

The Strategic Alliance Between The Port Of Pecém And The Port Of Rotterdam In The Green Hydrogen Value Chain: An Analysis Of Bilateral Benefits In Light Of The Resource-Based Theory Of The Firm

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Abstract:

Background: This study examines the strategic alliance between Pecém (Ceará, Brazil) and Rotterdam (The Netherlands) within the broader framework of the global energy transition. It highlights the relevance of international cooperation in the context of climate change and analyzes the benefits and conditions that support strategic alliances. Furthermore, it explores the theoretical foundation of the Resource-Based View (RBV) to understand the drivers and implications of the partnership between Pecém and Rotterdam in the green hydrogen value chain.

Materials and Methods: A qualitative research approach was adopted to investigate the applicability of the Resource-Based View to the Pecém–Rotterdam alliance. The study employed bibliographic and documentary research, with the consultation of sources organized into four categories: (1) international cooperation; (2) strategic alliances; (3) the Resource-Based View; and (4) the specific resources and capabilities of Pecém and Rotterdam in the context of green hydrogen production and exportation.

Results: The findings reveal that the alliance between Pecém and Rotterdam reflects a mutually beneficial cooperation model, enhancing both regions' strategic positions in the emerging global green hydrogen market. The integration of complementary resources and capabilities has the potential to generate competitive advantages, promote sustainable development, and foster a more resilient and diversified energy matrix.

Conclusion: The strategic cooperation between Pecém and Rotterdam demonstrates the relevance of applying the Resource-Based View to analyze international energy partnerships. The study reinforces the importance of aligning institutional capabilities and resource complementarities to foster innovation and competitiveness in the green hydrogen sector.

Keywords: Strategic alliances; Resource-Based View; Green hydrogen; International cooperation; Port infrastructure; Energy transition.

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I. Introduction

The ongoing energy transition and the decarbonization of the global economy are widely recognized as the most appropriate and urgent solutions to mitigate the effects of global warming by offsetting the use of fossil fuels. Given that these actions are difficult for individual countries to carry out due to insufficient resources, there is a consensus that greater synergy and collective efforts by the international community will lead to more effective responses in addressing the disruptions caused by climate change.

In this context, the state of Ceará emerges as a potential contributor to the global energy transition, due to its proven political, economic, and environmental conditions for producing green hydrogen (H₂V) and exporting it to Europe through the Pecém Industrial and Port Complex (CIPP).

Within the scope of Ceará's international strategic business management, high-level decision-makers have undertaken initiatives with European countries with the aim of sharing the State's competitive advantages, fostering new partnerships and agreements based on mutual interests and benefits in the energy sector.

In this promising scenario of international cooperation involving Ceará, it becomes possible to foresee the application of well-established concepts of strategic management—such as the Resource-Based View (RBV)—in supporting the political and economic decision-making processes of the State.

Regarding the methodology, a qualitative approach was selected. As for the research techniques, the study was based on bibliographic and documentary analysis, drawing on national and international publications, reports from international organizations, scientific articles, and online sources. Based on the review and consolidation of these materials, the most relevant issues related to the present study were identified.

Thus, the general objective of this study is to analyze the strategic alliances between Pecém–Ceará and Rotterdam–The Netherlands in green hydrogen production through the lens of the Resource-Based View. The aim is to provide high-level decision-makers with analytical tools that support clearer formulation of business strategies in the context of international cooperation.

The specific objectives are: to describe the importance and urgency of joint international efforts through cooperation in the context of the global energy transition; to characterize the mutual benefits and underlying causes that drive countries and institutions to establish strategic alliances; to discuss the main concepts of the Resource-Based View and its applicability in the context of international cooperation; and to provide a brief historical overview that highlights the mutual benefits of the alliance between Pecém–Ceará and Rotterdam–The Netherlands.

This article is structured into four sections, providing a comprehensive analysis of the strategic alliances between Pecém–Ceará and Rotterdam–The Netherlands within Ceará’s current energy landscape. The first section, Introduction, presents the central theme of the study. The second section, Methodology, describes the research approach, including data collection and analysis strategies. The third section, Theoretical Framework, discusses the motivations and importance of international cooperation in the context of the global energy transition; the characteristics of strategic alliances as drivers of competitive advantages; the fundamentals of the Resource-Based View; and the resources, capabilities, and mutual benefits arising from the Pecém–Ceará and Rotterdam–The Netherlands alliance in support of green hydrogen production and commercialization in Europe.

