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Green Horizons: China's Investments in Renewable Energies in Latin America and its Geoeconomic Implications

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Masters in International Studies

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ISCTE-IUL

October 2024

SOCIOLOGIA
E POLÍTICAS PÚBLICAS

History Department

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Aos que sempre acreditaram em mim, com todo o meu amor.

Agradecimentos

Gostaria de expressar minha profunda gratidão a todos os que, de uma forma ou de outra, contribuíram para que este trabalho se tornasse realidade.

Primeiramente, agradeço imensamente à minha família, que sempre foi o meu pilar em todas as etapas da minha vida. Aos meus pais, Susana e Carlos, pelo seu amor incondicional, paciência e pela confiança que depositaram em mim, mesmo nos momentos em que parecia impossível. Vocês sempre acreditaram no meu potencial, mesmo quando eu mesma duvidei, e o vosso apoio inabalável deu-me a força necessária para seguir em frente.

Aos meus amigos, que compartilharam comigo cada vitória e também cada momento de dificuldade, sou profundamente grata. A vossa amizade e apoio foram essenciais para me manter motivada e equilibrada ao longo deste processo. Em especial, agradeço por me ouvirem, por me animarem e até mesmo pelas distrações que, muitas vezes, foram necessárias para recarregar as energias e voltar ao trabalho com ânimo renovado.

Ao meu namorado, o meu agradecimento especial. Obrigada por estares ao meu lado em todos os momentos, pela paciência, carinho e por sempre me lembrares de que cada esforço vale a pena. És uma fonte constante de amor e inspiração, e sou imensamente grata por te ter ao meu lado nesta jornada.

Agradeço também à minha orientadora, Dra. Cátia Miriam da Costa, pela sua orientação, paciência e rigor, oferecendo conselhos e feedbacks valiosos que foram cruciais para o desenvolvimento desta pesquisa.

Um agradecimento especial à minha gata por ter apagado tantas versões da minha tese ao deitar-se em cima do meu computador. Sem ela não era possível ter refinado tantas vezes o mesmo tópico, nem apreciar tanto o modo de guardar automaticamente.

Por fim, a todos aqueles que, de maneira direta ou indireta, contribuíram para a realização desta tese, sublinho a minha gratidão sincera.

Resumo

Esta tese explora o impacto geoeconómico dos investimentos chineses em energias renováveis na América Latina, centrando-se especificamente no Chile e na Argentina. O estudo examina a forma como a Belt and Road Initiative (BRI) da China se expandiu para os sectores das energias renováveis, particularmente no contexto do hidrogénio verde, remodelando o panorama energético nestes países. Através da lente da geoeconomia, esta investigação analisa as motivações estratégicas por detrás dos crescentes investimentos e parcerias da China, destacando a forma como influenciam a dinâmica do mercado, os fluxos comerciais e as trajetórias económicas a longo prazo tanto da América Latina como da China.

Com base em estudos de caso de projetos-chave de energias renováveis, incluindo desenvolvimentos solares e eólicos, a tese avalia o significado económico destas iniciativas para as economias latino-americanas e o seu papel nas transições energéticas globais. Ao situar estes investimentos dentro das tendências mais amplas dos mercados internacionais de energia, a investigação lança luz sobre as dependências económicas que estão a ser forjadas e as potenciais mudanças futuras nas relações de poder regionais e globais, à medida que as energias renováveis se tornam um ponto focal de competição e cooperação económica.

Palavras-chave: Relações Internacionais; China; América Latina; Energias Renováveis; Geoeconomia.

Abstract

This thesis explores the geoeconomic impact of Chinese investments in renewable energy within Latin America, focusing specifically on Chile and Argentina. The study examines how China's Belt and Road Initiative (BRI) has expanded into renewable energy sectors, particularly in the context of green hydrogen, reshaping the energy landscape in these countries. Through the lens of geoeconomics, this research analyses the strategic motivations behind China's increasing investments and partnerships, highlighting how they influence market dynamics, trade flows, and the long-term economic trajectories of both Latin America and China.

Drawing on case studies of key renewable energy projects, including solar and wind developments, the thesis evaluates the economic significance of these initiatives for Latin American economies and their role in global energy transitions. By situating these investments within the broader trends of international energy markets, the research sheds light on the economic dependencies being forged and the potential future shifts in regional and global power relations as renewable energy becomes a focal point of economic competition and cooperation.

Keywords: International Relations; China; Latin America; Renewable Energies; Geoeconomics.

