal market mediation. HIF assembled patient capital as a substitute for the missing institutional infrastructure that would coordinate such commitments under more stable

conditions. The relational capital constructed across this sequence is durable: it persisted through the IMO postponement and the Chilean permitting delays.

The three modalities together construct institutional resources: local social licence (legitimacy building, C1–C4, D1–D3), a tangible reference object (cognitive spanning, A2–A4) and durable relations (relational capital, B1–B4). Each reflects effectual heuristics operating at venture scale. The pattern is institutionally accretive, producing the venture resilience the macro-level analysis (Section 5.3) connects to trajectory under informal voids.

5.2.2 H2V Magallanes: Rigid Institutional Entrepreneurship

The H2V data structure presents a substantively different profile. Three rigid modalities are observable, each portraying empirical themes in the H2V coding (Appendix C). Together they rely on existing institutional resources rather than build new ones, which, this analysis suggests, is the structural reason for the case's vulnerability to the same conditions HIF navigates.

Procedural legitimacy.

The procedural-legitimacy modality reflects four second order themes from the data. Power-generation logic for an industrial venture (A4) concession refusal (C1), social-risk commitments (C2) and selective stakeholder weighting (C3). The pattern these themes describe, namely, treating formal regulatory as the sufficient form of legitimacy and channeling institutional engagement through the EIA, expresses the conflation of regulative legitimacy with substantive legitimacy that characterises causal logic operating in an institutional environment.

The cognitive premise of the modality is captured by A4. Frame import from the power-generation business treats formal regulatory permission, secured through technically competent EIA submission, as the form legitimacy takes. The premise is consistent with how legitimacy operates for ordinary power generation in a stable regulatory environment, where regulatory permission and social acceptance are tightly coupled; under informal voids the premise fails because the coupling does not hold.

The behavioural expressions of the modality run through C1 to C3. The concession-refusal material under C1 evidences the modality's posture toward stakeholder demands that would

require substantive project redesign. The HNH refusal of HIF's offer to stop turbines in the presence of birds, on the basis of manufacturer warranty constraints, is captured directly:

> by recommendation from the manufacturer, you cannot stop them more than five times a year. And they were offering to do it every time a bird showed up nearby... that would have damaged the turbines heavily (Former Project Director, P7).

Stakeholder concerns are treated as risks to be managed within the existing project configuration. The social-risk-commitment material under C2 captures the modality's posture toward the labour-community interface: "take the workers from the airport, take them directly to the camp on site, and they wouldn't... be wandering around the city" (P7, C2). The construction workforce was to be bracketed from the host community rather than integrated into it. The selective-stakeholder-weighting material under C3 captures the modality's posture toward NGO opposition:

> most of the questions came from ONGs, not from normal people... it's basically noise made by ONGs... that are financed by basically Norway, which is the main competitor of Chile (Director H2V Magallanes, P6).

NGOs are portrayed as competitive interference rather than as legitimate actors whose concerns might require substantive engagement.

The structural contrast with HIF's legitimacy-building modality is direct: causal logic treats stakeholders as risks managed within a formal compliance perimeter and assumes the formal architecture suffices to deliver legitimacy outcomes. Each firm self-financed extensive EIA processes (1,500 and 1,400 question rounds in the HNH case, costing over USD 7 million across two rounds, with ecosystem-wide spending of USD 10 to 50 million per project per P8) on the implicit assumption that formal compliance, secured through sufficient technical effort, would deliver the legitimacy outcome required. The social licence literature (Boutilier, 2014; Gehman et al. 2017) explicitly identifies this as a characteristic failure mode of capital-intensive industrial

development. What is significant in the H2V case is what is absent: no documented cognitive-spanning infrastructure, no NGO-collaborator engagement, no made-in-Magallanes positioning. When the formal architecture does not deliver permission on terms compatible with the project's commercial timetable, the venture has no substitute infrastructure to fall back on.

Transplantation.

Scale-driven logic (A1), prediction-based investment logic (A2), capex-amortisation as design constraint (A3) and power-generation logic for an industrial venture (A4), can all be understood as transplantation. The pattern these themes describe is one of projects designed with templates imported from prior contexts expresses the prediction-based investment logic identified at the micro level. The causal disposition that assumes the future will resemble what existing analogies suggest, supports transplanting templates across varying institutional contexts.

The scale logic under A1 and A3 was anchored to capex reasoning familiar from large-power-infrastructure development: "everybody was saying... this new industry would be similar to the mining industry in Chile, same size, if not bigger" (P7, A2). The prediction logic was anchored to analogies from solar PV, LNG demand patterns and the Chilean mining industry. Similarly, the business-model was anchored to firms' utility-sector origins the transferability of which is summed up by the Director of H2 Chile: "Utilities' knowledge is more limited to the power-generation side, and believing that would be enough for a hydrogen project has proven not to be the case (P8). The technology assumption that 500 of the world's largest available electrolysers could be installed at a single site captures the cumulative result: "totally illogical" in retrospect (P7, A2), but coherent within the templates that treated gigascale industrial deployment as a known problem.

Kostova's (1999) construct of institutional distance specifies why templates that travel cleanly within familiar contexts encounter friction when imported into structurally novel ones. The H2V developers' templates were imported across substantial distance (utility power-sector to greenfield industry, established commodity markets to a market that did not yet exist, mature regulatory environments to a regional EIA system) and the friction was systemic. The modality renders the venture trajectory reliant on the cross-context transferability of these ideas.

Aggregating.

Industry coordination (B1), preventing individual concessions (B2) and the coordinated retreat decision (B3) represent the aggregating modality. The pattern these themes describe, such as channeling the principal institutional engagement through a formal coalition vehicle, expresses the goal-first design pattern identified at the micro level. H2V Magallanes coordinates a coalition of firms whose individual plans assume the same predictable institutional response, and its function presupposes the predictability of the institutional context it engages.

The former Project Director articulated the modality directly: "we acted on behalf of the industry. So it gave much more weight to whatever we were saying. We represented an investment of about 70 billion US dollars" (P7, Appendix C, B1). The concession-discipline material under B2 captures the internal mechanism that allowed aggregation:

> we made sure that if anyone was to be making a commitment with the community, it would be in line with all other projects ... we made sure that those things would not impact the rest (Former Project Director HNH Energy, P7).

The retreat data under B3 captures the modality's failure mode: "a union of just five or four members is not worth to keep paying for that organisation. That's why they decide to cancel" (P6, B3).

The collective institutional entrepreneurship literature (Hardy & Maguire, 2008; Wijen & Ansari, 2007) documents both the characteristic strength of such vehicles (aggregated voice, concession discipline, representational scale) and their characteristic vulnerability (dependence on formal-institutional responsiveness and on membership stability). The H2V case illustrates the vulnerability directly. When the predictability H2V Magallanes presupposed did not hold, the aggregation lost its lever. HIF's decision to leave was an active institutional choice to operate outside of the aggregating organisation the rest of the ecosystem relied on. Ventures whose decision logic was causal sustained their reliance on it until it ceased to function.

The three modalities together produce a pattern of institutional reliance: procedural legitimacy (A4, C1–C3) renders the venture's trajectory reliant on formal regulatory permission as the

sufficient form of legitimacy; transplantation (A1–A4) renders it reliant on consistency and cross-context transferability; aggregating (B1–B3) renders it reliant on the responsiveness of coordination channels. Each reflects causal dispositions operating at venture scale; each leaves the venture dependent on a presupposition the informal-void environment does not honour. HIF, meanwhile, constructed a substitute legitimacy infrastructure that reduced its dependence on any single institutional norm. The asymmetry between the two triads, resilience versus reliance, is a direct expression of the asymmetry between effectual and causal logic established at the micro level. This determines how each venture interacts with the macro conditions examined in Section 5.3 and produces the divergent venture trajectories the framework anticipates: venture resilience for HIF, venture reliance for the H2V developers.

5.3 Macro Level: Informal Institutional Voids

The two meso patterns operate within a shared macro institutional environment. The contextual coding (Appendix D) characterises this environment, and three features warrant emphasis.

First, regulatory volatility within a formally functioning system. The Chilean Environmental Impact Assessment (SEIA) architecture is formally and procedurally codified (Appendix D, A1), yet the previous environmental ministry issued a high volume of new regulations across roughly thirty months (Appendix D, A2). The Director of H2V Magallanes captured the practical consequence: “you never have a clear path or clear view of what you actually needed” (P6). This is not the institutional absence Khanna and Palepu (1997) describe but volatility within a formally present architecture, corresponding to the condition Webb, Khoury and Hitt (2020) specify as an informal institutional void. The Chilean Green Hydrogen Action Plan’s own target of reducing project authorisation times by 30 per cent (CMS, 2025) reflects governmental recognition of this dynamic.