Finally, the Final Considerations section summarizes the main findings of the research, highlighting the applicability of the Resource-Based View to support high-level decision-making in the implementation of strategic alliances related to green hydrogen production and export to Europe.

II. Material And Methods

This study employed a qualitative approach, which aligns with its primary objective: to analyze, through the lens of the Resource-Based View (RBV), the concepts and theoretical frameworks underlying the strategic alliance between the Pecém Industrial and Port Complex (Ceará, Brazil) and the Port of Rotterdam (The Netherlands), in the context of green hydrogen (H₂V) production and exportation. The qualitative approach is widely acknowledged in the scientific community for its capacity to enable contextual, interpretative, and in-depth analyses, offering a comprehensive understanding of the multiple dimensions and implications of such strategic cooperation—both for the State of Ceará and for Europe—especially within the contemporary energy transition scenario.

As highlighted by Pitanga (2020), in qualitative research, the epistemological stance is assumed by the researchers, who must commit cognitively to the rigor and quality of the investigative process. This is particularly relevant in studies addressing complex phenomena such as international partnerships aimed at the development of sustainable energy vectors, which are shaped by broad and dynamic internal and external variables.

The methodological procedures adopted in this study included a literature review and documentary analysis, both of which are recognized as essential strategies in the construction of scientific knowledge. These procedures enable the systematization, deepening, and critical examination of the current state of research on a given topic. According to Pereira et al. (2018), literature reviews significantly contribute to the broadening of understanding regarding the object of study, while also promoting the consolidation of theoretically grounded approaches.

For the literature review, sources were selected and organized into three main categories: (1) studies focusing on the theoretical foundations of strategic alliances; (2) publications addressing the principles and applications of the Resource-Based View; and (3) documents and scholarly outputs that explore the conditions and mutual benefits (win-win logic) stemming from the strategic alliance between Ceará and the Netherlands with regard to the green hydrogen production chain and its integration into the European energy market.

This classification enabled an integrated and contextualized analysis of the theoretical and practical contributions that underpin the potential socio-economic, environmental, and energy-related gains derived from the cooperation between the regions involved, with an emphasis on the creation of sustainable competitive advantages. As emphasized by Carvalho (2020), literature reviews should be understood as a scientific method capable of critically guiding the research process and advancing knowledge in the field. In a complementary manner, documentary analysis—as discussed by Grazziotin, Klaus, and Pereira (2022)—facilitates the retrieval and interpretation of formal and institutional records, providing relevant empirical evidence and representing a robust methodological path within the social sciences.

The collection and analysis of bibliographic and documentary material involved the consultation of peer-reviewed scientific articles, specialized books, technical reports from international organizations, theses, dissertations, government publications, and digital information repositories. This ensured a comprehensive, up-to-date, and critically grounded perspective on the theme of international cooperation in the energy sector, with particular emphasis on the production and exportation of green hydrogen.

III. Literature Review

This theoretical framework was organized into four subsections. The first subsection provides a description of international cooperation within the context of the global energy transition. The second aims to characterize the causes, effects, and advantages associated with the establishment of strategic alliances. The third presents the general conceptual foundations of the Resource-Based View (RBV). The fourth subsection outlines the circumstances and prospects for mutual gains for both the state of Ceará and Europe—particularly the Netherlands and Germany—resulting from the international cooperation between Pecém and Rotterdam in the context of green hydrogen (H₂V) production for the European market.

International Cooperation in the Context of the Global Energy Transition

The international community has increasingly witnessed the severe impacts of greenhouse gas (GHG) emissions, global warming, and climate change. These phenomena have resulted in significant socio-economic and environmental consequences, many of which are immeasurable and, in several instances, irreversible (Barbosa, & Gomes, 2024).

In response to the global imperative of replacing fossil fuels with cleaner and more sustainable alternatives, numerous countries have launched initiatives aimed at expanding the use of renewable energy and developing low-carbon technologies. Research and development (R&D) in clean energy have thus become strategic priorities in many national and international agendas.

In this complex and challenging scenario, international cooperation has become a critical instrument for facilitating the energy transition, particularly given the structural inequalities that hinder isolated national mitigation strategies. A key milestone in this regard was the adoption of the 2030 Agenda for Sustainable Development by United Nations Member States in 2015, which established the Sustainable Development Goals (SDGs). Among these, SDG 7—Affordable and Clean Energy—explicitly promotes the strengthening of international cooperation by 2030, with the aim of improving access to clean energy technologies, infrastructure, and energy efficiency (United Nations, 2015).