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CHAPTER 1

Introduction

If there was a theme to define the objectives of the last century, energy transition would be a strong contestant for the picking, especially as nations grapple with the urgent need to address climate change and achieve long-term environmental stability. The pivotal shift towards sustainable energy solutions is the global quest that has catalysed significant changes in the geopolitical and economic landscapes, giving rise to an era defined by the intertwining of geoeconomics and energy. At the forefront of this revolutionary transformation is China, an actor with increasing leverage in economic might and academically recognized as a rising global power, who might shape the very trajectory of renewable energy investments, particularly in Latin America.

The discussion of the intersection of geoeconomics and energy is hardly a new one, as economists and other academics have long predicted the energy crisis, we see ourselves facing now – energy transition is, more than ever, a vital aspect of every global community. This intersection is both complex and dynamic, with far-reaching implications for countries and their neighbouring territories. The nature of these investments extends beyond mere economic transactions, often entailing strategic considerations and geoeconomic implications that resonate far beyond national borders.

Climate change has cemented a clock on every nation, marking the time they must deescalate their contribution to worldwide pollution – such as the burning of fossil fuels-, and to create effective, sustainable policies before irreversible damage. New means of clean energy are debated as the most efficient in limiting carbon emissions and obtaining net zero. Still, one of the surprising discoveries of the century has been green hydrogen – the cleanest source of green energy so far, with a zero-carbon emission rate and depending solely on renewable energies and resources. It is within this context that this thesis seeks to delve into the evolving landscape of the investments being made in renewable energy, by the biggest investor in the world, in a region thriving in resources – the burgeoning partnership between China and Latin America.

This thesis aims to provide a comprehensive and critical understanding of the intricate dynamics at play, which makes for diverse, multifaceted, and numerous objectives. The main objective must be stated as the understanding of the involvement of China in renewable energy projects in the LAC (Latin America and the Caribbean) region, particularly in the development of green hydrogen in Argentina and Chile, two of the most promising countries in the LAC for green energy supply, and the geoeconomic implications of these investments. In a more specific manner, the examination of the historical development of Chinese investments in renewable energy is critical to contextualise and justify the current economic trends, as well as the analysis of the state and potential of green hydrogen projects in Chile and Argentina. This thesis also intends to evaluate the role of China in renewable energy projects

and its competition/collaboration with the United States of America. Finally, the study seeks to explore the geoeconomic implications of China's involvement in renewable energy in this particular region and, lastly, to investigate the influence of the Belt and Road Initiative (BRI) on the dynamics of renewable energy and diplomacy in Latin America.

By unravelling the intricate web of geoeconomics, renewable energy, and global partnerships, this research aims to contribute to a deeper understanding of the energy transition and its implications for the future of sustainable development. It's of paramount importance due to its timely and multifaceted exploration of the intersection between renewable energy, geoeconomics, and international relations. As previously stated, the global challenge of climate change has never been more pressing and energy transition is a top priority in sustainable solutions. By focusing on these investments, this research addresses this pressing need while also uncovering the intricate dynamics of competition and collaboration in different geographic areas.

The structure of this thesis is thoughtfully designed to traverse the intricate landscape of the three key concepts: renewable energy investments, geoeconomics, and international relations. Beginning with a literature review, the groundwork is laid by examining the historical trajectory of renewable energy investments, the emergence of geoeconomics in global affairs, and the evolving role of China in the context of renewable energy transitions. This foundational chapter sets the stage for deeper explorations and discussions in subsequent chapters.

The subsequent chapters delve into the core of the research, analysing the evolution of Chinese investments in renewable energy within the LAC region. These chapters offer more than a historical narrative; they are critical investigations into the underlying forces, major players, and broader implications of these investments. Moreover, they delve into the state and potential of green hydrogen projects in Chile and Argentina, countries poised to influence the renewable energy landscape significantly. Moving beyond, the chapters explore the geoeconomic dimensions of China's involvement in renewable energy. This includes an in-depth look into the Belt and Road Initiative's impact on renewable energy dynamics and diplomacy within the LAC region. A comparative analysis between Chile and Argentina further enriches the discourse by providing insights into their respective energy contexts, governmental policies, and shared challenges, thus contributing significantly to the understanding of renewable energy transitions.