Second, governance fragmentation. The contextual material records national-level endorsement of green hydrogen as state policy (Appendix D, A3) alongside intermediate-level regulatory difficulty (A2, A4). The former CTO of HIF captured the fragmentation directly: “on the top level, if you speak to the government, everything, oh yes, green energy, it’s fine. But on the intermediate level, the people are unsecure” (P3). Documentary evidence confirms fragmentation at scale: even the Regional Government of Magallanes, described in interviews as broadly

supportive, issued an unfavourable assessment of TotalEnergies' EIA in 2025 (La Prensa Austral, 2025).

Third, contested cultural-cognitive expectations about the legitimacy of sustainability development. The contextual material records both substantial community welcome of investment (Appendix D, D2) and persistent NGO opposition focused on conservation concerns (D3), alongside the recurring legitimacy question of why fuel produced in Magallanes should be destined for distant markets. The legitimacy of sustainability development was not socially settled but actively negotiated, with the mining-north reference frame (D4) providing residents with a culturally available comparator against which large-scale industrial development was measured. A fourth condition operates as a covariate of the informal void: global market and policy turbulence (Appendix D, B), including subsidised competitor entry from India, Oman and China (B2), the IMO Net-Zero Framework postponement (Environmental Defense Fund, 2025; Ammonia Energy Association, 2025), and unsettled international standards regimes (B5).

Both HIF and the H2V ecosystem encountered these macro conditions in equivalent form. The macro level provides the contextual environment within which institutional work happens; it does not act mechanically on the venture but determines what kinds of institutional work are necessary for the venture to advance. The divergence in venture trajectories therefore cannot be attributed to environmental differential. It must be sought in the way each venture engaged the shared environment, which is to say, in the micro and meso patterns examined above.

The integration across levels follows a specific direction. Effectual decision logic at the micro level generates HIF's adaptive multi-modal pattern at the meso level: each modality reflects an effectual disposition operating at venture scale, and under conditions of informal institutional voids this pattern is structurally suited because it does not depend on any single institutional channel functioning predictably. The new resources it constructs, including the local social licence that the void condition most directly destabilises, compound across jurisdictions and stakeholder relationships not anticipated at construction, producing venture resilience.

Causal decision logic generates H2V's rigid concentrated pattern, in which each modality presupposes formal-institutional behaviour the informal void destabilises. When these presuppositions fail, the available response is retrenchment and retrospective reframing rather than recalibration. The venture's trajectory is rendered dependent on the very institutional

conditions the informal void destabilises, with no substitute infrastructure to fall back on. The characteristic failure mode of effectual logic under informal voids is recalibration; the characteristic failure mode of causal logic is sustained commitment to invalidated plans.

5.4 Propositions

Two propositions arise from the cross-case analysis. They are presented as products of empirical interpretation rather than as hypotheses tested in advance.

Proposition 1.

Under conditions of informal institutional voids, effectual decision logic enables adaptive institutional entrepreneurship through legitimacy building, cognitive spanning and relational capital construction. This produces venture resilience because the institutional resources built, particularly the local social licence that informal voids most directly destabilise, accumulate as durable legitimacy assets that compound across jurisdictions and stakeholder relationships. The mechanism is not the avoidance of institutional volatility but the venture's capacity to engage it through means-driven, staged and co-creative practice that yields legitimacy assets the venture can carry across institutional venues.

Proposition 2.

Under the same conditions, causal decision logic produces rigid concentrated institutional entrepreneurship through Procedural legitimacy, transplantation and aggregating that relies on existing institutional resources, or treats those resources as sufficient when they are not, rather than building new ones, producing venture reliance. The characteristic failure mode is not adaptation but sustained commitment to invalidated plans, leaving the venture dependent on institutional conditions the informal void destabilises and without the social licence that informal voids make a necessary condition of progress.

6. Conclusion

6.1 Summary of Findings

This study examined how decision-making logics shape early venture trajectory in the context of informal institutional voids, drawing on a comparative case study of green hydrogen and e-fuel ventures in Magallanes, Chile. Two ventures operating in substantially the same regional institutional environment, with comparable resource availability and overlapping technological foundations, followed visibly divergent trajectories. HIF advanced through two unanimous environmental approvals on its commercial-scale projects, sustained an operational pilot plant, and maintained a multi-jurisdictional project portfolio. The H2V developer ecosystem, having engaged the same institutional environment through a coordinated trade-association lobby and individual commercial-scale permitting processes, experienced project cancellations, suspensions and a coordinated pause of the trade association itself.

The analytical argument the study develops is that this divergence is traceable to the decision-making logic the ventures employed, which shaped the form of institutional entrepreneurship each enacted. HIF's effectual logic produced an adaptive multi-modal pattern (legitimacy building, cognitive spanning, relational capital), each constructing a new institutional resource (local social licence, substitute legitimacy infrastructure at the category level, durable relational substrate) that compounded across jurisdictions not anticipated at construction. The H2V developers' causal logic produced a rigid concentrated pattern (Procedural legitimacy, transplantation, aggregating), each relying on existing institutional resources whose continued reliability the informal void destabilised.

6.2 Theoretical Reflections

The most theoretically central finding is that social licence emerges as the operational content of what informal institutional voids destabilise and what adaptive institutional entrepreneurship constructs. The void literature has tended to describe what is missing in abstract institutional terms; the social licence concept provides a sector-specific, behaviourally observable form of legitimacy whose construction can be empirically traced. The HIF case evidences that construction (Faro del Sur and Cabo Negro unanimous environmental approvals, the operational

integration with Gasco, ENAP and the Chilean Navy, the substantive incorporation of NGO concerns into project design); the H2V case evidences its absence (suspended EIAs, cancelled projects, contracted trade-association membership). The connection between informal institutional voids and social licence is direct: where the informal layer fails to provide stable expectations, formal permission cannot substitute for the substantive legitimacy that capital-intensive ventures require, and the work of constructing that legitimacy must be done within the venture itself.

A second theoretical reflection concerns the differential robustness of effectual and causal logic to informal institutional voids. The asymmetry between the two patterns is not merely about institutional engagement; it is about the form of resource the venture accumulates over its early development period. The effectual pattern produces accumulating legitimacy assets and tangible anchors that separate the venture from market and regulatory volatility, while the causal pattern produces sunk cost without legitimacy when the predictability assumption fails. The framework proposes venture resilience and reliance respectively as the key aspects of the trajectories.

A third reflection concerns the embedded-agency puzzle (Garud et al. 2007). The HIF case provides empirical traction on this puzzle by showing that institutional engagement and institutional construction can be undertaken simultaneously: the same firm that participated in H2V Magallanes at founding and departed when its interest structure became incompatible was constructing alternative institutional resources (the Haru Oni reference object, the Porsche-Shell coalition, the locally-embedded social licence) throughout. The active institutional choice the departure represents (Diario Financiero, 2023; TotalEnergies H2, 2024) is itself evidence that effectual logic at the micro level produces meso-level engagement that may include exiting from collective vehicles whose presuppositions diverge from the venture's.

The wider implication is that the alignment between decision-making logic and institutional environment is a critical, and presently underspecified, determinant of venture trajectory. Where institutional conditions are volatile and incompletely specified even within formally functioning regulatory architectures, the form of institutional entrepreneurship necessary for venture progress matters at least as much as the resources mobilised. The implication is not that effectual logic is universally superior; it is that effectual heuristics enable the construction of substitute legitimacy infrastructure precisely under the conditions that destabilise causal predictive planning.

6.3 Theoretical Contributions

The study contributes to four interconnected literatures.

To the institutional voids literature, the analysis empirically distinguishes formal and informal voids in a context where the formal architecture functions but the informal layer destabilises, supporting Webb et al.'s (2020) distinction and responding to Bothello et al.'s (2019) critique of deficit framings by specifying a particular informal-layer failure rather than describing Chile as institutionally void in any general comparative sense.

To the literature on legitimacy and social licence, the analysis identifies social licence (Boutilier, 2014; Gehman et al. 2017) as the operational content of what informal voids destabilise and what adaptive institutional entrepreneurship constructs, empirically supporting Aldrich and Fiol's (1994) identification of the cognitive legitimacy challenge for new industries through the Haru Oni case, and demonstrates the structural inverse in the H2V case where formal permitting work substitutes for substantive social-licence construction.