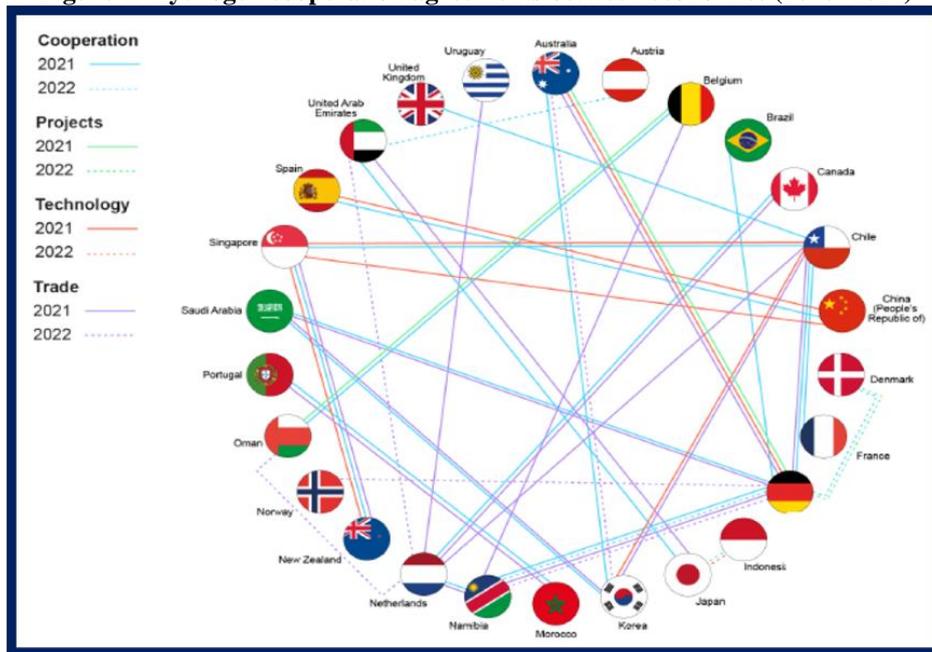
Another significant climate and environmental milestone was the Paris Agreement. Article 7 of the agreement emphasizes international cooperation as essential for addressing climate issues, aiming to reduce technological and financial disparities between the Global North and South through information sharing, enhanced R&D, and the exchange of best practices (FKA, 2022). These collaborative efforts are intended to contribute to the mitigation of climate change by promoting investments in low-emission technologies (IPCC, 2023).

Among the promising solutions in the clean energy sector is hydrogen (H₂), widely recognized as a key pillar of the energy transition due to its potential to decarbonize hard-to-abate sectors (MME, 2023). This understanding aligns with United Nations policy reports (2022) and recent academic contributions highlighting the strategic role of hydrogen in decarbonization pathways (Santos, & Gândara, 2022).

In Brazil, the National Hydrogen Program (PNH₂), coordinated by the Ministry of Mines and Energy (MME), has identified international cooperation as a critical enabler for the technological and market development of low-emission hydrogen.

Acknowledging the urgent need to address adverse climatic conditions and rising carbon emissions, the international community has made a concerted effort to establish bilateral and multilateral partnerships aimed at developing global value chains for low-carbon hydrogen. Figure 1 below illustrates the cooperation agreements established between 2020 and 2022 in support of this objective (Lima, 2023).

Figure 1. Hydrogen cooperation agreements between economies (2020–2022)



Source: IEA (2022, p. 205).

It can be concluded, albeit partially, that international cooperation—grounded in both national and international policy frameworks—constitutes an essential, if not imperative, strategy for enabling the global energy transition. The synergy among diverse stakeholders and the coordination of multilateral efforts are expected to strengthen the green hydrogen (H₂V) value chain, which is critical for fulfilling the commitments of the 2030 Agenda and the Paris Agreement.

Among the possible mechanisms for collaboration between countries, institutions, companies, or organizations, strategic alliances stand out as a means of enhancing cooperative performance and increasing efficiency in advancing the H₂V economy, widely regarded as the fuel of the future.