After carefully considering the aspects mentioned, we must question China's involvement in renewable energy projects in Chile and Argentina, with a focus on green hydrogen, and how it affects global energy diplomacy. The answer to this central question will, hopefully, emerge with clarity. The analysis of China's role in these renewable energy ventures, particularly in the context of green hydrogen production, will shed light on the intricacies of global energy dynamics and the implications for international relations.

CHAPTER 2

Literature Review

This chapter explores the conceptual foundations that underpin this study's examination of Chinese investments in renewable energy. By analyzing the evolution of renewable energies alongside the emerging field of geoeconomics, the discussion provides a robust framework for understanding the strategic motivations behind China's engagement in Latin America.

2.1. Geoeconomics- Theoretical Framework

In recent decades, the discourse surrounding international relations has expanded to encompass not only traditional geopolitical considerations but also the increasingly influential realm of geoeconomics. Geoeconomics has gained prominence as states navigate a complex global landscape, where economic tools are increasingly employed to achieve national objectives.

While there isn't a universally accepted definition of this concept, for the purpose of this thesis, the definition by Blackwill and Harris (2016) is particularly suitable. They define geoeconomics as "the use of economic instruments to promote and defend national interests, and to produce beneficial geopolitical results; and the effects of other nations' economic actions on a country's geopolitical goals" (Blackwill & Harris, 2016, p. 20). Central to this discourse is the interplay between economic interests, strategic investments, and the pursuit of national objectives in an interconnected world.

Costa (2024) emphasizes that China has developed a distinct geoeconomic strategy, one that integrates economic growth with geopolitical projection. The author notes that "over the last few decades, [China] has developed a geoeconomic strategy that allowed it to grow and develop internally, while also projecting its economy externally" (Costa, 2024, p. 31, translated by the author). This reflects how China has systematically used economic influence, particularly through mechanisms such as infrastructure investment, to extend its reach into key regions across the globe.

Blackwill and Harris (2016) meticulously dissect the intricate relationship between geopolitics and geoeconomics, advocating for their distinct treatment despite their interconnectedness. Unlike geopolitics, which traditionally emphasizes military power in pursuit of geopolitical aims, geoeconomics presents a paradigm where economic tools are wielded to achieve strategic objectives. The authors posit that geoeconomics entails a reversal of the means-ends relationship, where military or geopolitical muscle is deployed to bring about favourable economic outcomes. They assert, "Geoeconomics, in our view, is about providing a parallel account of how a state builds and exercises power by reference to economic factors rather than geographic ones" (Blackwill & Harris, 2016, p. 24). This conceptual shift challenges conventional notions and underscores the importance of delineating between the two domains.

This distinction becomes particularly relevant in the case of rising powers like China, whose military capabilities, while growing, have not reached a level comparable to those of the United States. Instead, China leverages its economic influence—through investment, infrastructure development, and trade—as a primary tool for expanding its global reach. The BRI, for example, exemplifies how geoeconomic strategies are implemented with the dual aim of economic gain and political influence (Costa, 2024). China's deliberate efforts to avoid direct military confrontation, while simultaneously securing long-term economic dependencies, highlight the strategic depth of its geoeconomic approach (Blackwill & Harris, 2016). This is not just a reflection of economic ambition but a calculated manoeuvre to shift the balance of global power.

Costa (2024) also highlights how China's economic rise has allowed it to create alternative global frameworks, bypassing traditional Western-dominated institutions. For instance, through the establishment of regional forums and the Shanghai Cooperation Organization, China has "leveraged its political projection" by expanding its influence over countries vital to its resource needs (Costa, 2024, p. 31). This demonstrates how China uses its geoeconomic strategy to secure access to key resources while expanding its political influence without engaging in direct military confrontations.

Moreover, Blackwill and Harris (2016) elucidate the historical context of economic liberalism and mercantilism to clarify their relevance to contemporary geoeconomic discourse. They argue that both economic ideologies are deeply intertwined with the pursuit of state interests through economic means, albeit with differing tactical approaches (Blackwill & Harris, 2016, p. 29). By examining the writings of prominent economists such as Adam Smith and Norman Angell, the authors illustrate how economic liberalism views laissez-faire as a form of geoeconomics, albeit with a distinct emphasis on economic rationality (Blackwill & Harris, 2016, p. 30). This historical perspective enriches the understanding of how contemporary states utilize economic strategies to achieve their geopolitical goals.