To effectuation research (Sarasvathy, 2001; Read & Sarasvathy, 2005), the analysis extends empirical reach into capital-intensive sustainability ventures, grounds the causal/effectual distinction in Knightian uncertainty (McMullen & Shepherd, 2006), responds to Arend, Sarooghi and Burkemper's (2015) under-specification critique by identifying institutional entrepreneurship as the meso channel, and qualifies Reymen et al.'s (2015) mode-of-action perspective by showing that under informal voids effectual reasoning may need to be sustained through execution rather than transitioned out of.

To institutional entrepreneurship research, the study identifies decision-making logic as a third enabler alongside the field-level conditions and social position Battilana et al. (2009) identify. It empirically supports Tracey and Phillips' (2011) typology of adaptive institutional entrepreneurship and develops a counterpart triad theoretically anchored in collective action, template-transfer and regulative-legitimation literatures (Hardy & Maguire, 2008; Kostova, 1999; Scott, 1995; Boutilier, 2014). HIF's adaptive triad constitutes Lawrence and Suddaby's (2006) creating work; the H2V rigid triad constitutes maintaining work combined with the absence of creating work where it would have been needed.

6.4 Practical Implications

For entrepreneurial actors developing capital-intensive sustainability ventures in institutionally volatile environments, the analysis suggests several practical orientations. Substantive engagement with local stakeholders cannot be substituted by formal compliance work, however technically competent; the social licence layer must be constructed directly through means available locally rather than relied on as a by-product of regulatory permission. Staged commitment, including tangible asset commitment at deliberately sub-commercial scale, produces both technical learning and legitimacy returns that compound across institutional venues not anticipated at the moment of commitment. Coalition partners selected for patience as much as capital, and relationships built before they are needed for execution, produce relational substrate durable across institutional contexts. For policymakers and regulators, the analysis suggests that stability of expectation (rather than the strictness or leniency of formal rules) is the institutional condition most critical to venture progress, and that institutional fragmentation between levels of government can sustain destabilising informal voids even where formal commitments to sustainability development are strong.

6.5 Limitations and Future Research

The study's limitations are inherent to the qualitative comparative case study design. Findings are not statistically generalisable; they articulate a theoretical relationship that future studies can test in other contexts. The single-locality, single-sector focus strengthens internal explanatory leverage but limits transferability. The structural asymmetry of the case design (one venture studied at the firm level with multiple internal informants; an ecosystem studied at a higher level of aggregation with adjacent informants) was discussed in Section 3.2 as a mitigation against survivor bias but limits the granularity available for the H2V case. The reconstructed longitudinal design relies partly on retrospective accounts; recall and post-hoc rationalisation risks are mitigated through event-sequencing against documented dates and through the longitudinal follow-up interviews with P2, P6 and P7, but cannot be fully eliminated.

Three lines of future research arise. First, comparative studies of capital-intensive sustainability ventures across other institutionally volatile contexts would test the generalisability of the framework developed here, particularly the proposition that social licence operates as the operational content of what informal institutional voids destabilise. Second, longitudinal study of HIF's subsequent trajectory would test whether the adaptive pattern remains operative through

execution or whether it transitions toward more causal patterns as project commitments mature. Third, examination of cases in which causal and effectual modalities are deliberately combined would clarify whether the resilience-reliance asymmetry is binary or whether intermediate trajectories are stable.

References

Academic Books and Journal Articles

Acemoglu, D., & Robinson, J. A. (2012). *Why Nations Fail: The origins of power, prosperity, and poverty*, New York: Crown Publishers

Ahlstrom, D., & Bruton, G. D. (2006). Venture Capital in Emerging Economies: Networks and institutional change, *Entrepreneurship Theory and Practice*, vol. 30, no. 2, pp.299-320, https://doi.org/10.1111/j.1540-6520.2006.00122.x

Aldrich, H. E., & Fiol, C. M. (1994). Fools Rush In? The institutional context of industry creation, *Academy of Management Review*, vol. 19, no. 4, pp.645-670, https://doi.org/10.5465/amr.1994.9412190214

Arend, R. J., Sarooghi, H., & Burkemper, A. (2015). Effectuation as Ineffectual? Applying the 3E theory-assessment framework to a proposed new theory of entrepreneurship, *Academy of Management Review*, vol. 40, no. 4, pp.630-651, https://doi.org/10.5465/amr.2014.0455

Battilana, J., Leca, B., & Boxenbaum, E. (2009). How Actors Change Institutions: Towards a theory of institutional entrepreneurship, *Academy of Management Annals*, vol. 3, no. 1, pp.65-107, https://doi.org/10.5465/19416520903053598

Bell, E., Bryman, A., & Harley, B. (2019). *Business Research Methods*, 5th edn, Oxford: Oxford University Press

Bothello, J., Nason, R. S., & Schnyder, G. (2019). Institutional Voids and Organization Studies: Towards an epistemological rupture, *Organization Studies*, vol. 40, no. 10, pp.1499-1512, https://doi.org/10.1177/0170840618819037

Boutilier, R. G. (2014). Frequently Asked Questions about the Social Licence to Operate, *Impact Assessment and Project Appraisal*, vol. 32, no. 4, pp.263-272, https://doi.org/10.1080/14615517.2014.941141

Deephouse, D. L., Bundy, J., Tost, L. P., & Suchman, M. C. (2017). Organizational Legitimacy: Six key questions, in R. Greenwood, C. Oliver, T. B. Lawrence & R. E. Meyer (eds), *The SAGE Handbook of Organizational Institutionalism*, 2nd edn, London: SAGE, pp.27-54

DiMaggio, P. J. (1988). Interest and Agency in Institutional Theory, in L. G. Zucker (ed.), *Institutional Patterns and Organizations: Culture and environment*, Cambridge, MA: Ballinger, pp.3-21

DiMaggio, P. J., & Powell, W. W. (1983). The Iron Cage Revisited: Institutional isomorphism and collective rationality in organizational fields, *American Sociological Review*, vol. 48, no. 2, pp.147-160, https://doi.org/10.2307/2095101

Doh, J., Rodrigues, S., Saka-Helmhout, A., & Makhija, M. (2017). International Business Responses to Institutional Voids, *Journal of International Business Studies*, vol. 48, no. 3, pp.293-307, https://doi.org/10.1057/s41267-017-0074-z

Eisenhardt, K. M. (1989). Building Theories from Case Study Research, *Academy of Management Review*, vol. 14, no. 4, pp.532-550, https://doi.org/10.5465/amr.1989.4308385

Garud, R., Hardy, C., & Maguire, S. (2007). Institutional Entrepreneurship as Embedded Agency: An introduction to the special issue, *Organization Studies*, vol. 28, no. 7, pp.957-969, https://doi.org/10.1177/0170840607078958

Gehman, J., Lefsrud, L. M., & Lounsbury, M. (2017). Social License to Operate: Legitimacy by another name?, *Canadian Public Administration*, vol. 60, no. 2, pp.293-317, https://doi.org/10.1111/capa.12218

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia methodology, *Organizational Research Methods*, vol. 16, no. 1, pp.15-31, https://doi.org/10.1177/1094428112452151

Grégoire, D. A., & Cherchem, N. (2020). A Structured Literature Review and Suggestions for Future Effectuation Research, *Small Business Economics*, vol. 54, no. 3, pp.621-639, https://doi.org/10.1007/s11187-019-00158-5

Hardy, C., & Maguire, S. (2008). Institutional Entrepreneurship, in R. Greenwood, C. Oliver, K. Sahlin & R. Suddaby (eds), *The SAGE Handbook of Organizational Institutionalism*, London: SAGE, pp.198-217

Khanna, T., & Palepu, K. (1997). Why Focused Strategies May Be Wrong for Emerging Markets, *Harvard Business Review*, vol. 75, no. 4, pp.41-51

Khanna, T., & Palepu, K. (2006). Emerging Giants: Building world-class companies in developing countries, *Harvard Business Review*, vol. 84, no. 10, pp.60-69

Knight, F. H. (1921). *Risk, Uncertainty and Profit*, Boston: Houghton Mifflin

Kostova, T. (1999). Transnational Transfer of Strategic Organizational Practices: A contextual perspective, *Academy of Management Review*, vol. 24, no. 2, pp.308-324, https://doi.org/10.5465/amr.1999.1893938