Characteristics and Benefits of Strategic Alliances

The globalization of the economy, trade, and international business has intensified competition among countries, companies, and industries in the provision of products, goods, and services. Over time, it became clear that the autonomous pursuit of profitability faced structural limitations, as full self-sufficiency in resources and capabilities proved largely unattainable. Within this context, strategic alliances emerged as effective instruments for resource sharing and the enhancement of competitive advantages (Klotzle, 2002).

The increasing competitiveness has become a matter of survival, directly impacting variables such as productivity, costs, quality, technological innovation, and human resource qualification. Given the practical impossibility of full autonomy by individual firms, strategic alliances are justified as a viable response to market challenges (Klotzle, 2002).

According to Teece (1992, as cited in Klotzle, 2002), strategic alliances are agreements in which two or more partners share the commitment to achieving a common goal by combining their capabilities and resources. These agreements entail a degree of strategic and operational coordination and may involve joint activities in research and development (R&D), technology transfer, licensing of production and sales, and cooperative marketing strategies.

Similarly, Garai (1999, as cited in Klotzle, 2002) emphasizes joint efforts in marketing and R&D, collaboration in product development, and technology transfer as key components of strategic alliances. Gulati (1998) and Borges and Bastos (2020) define such alliances as voluntary agreements between organizations aimed at exchanging, sharing, or cooperatively developing projects and resources, including products, services, and technologies.

Gomes-Casseres (1999, as cited in Vilela & Jhuniar, 2018) outlines the essential elements of successful strategic alliances: (1) clearly defined objectives; (2) complementary competencies between partners; (3) fair distribution of tasks and responsibilities; (4) mechanisms to stimulate cooperation; (5) effective communication and mutual trust; (6) long-term planning; (7) joint project development; and (8) operational flexibility.

Gofredo and Bataglia (2015, as cited in Vilela & Jhuniór, 2018) identify organizational learning as a major advantage of strategic alliances, as the knowledge generated through collaboration contributes to the consolidation of competitive advantages.

Thus, strategic alliances can be understood as economic and commercial partnerships between organizations, aimed primarily at increasing the effectiveness of competitive strategies through organizational synergy. These alliances generate benefits across various domains, including technological innovation, workforce qualification, and product improvement (Borges & Bastos, 2020).

By combining the abovementioned characteristics, partner organizations aim to achieve superior outcomes compared to those they could obtain independently, as argued by Eiriz (2001) and Garcias (2001, as cited in Vilela & Jhuniór, 2018).

Table 1 presents a summary of the main characteristics, causes, and benefits of strategic alliances, based on the authors cited.

Characteristics	Benefits
Spontaneous agreements between the parties; Clarity in strategic objectives (reconcilable); Encouragement of cooperation; Complementary skills; Commitment to established goals; Sharing of resources and capabilities; Coordination at the highest level of activities (R&D, marketing, joint product development, technology transfer); Distribution of tasks and responsibilities; Effective communication and established trust; Long-term planning; Flexibility.	Economic development; Development of skills and competencies; Access to new technologies and foreign markets; Exchange, sharing, or cooperative development of resources; Achievement of better results; Improvement in the performance of the involved parties; Higher individual and collective returns; Generation, transmission, and sharing of new knowledge and information; Innovation in products and processes; Creation of value in the business model; Enhancement of competitive business strategies; and Product improvement.

Source: Garai (1999), Gomes-Casseres (1999), Garcias (2001), Eiriz (2001), Klotzle (2002), Borges e Bastos (2020).

Douglas and Craig (1995, as cited in Eiriz, 2001) offered important insights into the nature of strategic alliances by identifying three primary forms of collaboration among partners: (a) research and development (R&D) of new products; (b) production and logistics activities; and (c) joint efforts in marketing and distribution. These cooperative mechanisms are central to enhancing organizational capabilities and increasing competitiveness in global markets.

In alignment with this view, Eiriz (2001) proposed that strategic alliances may encompass three main domains of cooperation: the commercial domain, the technical domain (related to production), and the financial domain. Each domain corresponds to distinct types of strategic alliances, with specific characteristics and objectives determined by the nature of the collaborative relationship (see Table 2).

Table 2: Three Domains of Cooperation in Strategic Alliances

Domain	Strategic Alliances in	Examples
Commercial	Purchasing, sales, and marketing; distribution of products and after-sales services.	Establishment of distribution agreements between a producing company and another company that has dominance or presence in the distribution networks up to the end consumer. In this case, the distributor accesses the finished product, selling it to various distribution channels.
Technical (Production)	Production activities, human resources management, and technological R&D	When product and process R&D becomes significant in business, especially when costs are high, sharing investments between companies.
Financial	Capital involvement and degree of partner integration	Establishment of joint ventures through the creation of a new entity, involving capital for its shareholder structure, commonly used to pursue commercial or production/technical objectives.