Langley, A. (1999). Strategies for Theorizing from Process Data, *Academy of Management Review*, vol. 24, no. 4, pp.691-710, https://doi.org/10.5465/amr.1999.2553248

Lawrence, T. B., & Suddaby, R. (2006). Institutions and Institutional Work, in S. R. Clegg, C. Hardy, T. B. Lawrence & W. R. Nord (eds), *The SAGE Handbook of Organization Studies*, 2nd edn, London: SAGE, pp.215-254

Leca, B., Battilana, J., & Boxenbaum, E. (2008). Agency and Institutions: A review of institutional entrepreneurship, *Harvard Business School Working Paper*, no. 08-096, https://www.hbs.edu/faculty/Pages/item.aspx?num=33032

Maguire, S., Hardy, C., & Lawrence, T. B. (2004). Institutional Entrepreneurship in Emerging Fields: HIV/AIDS treatment advocacy in Canada, 1989-1995, *Academy of Management Journal*, vol. 47, no. 5, pp.657-679, https://doi.org/10.5465/20159610

Mair, J., & Marti, I. (2009). Entrepreneurship in and around Institutional Voids: A case study from Bangladesh, *Journal of Business Venturing*, vol. 24, no. 5, pp.419-435, https://doi.org/10.1016/j.jbusvent.2008.04.006

Mair, J., Marti, I., & Ventresca, M. J. (2012). Building Inclusive Markets in Rural Bangladesh: How intermediaries work institutional voids, *Academy of Management Journal*, vol. 55, no. 4, pp.819-850, https://doi.org/10.5465/amj.2010.0627

McMullen, J. S., & Shepherd, D. A. (2006). Entrepreneurial Action and the Role of Uncertainty in the Theory of the Entrepreneur, *Academy of Management Review*, vol. 31, no. 1, pp.132-152, https://doi.org/10.5465/amr.2006.19379628

North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*, Cambridge: Cambridge University Press

Prno, J., & Slocombe, D. S. (2012). Exploring the Origins of 'Social License to Operate' in the Mining Sector: Perspectives from governance and sustainability theories, *Resources Policy*, vol. 37, no. 3, pp.346-357, https://doi.org/10.1016/j.resourpol.2012.04.002

Read, S., & Sarasvathy, S. D. (2005). Knowing What to Do and Doing What You Know: Effectuation as a form of entrepreneurial expertise, *The Journal of Private Equity*, vol. 9, no. 1, pp.45-62, https://doi.org/10.3905/jpe.2005.605370

Sahlin, K., & Wedlin, L. (2008). Circulating Ideas: Imitation, translation and editing, in R. Greenwood, C. Oliver, K. Sahlin & R. Suddaby (eds), *The SAGE Handbook of Organizational Institutionalism*, London: SAGE, pp.218-242

Sarasvathy, S. D. (2001). Causation and Effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency, *Academy of Management Review*, vol. 26, no. 2, pp.243-263, https://doi.org/10.5465/amr.2001.4378020

Scott, W. R. (1995). *Institutions and Organizations*, Thousand Oaks, CA: SAGE

Suchman, M. C. (1995). Managing Legitimacy: Strategic and institutional approaches, *Academy of Management Review*, vol. 20, no. 3, pp.571-610, https://doi.org/10.5465/amr.1995.9508080331

Tracey, P., & Phillips, N. (2011). Entrepreneurship in Emerging Markets: Strategies for new venture creation in uncertain institutional contexts, *Management International Review*, vol. 51, no. 1, pp.23-39, https://doi.org/10.1007/s11575-010-0066-8

Van de Ven, A. H. (2007). *Engaged Scholarship: A guide for organizational and social research*, Oxford: Oxford University Press

Webb, J. W., Khoury, T. A., & Hitt, M. A. (2020). The Influence of Formal and Informal Institutional Voids on Entrepreneurship, *Entrepreneurship Theory and Practice*, vol. 44, no. 3, pp.504-526, https://doi.org/10.1177/1042258719830310

Wijen, F., & Ansari, S. (2007). Overcoming Inaction Through Collective Institutional Entrepreneurship: Insights from regime theory, *Organization Studies*, vol. 28, no. 7, pp.1079-1100, https://doi.org/10.1177/0170840607078115

Yin, R. K. (2003). *Case Study Research: Design and methods*, 3rd edn, Thousand Oaks, CA: SAGE

Industry, Policy and Corporate Sources

Ammonia Energy Association. (2025). IMO Net-Zero Framework Adoption Postponed, https://www.ammoniaenergy.org

CMS. (2025). Chile's Green Hydrogen Action Plan, https://cms.law

Environmental Defense Fund. (2025). IMO Net-Zero Framework Vote Postponed, https://www.edf.org

H2V Magallanes. (2024). Member Composition and Activities, https://h2vmagallanes.cl

HIF Global. (2025). HIF, Porsche and Shell Sign Tripartite Supply Agreement, https://www.hifglobal.com

Porsche Newsroom. (2022a). Porsche Invests USD 75 Million in HIF Global LLC, https://newsroom.porsche.com

Porsche Newsroom. (2022b). Haru Oni Pilot Plant Opening, https://newsroom.porsche.com

TotalEnergies H2. (2024). H2 Magallanes Project Update, https://totalenergies.com

News and Sector Press Sources

Diario Financiero. (2023). H2 Magallanes Project Filing, *Diario Financiero*, https://www.df.cl

Diario Financiero. (2025). TotalEnergies Suspends USD 16 Billion Permitting Process, *Diario Financiero*, https://www.df.cl

Energy Capital Houston. (2024). HIF Global Closes USD 164 Million Investment Round Led by Idemitsu, https://energycapitalhtx.com

Fertilizer Daily. (2025). HNH Energy Permitting Suspended After Technical Observations, https://www.fertilizerdaily.com

Hydrogen Insight. (2025). EDF Cancels Energia Verde Austral Project, https://www.hydrogeninsight.com

La Prensa Austral. (2025). SEA Magallanes Grants H2 Magallanes EIA Suspension, *La Prensa Austral*, https://laprensaaustral.cl

La Tercera. (2023). Faro del Sur Withdrawal and Resubmission, *La Tercera*, https://www.latercera.com

Offshore Energy. (2025). HIF Receives First EU RFNBO Certification Outside European Union, https://www.offshore-energy.biz

Radio Polar. (2026). Gremio Pause Announcement, *Radio Polar*, https://radiopolar.com

redimin.cl. (2025). Cabo Negro Environmental Approval, https://www.redimin.cl

Renewables Now. (2021). HIF Formal Incorporation and Magallanes Development, https://renewablesnow.com

Revista Electricidad. (2026). Faro del Sur Unanimous Environmental Approval, https://www.revistaei.cl

Strategic Energy Europe. (2026). First Underground High-Voltage Transmission Line for a Wind Farm in Chile, https://strategicenergy.eu

Appendices

Appendix A - Interview Guide

Opening Briefing

Participants were thanked for their time and informed of the research context: a comparative master's thesis study at Lund University examining how entrepreneurial organisations navigate complex institutional environments when developing large-scale sustainable energy projects. Participants were told that the research was process-oriented: interested in how decisions unfolded over time and the reasoning behind them. Recording consent was obtained, anonymisation procedures explained, and participants invited to ask clarifying questions before the interview began.

Section 1: Role and Orientation

1. Could you start by telling us how you came to be in your current role, and what your work involves day-to-day?
2. What is the scope of your involvement in the venture's development – at what stage do you typically engage, and with which other functions or teams?

Section 2: Venture Formation and Early Development

3. Could you walk us through how the venture or project first came to be conceived? What was the initial idea and how did it develop?
4. What were the key early decisions about the shape of the venture – the technology pathway, the scale, the location? How were those decisions made?
5. Who were the most important partners, investors or stakeholders in the early development phase, and how did those relationships come about?

Section 3: Navigating the Institutional Environment

6. Can you walk us through the environmental permitting process for the venture? What were the most significant moments?
7. Were there points where the regulatory requirements or expectations shifted in ways you hadn't anticipated? How did you and your team respond?
8. How did you experience the relationship between national-level policy and regional or intermediate-level regulatory practice? Did messages and requirements align?
9. What were the most significant infrastructural or coordination challenges in implementing the project in Magallanes specifically?

Section 4: Stakeholder Engagement

10. How did you approach the community and stakeholder engagement around the project? Who were the key groups, and how did you decide how to engage with them?
11. Were there particular sources of opposition or contestation? How did you understand and respond to them?
12. Were there specific changes made to the project in response to concerns raised during stakeholder engagement? How were those decisions taken?
13. How did you manage the tension between visibility and discretion – were there moments where public attention helped, and moments where it complicated the work?

Section 5: Setbacks and Recalibration

14. What were the most significant setbacks or unexpected developments the venture encountered? How did you respond?
15. Were there moments where the underlying business case or strategy needed to be reconsidered? What prompted that reconsideration?
16. Looking at peer projects or competitors in the region, how do you understand the differences between trajectories that have advanced and those that have stalled?

Section 6: Reflection

17. Looking back at the development process, what do you think were the two or three decisions that made the biggest difference to the outcome?
18. Are there things you would do differently if you were starting the same project now?
19. Is there anything about your experience or your organisation's approach that you think we should understand that we haven't asked about?

Post-Interview Procedure

Following each interview, the interviewing team produced independent debrief notes capturing initial impressions, particularly significant quotes, points of corroboration or contradiction with the existing dataset, and areas warranting follow-up. These debrief notes informed subsequent interview design and the coding process described in Section 3.4.

Appendix B - HIF Coding

1st-Order Concepts	2nd-Order Themes	Aggregate Dimensions

"We tried everything. We started with the [idea] to interconnect Chile with Magallanes, with a submarine transmission line. We also worked in interconnection with Argentina, but all alternatives were very difficult."*(P4)* "We were like more than half a year talking to some aluminium industry… but there was a huge problem… they needed this kind of bricks, like the 24/7 supply of energy." *(P4)* "We came up with the hydrogen as a first stage, but then the hydrogen couldn't be – and still is – very difficult to transport because of the liquefaction."*(P4)* "I studied a project in Germany, Power to Gas… from Audi. And I said, okay, let's look at this area. Actually, I focused more and more in this new development."*(P3)* "Not easy, or probably also not possible, to transfer that power with transmission lines to demand centers in the north or over to Argentina or somewhere else."*(P2)* "Liquid energy carriers, like oil, liquid gas, are transported around the world. It's quite easy and cheap to do so. So this was actually the birth of that idea." *(P2)*	**A1. Iterative technology-pathway**	**A. Construction of the venture's shape**
"It was quite clear in the beginning that we would need to demonstrate that this is possible. And therefore also from the beginning, it was planned to install a demonstration plant." *(P2)* "It was imperative to move from a PowerPoint solution to a real solution. We needed to demonstrate that this could be done outside a lab, in an industrial scale, but not commercial scale." *(P4)* "I think that is one of the reasons for the success of the company HIF – one thing is to have concept project development, and the other thing is to have a real on the ground pilot plant." *(P3)* "We have got more than 1000 visits per year since we are running this plant from all kind of institutions and governments, people, negotiators of the COP, students from universities and from schools."*(P4)* "It's a mix between an industrial plant and a museum."*(P4)* "We are real. What this stuff is about, people can actually see it. It's not a project, just on paper." *(P5)*	**A2. Pilot plant as proof**	

"Our next step is a very manageable size. I mean, it's a 386 megawatt project… it's not a monster project like a gigawatt break." *(P4)* "We realised in all these years that we cannot develop gigawatt projects… you could, but you have to make them in stages, small stages." *(P4)* "It was also one of our – also my – mistake. I started the development from the technical perspective and said, we have to go to the commercial size directly. That was a mistake. You have to start smaller."*(P3)* "If you have a very big project and it was never built the first time… the total lump-sum cost of a plant has nothing to do with the real cost, because it's only contingencies." *(P3)* "Faro del Sur is actually a small wind farm compared to most of them. I think in the end, that might have worked to our favour as well… if you look, a lot of the gigawatt-scale wind farms have not moved forward."*(P5)*	**A3. Disciplined right-sizing**	
"Wind and PV was very expensive 20 years ago… factor of 10 or 20 more expensive than fossil generated electricity. Nowadays, there are lots of regions worldwide where PV and wind are the lowest cost energy sources." *(P2)* "Costs will go down only with executed projects."*(P3)* "You have a learning curve: double installed capacity, you have like 22–23% reduction in cost of the infrastructure. We are communicating only with 15%, and then it would go down very quick." *(P3)* "We need that scale up. We need several proto-type installations to reduce the cost." *(P2)*	**A4. Small-scale justification**	
"I had some contact in Porsche since many years, and we did some R&D work… I made a patent for new kind of [PV] plant. And there I had contacts with Porsche engineering." *(P3)* "We had a project. We wanted to build electrical busses in Santiago… we placed some orders to Porsche engineering to help us with studies. I think that was also one reason that this connection was prompted." *(P3)* "We had already five years, six years of work together." *(P3)* "There was a conference. There was a respect. They knew that we are not [just anyone]." *(P3)*	**B1. Pre-existing relationships**	**B. Resource mobilisation through partnerships**

"Porsche needed an alternative that can drop the emissions but keep the combustion car… we ended up being a very good solution." *(P4)* "Porsche is up to now also the off-taker of the fuel of the Haru Oni plant." *(P2)* "Porsche initially said: 'We will never invest in infrastructure… only demonstration.' And then one and a half years later, up to the top level, to the CEO of Porsche, they said no – we want to do [it]."*(P3)* "With this smaller project, we had them connected, and we had challenges. We solved them together, and then they said no – then they switched completely."*(P3)*	**B2. Customer-investor convergence**	
"The value of our company is zero. It's only because of some persons." *(P3, quoting Heather)* "The real success – the reason for success of the company, HIF – are really the top executives… One thing is the technology. But the other thing is, you need the entrepreneurship, the people to convince other people." *(P3)* "Cesar is very good in propensity people to catch them." *(P3)* "I know Alex already since 10 years, and we speak the same language. He had an offer for a professor at the university… and even though, he decided for [us], because he was also fascinated from our approach."*(P3)* "Rodrigo has been involved with Marga Yanis since 2014… really a broad range of groups and people that we [know]." *(P5)*	**B3. Recruitment as relationship work**	
"Spendings on project developments are high in the initial phases, and there's no return in these initial phases… therefore it's very important to have good partners, good investors in the beginning, who believe in the future and the future returns." *(P2)* "One of the first investors was the energy investment group from the US." *(P2)* "We had then a second round of investment… where also Japanese investors came into the company."*(P2)* "You always need front-up money." *(P2)*	**B4. Patient capital**	

"We usually do for all of our projects. We go out to the community… it's a sort of a feedback loop to make sure that we don't have any big red flags, and if there are concerns, how that can then be adjusted in either location or design." *(P5)* "We actually contacted some of the specialists and people that ended up being, in a way, against the large-scale wind farms. But these people were the ones that did the first studies down on our projects."*(P5)* "This is sort of early stakeholder engagement to understand before we even sort of actually start doing the baseline studies for the environmental study, just to see where the project is at." *(P5)*	**C1. Pre-EIA stakeholder feedback loops**	**C. Permitting framed as design dialogue**
"We are introducing radar technologies, for example, as a first time in operation in a wind park for this project, in order to detect very early the movement of some species and try to avoid collisions." *(P4)* "We took also some decisions in terms of the height of the rotor, so we keep away from the first 30 metres from the ground that the species down there fly at most." *(P4)* "We decided to route it through the side of the highway so we didn't have to go through the middle of people's lands. And we also put that underground – first underground high-voltage transmission line in the country for a wind farm." *(P5 / P4)* "The plant is designed to take it from the ocean, from the Magellan Strait, it is fully recycled. To the extent that we don't have an outfall – no wastewater that goes back into [the environment]." *(P5)*	**C2. Stakeholder concerns into engineering specifications**	
"We selected only what we call here veranadas… the highlands of these farms that had the best resource, but also they were very much intervened in the last 100 years because of the cattle… and because of the oil and gas exploration." *(P4)* "We decided not to go north from a limit that you are getting more close from the Torres del Paine… we are like 200 kilometres south… 250." *(P4)* "We made a good screening at that time that we investigated based on different layers of information. Wind resource, of course, also the place where we wanted to be located, so we don't impact the scenery too much. And also away from places that, from the bird standpoint, are very sensitive." *(P4)*	**C3. Avoiding sensitive areas in site selection**	