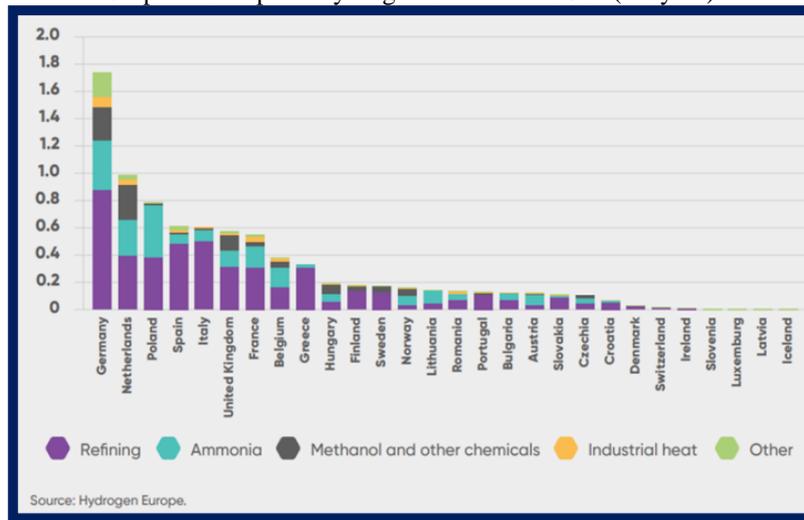
Source: Eiriz (2001).

According to Table 2, Eiriz (2001) concluded that an alliance is only strategic when it has an impact on all three domains, even if it is classified in only one. In other words, a strategic alliance is generally developed for one or more activities, but directly or indirectly, it ends up involving and having implications for the remaining activities.

Regarding international cooperation within the scope of the energy transition, Graph 1 demonstrates that Germany and the Netherlands were the largest markets in 2022 (Uribe, 2024), confirming that the State of Ceará strategically and wisely decided to strengthen the existing agreements related to H2V with both countries,

contextualized in the establishment of a joint venture in the CIPP. In both cases, Brazilian international cooperation is likely to ensure a market for H2V produced in Pecém (Barbosa & Gomes, 2025a).

Graph 1: European Hydrogen Demand in 2022 (Mt/year).



Source:

It can be partially concluded that strategic alliances have emerged as a solution found by the international market to create and develop competitive advantages. These partnerships allow the cooperating entities to join efforts, promote synergy of resources and capabilities, and pursue the conquest and consolidation of markets. This is a "win-win" process, where the benefits are simultaneously distributed across various areas of the participants, including research and development (R&D), production, logistics, distribution, and marketing, among others.

Resource-Based Theory of the Firm

The literature related to Strategic Management provides managers and decision-makers with a set of tools aimed at identifying data, obtaining information, and building knowledge to guide the development of Strategic Planning. Only with reliable use of these pieces of information and knowledge can the objectives and goals of organizations be defined.

Among the methodologies available to businesses are Porter's Five Competitive Forces, the classic SWOT matrix, the Marketing Mix, Resource-Based View, and the Resource-Based Theory of the Firm, among others. What is common across these approaches is the opportunity for companies to map their capabilities and resources, analyze the internal and external environment realities, understand current and future market trends, and track national and international contexts to identify opportunities, anticipate threats, and generate competitive advantages. All of this aims to consolidate the company's business model in a highly competitive market, with intense global competition.

The objective of this paper is to assess the applicability of the concepts from the Resource-Based Theory of the Firm as an inducer and compatible factor in the analysis, negotiation, formation, and development of the strategic alliances established between Pecém-Ceará and Rotterdam-Netherlands for the production and commercialization of H2V in the context of the Ceará-European energy transition.

The starting point is based on Wernerfelt's studies (1984, as cited in Klotzle, 2002), which argue that the sources of a company's competitiveness stem from its resources (both material and immaterial assets). Unlike traditional theories that focus heavily on analyzing the competitive environment, the Resource-Based Theory of the Firm primarily focuses on the resources owned by the company, meaning that greater emphasis is placed on internal aspects, such as technology, administrative capacity, managerial capacity, product lines, know-how, etc.