“For the Haru Oni facility, it was quite easy, because there’s a specific fast process in Chile, if you stay below a certain project size.” *(P2)* “However, for the first commercial-scale project, which is then hundreds of wind turbines, this was and still is much more challenging.” *(P2)* “It looked like it was going to be imminent that they were going to say that the study wasn’t complete. And so we withdrew the environmental impact study, went back to the field and continue doing more field studies.” *(P5)* “Then it took just under a year and a half… to permit the second time around the wind farm.” *(P5)* “I’m not too pessimistic… longer environmental permitting usually means [it’s] better. More questions are raised, investigations are made. It doesn’t make any sense to do sustainable fuel under unsustainable developments.” *(P2)*	**C4. Tactical permitting pivots**	
“We were a local company. I mean in terms of Chilean company, probably we understood a little bit better the importance to do the things right from the beginning.”*(P4)* “Our stakeholder engagement and communications was aimed at sort of not saying ‘here’s this international company, or this company from mainland Chile’ – in a way, it was ‘here is the made-in-Magallanes’ kind of thing.” *(P5)* “I come from a farmer region. My family had a farm, so all these tools help you to approach the farmers that are sometimes very reluctant to this kind of projects, and to have another view, much more from the nature point of view, not only the math and the numbers.” *(P4)*	**D1. “Made-in-Magallanes” identity**	**D. Local value as strategic positioning**
“We’ve had to have a team down there. We’ve got an operations team, maintenance team, not only just the development team for the commercial-scale facilities. So we’re in action.” *(P5)* “It’s not just what we’re saying, like people can actually see it’s what we’re doing as well. So we can be true to our word or not, but people can judge us on how we are.” *(P5)* “We are spending money. We are employing people, the people we’re employing are from Magallanes.”*(P5)*	**D2. Operational presence as credibility**	

"We came into an agreement with Gasco, which is a local company with operations in Magallanes… they started capturing the off-gases that would go to the flame, and they're now using that to do tests… to see if they can mix it with their LPG distribution system."*(P5)* "We actually produce salts that we're looking at then providing to, for example, de-ice the streets of Magallanes." *(P5)* "The Chilean Navy has been using some of the fuel to do trials. There's a cruise liner that does trips down in the Antarctic… we've been supplying the fuel for the zodiacs that accompany that cruise boat." *(P5)* "We also signed an agreement with ENAP, which is the National Oil and Gas distributor and refiner. Potentially, we could be leaving some of the fuel in Chile once we build phase one." *(P5)* "Big industry that comes in needs to be a part of the solution, not the problem." *(P5)*	**D3. Shared local value from project outputs**	
"We also work normally very much underground. We don't want the lights too much because it creates false expectations sometimes, and we were very careful always not to create wrong expectations." *(P4)* "We knew always that this is a very [novel] project that has a lot of challenges and risk." *(P4)* "The government made like a calculation about the potential of the region… it was 126 gigawatts of potential wind energy that could be developed in the region. And that was really, I think, bad." *(P4)* "[Other companies] paid a lot of money. They caused also an inflation in prices, because they thought this was very easy and there was like gold… they paid like, there was no reason." *(P4)*	**D4. Reputation discipline (avoiding false expectations)**	
"With the start of the cooperation of Porsche, we look for other developments in other countries, in the United States, in Australia." *(P3)* "Environmental permitting in the US and also Uruguay was much faster. So on the timeline, these projects overtook the Chile project." *(P2)* "In the US we already have the permit… it's more an economic and regulatory issue right now. So there's not much investment security on renewable projects in the US right now. So we are not so confident any longer that we really execute in the US." *(P2)* "We are also developing similar projects in Uruguay and Brazil and LATAM and other regions and in Australia." *(P4)*	**E1. Geographic diversification**	**E. Institutional positioning**

"It will be very important also to address the authorities, the government, [about] the importance of the energy independence – beside the reduction in emissions and all what is very important for the environment about these e-fuels, but also as a tool that allows you to be much more independent in terms of energy." *(P4)* "We have been talking with the branches of the Army, because obviously for them, it is much more important than the environmental impact of the e-fuels if we could have a national gasoline and we avoid to import them." *(P4)* "With the last Iran war, the prices of oil jumped so much you have a good spread to talk with."*(P4)* "It's a good key to move a region that is so isolated, in our case in Magallanes, that you could move a whole economy around this kind of project." *(P4)*	**E2. Reframing of the value proposition**	
"You do get projects that come in and think it's just about the permitting, and that's a big mistake – if you come in and think you just need to do some field studies and then present, it kind of blows up in your face a little bit, particularly with large projects." *(P5)* "[Otherwise] you do come up with sort of roadblocks along the way. Trying to anticipate that." *(P5)* "It's just that longer-term view of what it means to build a company within an area. Magallanes has an issue with waste, it's only got a fairly small population, not connected to the rest of Chile, so they need to deal with it all. Big industry that comes in needs to be a part of the solution." *(P5)*	**E3. Institutional construction**	

Appendix C - H2V Coding

1st-Order Concepts	2nd-Order Themes	Aggregate Dimensions
"We are sort of forced to go to this scale because you had to pay for the infrastructure." *(P7)* "If we were to go for only phase one, 580,000 tons per year, that was not enough to pay for the cost of the infrastructure." *(P7)* "Trying to develop an industry that would go from nothing – from zero to an industry that represented 18% of the fuel consumption of the world in 15 years."*(P7)*	**A1. Scale-driven logic**	**A. Strategic Architecture Decisions**
"When we start working on Chile, we thought that the project will be ready to decide on investment, say, after two or two and a half years, no more than that. And the process took at least [much longer]." *(P7)* "The expectation was that by 2025, we would have available electrolyzers of at least 100 megawatts capacity at a very low cost. Neither one happened."*(P7)* "The largest electrolyzer available, commercially available in the world, was about 20 megawatts capacity. We were planning to install one gigawatt of these electrolyzers – that meant 500 electrolyzers… totally illogical." *(P7)* "By 2030 was expecting to have five gigawatts of electrolyzers operating today. We have none – and there will be none by 2030 probably." *(P7)* "We expected a significant drop in electrolyzer prices around [the early 2020s], but that didn't happen."*(P8)* "India and Oman… was not in the map." *(P7)* "Everybody was saying… this new industry would be similar to the mining industry in Chile, same size, if not bigger. Today, we will be lucky we have one plant operating." *(P7)* "This is cyclic… we are sure it's going to be different… one or five years ahead." *(P6)*	**A2. Prediction-based investment logic**	
"The projects had to develop inexistent infrastructure, such as port… the cost of bringing labour in… started going up significantly." *(P7)* "There was the need to develop a port, expand the highway… expand the airport." *(P7)* "These projects are intensive in land use and territory… implementing a project of this magnitude."*(P8)*	**A3. Capex-amortisation as design constraint**	

"Hydrogen projects are industrial projects; they are not generation projects, even though they have a generation component." *(P8)* "Utilities' knowledge is more limited to the power-generation side, and believing that would be enough for a hydrogen project has proven not to be the case."*(P8)* "We submitted the EIA for the full project… otherwise you run the risk of having to account for the impacts during construction of the first phase in the baseline."*(P7)* "Engie traditionally operates power generation in the north, so they already had base infrastructure to move forward with hydrogen projects, which is why they chose the north." *(P8)*	**A4. Power generation-logic for an industrial venture**	
"We acted on behalf of the industry. So it gave much more weight to whatever we were saying." *(P7)* "We represented an investment of about 70 billion US dollars. So that gives you a lot of power." *(P7)* "Magallanes Pact, a program that included all the private companies developing in the sector, plus the regional government, CORFO, the different SEREMIs…" *(P8)*	**B1. Industry coordination**	**B. Collective-Action Decisions**
"We made sure that if anyone was to be making a commitment with the community, it would be in line with all other projects." *(P7)* "HIF was a founding member… invested in a lab… set the floor on anything else… we made sure that those things would not impact the rest." *(P7)* "Asking like 60% of the labour would be local… we made sure that there is a compromise to favour local hiring, but no commitment to any number at all."*(P7)*	**B2. Preventing individual concessions**	
"A union of just five or four members is not worth to keep paying for that organisation. That's why they decide to cancel this specific initiative." *(P6)* "It was a shame, but it wasn't possible to be justified to keep paying salaries and rental office." *(P6)* "HIF was not planned to produce ammonia… different challenges, different issues, that were not always aligned with the interest of the association." *(P7)*	**B3. Coordinated retreat decision**	

"HIF offered to stop the wind turbines in the presence of birds… we said no, we're not willing to accept."*(P7)* "By recommendation from the manufacturer, you cannot stop them more than five times a year. And they were offering to do it every time a bird showed up nearby… that would have damaged the turbines heavily." *(P7)* "I came in and offered $29 per hectare… there is no way in heaven that any project would be so profitable… you're gambling." *(P7, on Ignis)* "Ignis was the first one to leave the region… they found out that the contracts had not been registered with authorities, so they had no legal validity. It was just a piece of paper." *(P7)*	**C1. Concession refusal**	**C. Stakeholder Engagement & Concession Discipline**
"Take the workers from the airport, take them directly to the camp on site, and they wouldn't… be wandering around the city." *(P7)* "Make sure that people understood that there was a plan behind the management of all these issues."*(P7)* "Maximise the use of local workforce… we sort of sponsored training… but at best we would have accounted for about 30%." *(P7)*	**C2. Social-risk commitments**	
"Most of the questions came from ONGs, not from normal people." *(P6)* "It's basically noise made by ONGs… actually orange[s] that are financed by basically Norway, which is the main competitor of Chile." *(P6)* "More than 80% of people actually welcome this industry." *(P6)* "We work normally very much underground… we were very careful always not to create wrong expectations." *(P6)*	**C3. Selective stakeholder weighting**	
"We could have been able to sustain the operation for one year at minimum expenditure… they didn't take it, and they decided to start [shut down] the project… kind of a surprise to the team." *(P7)* "Total is already in the system, is trying to get the permit, but investing as low as possible. They actually reduced personnel. They have only two or three people now." *(P6)*	**D1. Holding as a strategic choice**	**D. Capital & Asset Preservation Decisions**
"Pay the lease or half of the lease for this year and then freeze the payments for another two years."*(P7)* "All projects are renegotiating the leases… either you accept the conditions or your cost of opportunity is zero." *(P7)*	**D2. Lease renegotiation**	

"EDF, the French company, decide to step aside."*(P6)* "ENA, which belongs to AES… is cancelled. In fact, the company's hydrogen team no longer exists; it's all disbanded. Engie also decided to cancel its hydrogen projects in the north; their team is not operating either." *(P8)* "I had a number of meetings with Korean and Japanese companies, inviting them to invest in HNH… they needed to be much more competitive in terms of cost." *(P7)*	**D3. Divergent firm responses**	
"We missed a huge opportunity, huge market opportunity, and we missed it because we [weren't] able to secure any contract." *(P6)* "If just one of the projects [had moved], then it will be fantastic for the region." *(P6)* "Probably five or 10 years ahead of ourselves."*(P7)*	**E1. "Missed window" narrative**	**E. Trajectory Reversal & Retrospective Sensemaking**
"The model that works can be seen at HIF, and also in the Atome project in Uruguay." *(P8)* "Implementing a strategy of early partnerships… should have been the strategy many of these companies adopted." *(P8)* "HIF had a very different risk appetite… it was born for [this business]… strategic partnering and early capital raising." *(P8)*	**E2. HIF comparisons**	
"Let's start small. Let's start with domestic demand… if the mining industry can adopt hydrogen or E-fuels as an option." *(P7)* "Turning Magallanes into a bunkering station like Singapore." *(P7)* "This needs to be rethink in a different way, more collaborative among projects, rather than competing with each other." *(P7)*	**E3. Retrospective architecture proposals**	
"It has become more a strategic insurance or the assurance of having independent source of energy."*(P7)* "Today, we're back in the discussion that, hey, maybe we need to give a big push to the hydrogen industry, not because of climate change issues, but because of securing energy sources and energy independency."*(P7)*	**E4. Reframe value proposition**	

Appendix D - Context

"Chile's got a pretty robust institutional system… it's a centralized system. The environmental laws and regulations are all made at the state level, but at the regional level there is an appointed environmental service that needs to run the process." *(P5)* "There's usually two, maybe three, maximum three rounds of questions and answers before it then it's permitted either accepted or not accepted." *(P5)* "Public participation is one of the most important and delicate parts of preparing the Environmental Impact Assessment." *(P8)*	**A1. Centralised-but-regional permitting architecture**	**A. Chilean institutional and regulatory context**
"The environmental ministry issued 52 new regulations in the last two, two and a half years. That means you never have a clear path or clear view of what you actually needed." *(P6)* "Former minister Grau was more close to the minister Rojas, the Minister of Environment. They did everything in order to put problems and issues on the development of the H2 project." *(P6)* "We had a government with an environmental minister who was really pushing a very green line of projects… there was a lot of guidelines that came out trying to really regulate how the environmental impact studies were presented, that made it kind of difficult, because rules were kind of changing or being adjusted as we moved through." *(P5)*	**A2. Regulatory change under prior ministry**	
"We are now in the fourth government term that has maintained the National Green Hydrogen Strategy as public policy." *(P8)* "Chile established a green hydrogen policy as a state policy, and defined that by 2050 had to be carbon neutral or net zero as an economy." *(P8)* "We have cooperation agreements signed with the European Union, with Rotterdam, with the Netherlands… that allowed us to secure funds from the World Bank, the Inter-American Development Bank, from KfW." *(P8)*	**A3. Policy continuity across governments**	

"Magallanes had only two people in the environmental area to assess the projects… they had to bring in and hire and grow that team significantly." *(P7)* "Most of the people that came to work on it were young environmental engineers, specialists. They had support from other regions in Chile, but they were not a full and complete understanding of the industry."*(P7)* "Government authorities… they are not so qualified, and they feel partially unsecure. And that has also an impact on the timing." *(P3)*	**A4. Limited regional capacity**	
"In order to enter the environmental system, you have to have the land secure." *(P7)* "[This] wouldn't be the case in, for example, Europe."*(P7)* "When you get the environmental license, you still have five years to start construction." *(P7)*	**A5. Land requirement constraint for permitting**	
"Japan and Korea established policies to decarbonize their economies and adopt at the beginning a coal-firing scheme between coal and ammonia… 70/30 combination in some of their power generation plants." *(P7)* "Talking to the Koreans, they said, at this point, the goal is to decarbonize the economy. We don't care if it's green, blue or gray ammonia, as long as this is carbon free." *(P7)* "The fact is that nobody's willing to pay for green, or nobody's willing to pay for a sustainable fuel, and blue and gray are way much cheaper than green." *(P7)* "Green ammonia prices remain well above, almost double, on average, the gray alternative." *(P8)*	**B1. Market evolution: expectations vs. reality**	**B. Global market and policy context**

"India and Oman coming up with huge volumes of green ammonia – or what they claim to be green ammonia – into the market at low prices." *(P7)* "India declared three ports in the north of the country as hydrogen hubs. The ports were done by the government." *(P7)* "Oman developed port camp facilities, hospitals, towns, cities, airports… on behalf of the government, and ammonia storage facilities and power generation facilities. All you had to do was develop the PTX plant." *(P7)* "Chifeng in Mongolia… November '24 [Envision] was completing their first pilot plant to produce green hydrogen, 20,000 tons per year… October '25 the same plant was capable of producing 300,000 tons per year." *(P7)* "India and Oman came out into the market with an offer for green ammonia in the range of 570 to $650 a ton. Magallanes at the best was able to go down to 1,000." *(P7)*	**B2. Subsidised competitor entry (India, Oman, China, NEOM)**	
"Trump took power in the US… he raised or sort of stopped all programs that the US had in place to promote the adoption of green hydrogen – the IRA, this Inflation Reduction Act." *(P7)* "There was an expectation that the IMO would confirm the adoption of ammonia or non-carbon fuels in the maritime industry. In May 2024 they voted that by 2050 the maritime industry had to be net zero… the decisions were postponed until October 2025… [then] postponed them until October 2026." *(P7)* "The US did a huge effort in lobbying countries not to adopt this policy… got support from oil-producing countries like Saudi Arabia, Kuwait, Iraq." *(P7)* "The IMO decision not to move forward with the new regulation that was voted in October last year… was a huge impact, because that meant you will not have fines if you continue using the regular fuels."*(P4)* "There's not much investment security on renewable projects in the US right now." *(P2)*	**B3. International regulatory shocks**	