When a partner possesses internally recognized relevant capabilities and resources, with competitive advantages and differentiating factors of interest to the other partner, and vice versa, there arises the possibility for these parties to combine efforts in pursuit of common objectives and goals, allowing for the exchange of experiences, expertise, and access to valuable business resources from another company (Klotzle, 2002).

From the above considerations, it is emphasized that there must be a relationship of complementarity and similarity between the resources provided by the different partners of the strategic alliance (Das & Teng, 2000, as cited in Klotzle, 2002). Otherwise, if there are asymmetries in these capabilities, there would be no justification for the interest in forming and developing strategic alliances.

A study conducted with 59 joint ventures between companies from Bangladesh and companies from both industrialized and developing countries concluded that the greater the balance between the resources provided by the different partners, the better the performance of the strategic alliances (Sim & Ali, 1998, as cited in Klotzle, 2002).

In light of the Resource-Based Theory of the Firm and in conjunction with the information presented in Tables 1 and 2 and in Figure 1, the following question arises: What were the factors, circumstances, resources, capabilities, and expertise that contributed to the formation and development of the strategic alliance between Pecém-Ceará and Rotterdam-Netherlands?

Scenarios and Initiatives in Ceará for the Production and Export of Green Hydrogen (H₂V) to Europe Strategic Alliances between Pecém-Ceará-Brazil and Rotterdam-Netherlands

The physiographic conditions of the state of Ceará and the location of the Port of Pecém have enabled the harnessing of numerous economic potentials. Positioned in the Northeastern Bulge (low latitude), within the Brazilian solar belt, the trade winds and high annual radiation directly influence the generation of renewable energy (wind and solar). Simultaneously, the land-sea articulation of Ceará's coastline along the Atlantic Ocean, coupled with its proximity to Europe, gives the Port of Pecém a high degree of maritime access and closeness to important international maritime routes, facilitating trade with the European continent (Barbosa & Gomes, 2024).

The government of the state of Ceará has implemented programs and investments in the Port of Pecém, aiming to enhance it as a strategy for economic development and ensure it has appropriate and diversified infrastructure and logistics (IPECE, 2022).

Currently, the Port Terminal serves as a link in the maritime transport logistics chain, integrating port and industrial activities, which characterizes it as an industrial port (ADECE, 2019) and marks a turning point in the economic development of the state. As a key link in global supply chains (hub for various commodities), it has been growing operationally due to continuous investments in port superstructures by its service providers (Nunes, 2024).

In October 2018, the Port Authority of Rotterdam and the state of Ceará signed an agreement regarding Rotterdam's participation in the development of the Port of Pecém, investing 75 million euros in the CIPP, securing 30% of the venture, and participating in strategic decisions with representation on the Executive Board, the Fiscal Council, and Management.

This interest arises from Rotterdam's recognition of Pecém as the primary logistics and industrial center in Northeast Brazil, which could provide opportunities for international trade flows and investments from Europe (Rotterdam, 2018).

In February 2021, the state of Ceará launched the Hydrogen Hub in partnership with the Federation of Industries of the State of Ceará and the Federal University of Ceará. Under a Memorandum of Understanding (MoU), it was planned to build a green hydrogen (H₂V) plant at the CIPP by the Australian company Energyx Energy, investing \$5.4 billion in the project (FIEC, 2021). This decision aligns with Oliveira's (2022) assertion that the potential for renewable energy generation and its proximity to strategic ports would stimulate the creation of hubs, contributing to the development of the market, technology for the national industry, international recognition, and providing a platform for access to other countries.

In May 2023, the Netherlands and the state of Ceará established the Green Hydrogen Corridor (Pecém and Rotterdam); at the same time, Pecém and Rotterdam implemented the Green Ports Partnership for the development of H₂V production. One of the expectations of these agreements is the establishment of firm demand contracts, considered a key factor for accelerating the development of the hydrogen hub (Chiappini, 2023). Furthermore, a maritime route was created for the commercialization of H₂V in the European market (Vasileva, 2023).

Another significant milestone occurred in November 2024. The ports of Pecém, Rotterdam, and Duisport (Germany) signed an MoU with the goal of expanding the Green Corridor (Ceará-Rotterdam) to Germany. The agreement aims to transport alternative fuels (e-methanol, green ammonia, and other derivatives), reinforcing commitments to decarbonization and energy security in Europe, Brazil's energy transition, the development of Brazilian green energy generation projects, and the promotion of socioeconomic development for Northeast Brazil (Ceará, 2024; Rotterdam, 2024).