"With the problems in the Middle East – Iran and their moves in the Strait – it has given proof to the world that how much we depend on Middle East oil."*(P7)* "60% of their oil comes through the Strait of Hormuz."*(P7)* "Europe had already been working on it since 2014 when they started cutting the dependency on Russian gas… they still rely on gas, mostly from the UK, Norway, in the US, but it's still at a higher cost than the gas that was coming from through the Russian pipelines." *(P7)* "With the last Iran war, the prices of oil jumped so much." *(P4)*	**B4. Geopolitical disruptions reframing energy markets**	
"Europe has sort of relaxed some of the requirements to become RFNBO compliant. They have accepted that, well, maybe it was too much." *(P7)* "Europe – the discussion has been around standards, how green is green? Asia, China and others have gone about cost of ammonia and production." *(P7)* "Korean Institute… their threshold was to consider ammonia to be green if your emissions in the process of producing it were less than four kilos of CO_2 per kilo of hydrogen." *(P7)*	**B5. Commodity tandards turbulence**	
"The largest electrolyzer available, commercially available in the world, was about 20 megawatts capacity. We were planning to install one gigawatt of these electrolyzers… that meant 500 electrolyzers."*(P7)* "The expectation was that by 2025, we would have available electrolyzers of at least 100 megawatts capacity at a very low cost. Neither one happened."*(P7)* "We expected a significant drop in electrolyzer prices around [the early 2020s], but that didn't happen."*(P8)* "Direct air capture is something where today there's no technology at competitive costs available."*(P3)*	**C1. Electrolyser scale and cost disappointment**	**Technology and infrastructure landscape**
"Hydrogen couldn't be – and still is – very difficult to transport because of the liquefaction. You need to go down almost to absolute zero. That's minus 260 degrees Celsius, and there's still lack of ships that can move hydrogen." *(P4)* "200 million tons of ammonia per year being traded in the world. 70% of it goes to fertilizers, pretty much all the rest to explosives." *(P7)* "If the hydrogen industry develops to the extent we hope, [ammonia trade] is going to be in the range of six to 800 million tons per year… because you will add the power generation industry and the maritime industry." *(P7)*	**C2. Hydrogen and ammonia transport**	

"There are no ports, no road network to transport large quantities of equipment, no capacity in public services such as airports, hospitals, no power transmission infrastructure. None of that exists in the region beyond what's needed to sustain the population currently living there." *(P8)* "The poor level of infrastructure in the region… required that the projects itself took responsibility or took care of developing their own facilities." *(P7)* "The complexity is not easy. If the project is much bigger and you have a long-term approach and one project after the other, it will definitely change… But for the first project, it's not easy." *(P3)* "We had to fly them in, you have to fly them back. They are on holiday or weekend and family. So the complexity is not so easy." *(P3)*	**C3. Absence of supporting infrastructure**	
"Magallanes is about 40% of the size of Germany, and they are living in total 160,000 people. So there's a limited number of people available… you need specific qualification." *(P3)* "Considering cost and availability, you can multiply every single factor [by] three, because all the experts – the welders, the process staff – you have to fly them in." *(P3)* "There were a lot of specialists, international specialists from China, from Germany, from England, from the licenser." *(P3)* "[HNH] estimated we would need about 4,000 workers during the construction period for a span of about four years, and much of them were not available in the region." *(P7)*	**D1. Limited skilled workforce**	**Local social-ecological landscape**
"Normal people here support the project because that means more work, investment, growing of the economy. So we are very welcome by the community." *(P6)* "More than 80% of people actually welcome this industry." *(P6)* "With the exception of just a few farmers – very few – everyone else were very happy. For them was a big opportunity to get a huge amount of money. They earned more money with rental to these companies than on farming." *(P7)* "Almost all companies have gone… [other companies] paid a lot of money and even buying farms at a very expensive price that was unrealistic for the area."*(P4)*	**D2. Community attitudes**	

"Most of the questions came from ONGs, not from normal people. We are not welcomed at all by environmentalists." *(P6)* "Voices also being raised from NGOs and environmental groups against the installation of such a massive industry and the impacts it would have on the environment." *(P7)* "The bigger resistant groups were, and still are, the NGOs related with conservation. Some of them, as in every country in the world, they don't want anything else. They don't want any development here. But others just are really worried about some species of bird that they don't want to impact." *(P4)* "The environmental groups have probably been the group that has been most resistant." *(P5)*	**D3. NGO opposition and conservation concerns**	
"Punta Arenas, if not the first, is among the first two cities in Chile with the best quality of life. These are cities where you still leave the door of your house open. You don't lock yourself at home." *(P7)* "There is this vision of what has happened with the mining industry in the north, where cities have been impacted, where quality of life has been damaged."*(P7)* "People were afraid that would be lost if all these massive amount of people and all the activities around the project [came in]." *(P7)* "Magallanes has an issue with waste, it's only got a fairly small population, but not connected to the rest of Chile, so they need to deal with it all." *(P5)*	**D4. "Mining-north" reference frame**	
"The one that is leading is led by Total Erin. Others come from Austrian companies. There is another that comes from a joint venture of Finnish and Spanish companies. All of them are foreign investors."*(P6)* "We represented an investment of about 70 billion US dollars." *(P7)* "CIP, the company I was working for, had 10 hydrogen projects around the world." *(P7)* "EDF had two initiatives… RWE decided to cancel/freeze as well… Engie also decided to cancel its hydrogen projects." *(P8)*	**E1. Foreign utility capital concentration (H2V members)**	**E. Investor and firm landscape**

"One of the first investors was the energy investment group from the US. And they were also part of AME in the beginning." *(P2)* "There's also a long connection to the German car OEM, Porsche. And they were also an early investor in HIF." *(P2)* "Second round of investment, I think this was in 2024 or so, where also Japanese investors came into the company." *(P2)* "It's very important to have good partners, good investors in the beginning, who believe in the future and the future returns." *(P2)*	**E2. Belief-based and customer-investor capital (HIF)**	
"There was such a big rush in securing land – the companies were willing to pay enormous amounts of money to secure those leases." *(P7)* "[We] were offering about $4 per hectare for the development phase. And there was a company coming from Spain called Ignis. They were desperately securing land and paying… they came in and offered $29 per hectare." *(P7)* "Ignis was the first one to leave the region… they found out that the contracts had not been registered with authorities, so they had no legal validity." *(P7)* "[Other companies] paid a lot of money. They caused also an inflation in prices, because they thought this was very easy and there was like gold." *(P4)*	**E3. Land-lease competition**	
"Magallanes Pact, a program that included all the private companies developing in the sector, plus the regional government, CORFO, the different SEREMIs." *(P8)* "H2 Chile association recently did an update of the project map. We had a map with about 81 identified projects until the beginning of the year. This update cut it down to about 63–64 projects." *(P8)* "A union of just five or four members is not worth to keep paying for that organisation. That's why they decide to cancel this specific initiative." *(P6)* "This association has decided to pause its operations precisely because of member companies leaving."*(P8)*	**E4. Industry coordination structures**	

Appendix E - AI Disclaimer

In accordance with the requirements of the master's programme, this statement accounts for the use of AI-based tools in the preparation of this thesis.

Tools used:

- **Otter.ai** – automated transcription of recorded interview sessions
- **Claude (Anthropic)** – drafting support, editorial review, and structural feedback
- **ChatGPT (OpenAI)** --occasional supplementary editorial review and clarification of theoretical concepts

Degree of use:

Transcription (Otter.ai). Recorded interview sessions with all participants (P1–P8) were transcribed using Otter.ai. Transcripts were subsequently reviewed manually for accuracy against the original audio, with corrections applied where the tool misrendered technical terminology, Spanish-language phrases, or speaker attribution. All transcripts used as primary data underwent this manual verification before coding.

Editorial and structural support (Claude). Claude was used as an editorial sounding board during the drafting process. Specific uses included: (i) feedback on overall thesis structure and read-thread coherence; (ii) identification of repetition between Chapters 4 and 5 and suggestions for alternative quotations from the transcript corpus to reduce redundancy; (iii) suggestions for tightening prose and reducing terminological proliferation; (iv) feedback on the alignment between coding aggregate dimensions and chapter sub-headings; (v) formatting support for the LUSEM Harvard reference list, including verification of citation conventions. The tool was also used to review the final manuscript for terminological inconsistencies, citation formatting errors, and other matters of academic style as listed in the editorial pass described in the methodology of the editing process.

Theoretical clarification (Claude and ChatGPT). Both tools were occasionally used to clarify the boundaries between established theoretical constructs where multiple readings of the

literature were possible. However, all theoretical claims advanced in the thesis were verified against the original cited sources.

Limits of AI involvement

No AI-based tools were used to generate empirical material, conduct interviews, perform coding, or develop the analytical argument of the thesis. The research design, theoretical framework, case selection, interview content, coding decisions, interpretation of empirical material, and the propositions presented in Chapter 5 are the work of the authors. All quotations from interview participants are verbatim from manually verified transcripts. All cited academic sources were located, read, and interpreted by the authors directly; no claims about cited works were accepted from AI tools without verification against the original.