Reaching Germany, Pecém's H₂V would increase its offer in the European market; Duisport, acting as a central logistics hub in the heart of Europe, would support Pecém by sharing its experience and expertise to expand the connection with inland Europe (Ceará, 2024; Rotterdam, 2024).

The Port Authority of Rotterdam clarified that one of the distribution channels for hydrogen in Europe would be through the Delta Rhine Corridor, via pipelines connecting Rotterdam to industrial complexes in the Netherlands, Germany, and Belgium. Notably, the completion of this corridor is expected by 2031/2032, at which point several companies are planning to import and distribute hydrogen (and its derivatives) to their respective

industrial complexes, thereby consolidating a value chain for European decarbonization (Rotterdam, 2024, apud Barbosa & Gomes, 2025b).

In January 2025, the state government, the authorities of the Port of Rotterdam, and the President of the CIPP established new partnerships with an expected investment of around \$24 billion in H2V production projects. These prospects would lead to the creation of 80,000 new jobs, boosting the socioeconomic development of the state (CIPP, 2025).

The current architecture of CIPP (port, export, industrial, and energy sectors), also present in the Suez Canal Economic Zone (Egypt), contributes to cost reduction by having shared infrastructures (IEA, 2022). Subsequently, the 2023-2025 Triannual Work Plan highlighted the competitive advantage of establishing hydrogen production plants in port (hub) complexes, which also include industrial plants (MME, 2023).

The senior management of CIPP is confident that the partnership with Rotterdam will enhance Pecém's capacity and efficiency to compete in the international market through the sharing of expertise, know-how, and the joint management of the industrial and port complex. Under these circumstances, the perspective is to increase Ceará's ability to attract more international investments in port infrastructure and the installation of new industries in the region (CIPP, 2025).

In conclusion, the export of H₂V to the European market would increase Ceará's trade balance, making it more surplus; with the influx of more foreign exchange, there would be more investments from the public sector and the productive sector.

On the Dutch side, the government of the Netherlands aims to reduce emissions by 55% by 2030 and reach net-zero emissions by 2050. In the Climate Fund for 2024, 28.1 billion euros were allocated for spending in the country until 2030; of this total, 7.5 billion euros would be allocated to developing the H2V industry, including 300 million euros for imports, which could favor projects in Pecém (Chiappini, 2023).

Hence, Rotterdam's competitiveness: considered the largest port in the continent, with the best European port infrastructure, the main entry point to Europe, access to a market of 440 million consumers, generating 565,000 jobs, handling 30,000 ships per year (maritime transport), and 100,000 ships per year via inland waterways (Uribe, 2024, p. 4).

Rotterdam would become a pioneer in the large-scale importation of H2V to supply Europe's energy needs. In 2022, during the World Hydrogen Summit, it was announced that 4.6 million tons would be distributed to Europe by 2030, with 4 million tons being imported and the remainder produced at the port itself (FKA, 2022). In other studies, the demand for H2V from Rotterdam to Germany could reach 20 million tons per year by 2050, with 18 million tons coming from imports (Figueirêdo, 2023).

It is important to note that Rotterdam is in contact with several European companies to explore potential H2 buyers, primarily located in the Chemelot industrial center (southeast Netherlands) and the adjacent North Rhine-Westphalia, with the presence of chemical industries, refineries, and steel mills (FKA, 2022).

Thus, from the considerations presented, it is possible to consolidate, within the political, diplomatic, geoeconomic, and energy spectrum, the characteristics of the Port of Pecém-Ceará and Rotterdam-Netherlands, focusing on strengthening the H2V value chain (Table 3).

Table 3: Characteristics of the Port of Pecém (Ceará) and Rotterdam (Netherlands)

Characteristics of the State of Ceará and/or the Port of Pecém	Strategic location in the Northeastern Peninsula; Proven potential for renewable energy generation; Maritime proximity to Europe; Excellent port, industrial, logistics, and export infrastructure; Significant investments in port infrastructure.
Potentials of the State of Ceará and/or the Port of Pecém	Support Ceará-based companies in exporting and investing in Europe; Increase in Ceará's trade balance (surplus); Socioeconomic development (job and income generation); Consolidation as a logistics and industrial hub in the Northeast; Competitiveness in production costs; Increased capacity and efficiency of Pecém; Better conditions to compete in the international market; Active participation in the just and inclusive energy transition; Strengthening of the naval and port sectors; Increased renewable energy generation; Diversification of the energy matrix in Ceará, the Northeast, and Brazil.
Characteristics of the Port of Rotterdam	Strategic location in the North Atlantic; Main entry point to Europe; Largest port in the European continent; Best port infrastructure in Europe; Connection to the European market via pipelines and waterways.

Potential of the Netherlands and/or the Port of Rotterdam	Support Dutch companies in exporting and investing in Brazil; Potential to contribute to the energy transition in Europe; Significant investments in hydrogen (H2V) producing countries; Main supplier of H2V to Europe; Opening the European market for Ceará's H2V; Global player in global energy security; Sharing of expertise and know-how; Joint management with Pecém.
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Source: Data from the researchers

In the context of international cooperation, strategic alliances between the State of Ceará and the Netherlands can be analyzed through the lens of Resource-Based Theory, which posits that these partnerships should aim for a "desired end state" of mutual benefits, in a "win-win" model. This concept emphasizes the importance of collaboration among participants, with the goal of optimizing resources and maximizing reciprocal advantages (BRIC GROUP, 2023).

The intersection of the information presented in Tables 1, 2, and 3 clearly demonstrates and supports the alignment between theoretical assumptions and the strategic partnerships established between the Port of Pecém (Ceará) and the Port of Rotterdam (Netherlands), particularly in the context of the global energy transition. The analyses show that both parties aim, through this alliance, to strengthen cooperation in key areas such as port logistics, renewable energy projects, with an emphasis on both onshore and offshore wind energy, and the production of green hydrogen (H₂V).

These partnerships not only align with the needs of adapting to the new global energy order but also fulfill the concepts of strategic alliances, which involve creating value through the integration of complementary resources and capabilities. A review of the literature on the topic reveals that the cooperation between the ports of Pecém and Rotterdam reflects a joint effort to develop sustainable and innovative solutions, focused on energy transition and the construction of a greener future for global industry.

IV. Conclusion

The race triggered by the international community to drive the energy transition and decarbonize the global economy is underway. The global commitment to mitigating the effects of global warming and climate change has been formalized in key international agreements, such as the 2030 Agenda and the Paris Agreement. However, only with the union of transnational efforts and the sharing of resources among the participants in this process will it be possible to strengthen the economic and technological capacities needed to face the challenges of the 21st century. In this context, international cooperation is essential.

This article aimed to analyze the strategic alliances between Pecém (Ceará) and Rotterdam (Netherlands) in the production of green hydrogen (H₂V) through the lens of Resource-Based Theory. From this analysis, the study seeks to provide guidance to high-level decision-makers, offering them greater clarity in formulating business strategies in the context of international cooperation.

The research achieved its objectives by providing a clearer understanding of international cooperation and strategic alliances in the current global context, marked by the effects of global warming and greenhouse gas emissions. The research findings highlight the high degree of political, economic, and energy integration between the Port of Pecém and the State of Ceará with the Port of Rotterdam and the Netherlands, particularly regarding the production and commercialization of H₂V. Ceará, as a producer and exporter, benefits from the geo-economic resources available at the Port of Pecém and the strategic energy interests of the Netherlands. In turn, the Netherlands gains by importing H₂V via the Port of Rotterdam to serve its domestic and European markets, such as Germany, at more competitive prices compared to other producing countries.

The qualitative approach, based on literature review and document analysis, was crucial for understanding the applicability of Resource-Based Theory as a driver for the formation and development of strategic alliances. This allowed for a detailed analysis of the partnerships established between Pecém-Ceará and Rotterdam-Netherlands in the energy transition process.

Furthermore, the research revealed the mutual benefits for both regions, which include securing investments, accessing new technologies, expanding markets, and promoting socioeconomic development, among other advantages. In this sense, the article demonstrates that Pecém-Ceará and Rotterdam-Netherlands are joining forces strategically and collaboratively ("win-win") in the 21st century, contributing to the global energy transition.

For future research, it is recommended to monitor the effectiveness of the economic-energy partnership between Pecém-Ceará and Rotterdam-Netherlands. This would include analyzing the results of investments made, new resources and capabilities that Ceará can share with the Netherlands, the prospects for H₂V demand, and distribution channels to be used in European consumer markets. Additionally, it would be important to monitor the impacts of these agreements on the socioeconomic development of the State of Ceará.

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