Costa (2024) asserts that China's approach exemplifies a modern geoeconomic strategy, where its focus on global economic expansion is intertwined with the need to secure essential resources. This is evident in China's focus on regions rich in raw materials and energy supplies, where it has progressively built its influence. As Costa observes, "the People's Republic of China has selectively directed its attention to... suppliers of raw materials as well as energy suppliers" (Costa, 2024, p. 33). This targeted approach not only ensures China's economic growth but also creates political leverage over nations that rely on Chinese investments and infrastructure projects. Such dependencies can serve as strategic tools in future geopolitical negotiations, effectively blurring the line between economic partnership and political alignment (Blackwill & Harris, 2016).

Blackwill and Harris' examination of the resurgence of geoeconomics holds particular relevance to this thesis topic, as their insights into the increasing prominence of economic factors in international relations shed light on the motivations behind China's investments in renewable energy projects across Latin America. For instance, through strategic investments in solar and wind energy, China not only addresses environmental concerns but also seeks to bolster its geopolitical influence in the region. This

is evident in projects like the Cauchari Solar Plant in Argentina and various wind farms in Chile, where Chinese companies play a crucial role in developing renewable energy infrastructure (Reuters, 2019).

2.2 Renewable Energies and Geoeconomics

While the interconnectedness of geoeconomics and renewable energies may not seem obvious at first glance, the book by Jocephim Klement (2021), "Geo-Economics: The Interplay between Geopolitics, Economics, and Investments," offers an interesting analysis of what he calls the "evolutionary" trajectory of energy. Klement's exposition is compelling as it compares the era of coal and steam-powered engines to crude oil and petroleum as the main sources of energy. He describes what he calls "the last major energy revolution" (Klement, 2021, p. 206), which not only impacted the energy sector but also reshaped geopolitical dynamics. Once-contested regions like the Ruhr area and the France-Germany border, known for their coal mining industry, gradually lost their significance as the focus shifted to oil-producing regions in the Middle East, turning them into geopolitical hotspots. Klement argues, "Today, we face a similar transition, this time from oil as an energy source to nuclear power and renewable energy sources, such as wind and solar power" (Klement, 2021, p. 207).

Renewable energies have become primary competitors to petroleum, as "lower prices drive growth" (Klement, 2021, p. 208). However, Klement argues that contrary to projections from organizations like the IEA, BP, and IRENA, the growth of renewable energy is subject to significant uncertainty, depending on GDP growth, political will, and technological progress. According to Klement's research, annual growth rates for renewable energy range from 3.7% to 8.4%, indicating that renewables are gradually catching up with fossil fuels as the primary source of power generation. This transition is characterized as a more evolutionary process rather than a spontaneous one. Notably, Klement points out that historical predictions for growth have often been revised upward, as actual developments have exceeded initial expectations. He emphasizes that the transition to renewable energy is driven more by economic factors than politics or ideology, as renewables are becoming cost-competitive, with wind and solar being the cheapest energy sources in many countries.

Amidst the backdrop of Blackwill and Harris's analysis on the resurgence of geoeconomics and Klement's valuable insights into the connection between these main concepts, Amin Mohseni-Cheraghlou, a macroeconomist with the GeoEconomics Center and leader of the Atlantic Council's Bretton Woods 2.0 Project, provides a contemporary narrative on how this phenomenon, particularly in the form of geoeconomic fragmentation, is impacting the global energy transition towards renewables. He contends that this fragmentation, as evidenced by events like the Global Financial Crisis of 2008, the COVID-19 pandemic, Brexit, and ongoing geopolitical tensions, poses a significant threat to global climate efforts. Mohseni-Cheraghlou (2023) argues that effective climate solutions are unlikely without coordinated international cooperation, and further fragmentation could stall net-zero targets worldwide, disproportionately affecting lower-income countries.

One of the primary channels through which geoeconomic fragmentation impacts climate change is via trade barriers. Mohseni-Cheraghlou (2023) highlights the energy transition's dependency on trade, particularly with China, which plays a crucial role in the production of renewable energy and emissions-reduction technologies. Notably, China's dominance in solar panel and wind turbine manufacturing, high-storage batteries, electric vehicles, and rare earth minerals underscores its central position in the global energy transition. Any trade disruptions with China, such as tariffs or export controls, could hamper the availability of these critical components, potentially derailing climate targets.

In light of this, Mohseni-Cheraghlou (2023) emphasizes the urgent need for the world's largest economies to recognize the negative climate impacts of geoeconomic fragmentation. He points out that with current emission rates, the world is on track to exceed the 1.5 degrees Celsius target within the next six years, underscoring the pressing need for immediate action. Furthermore, he suggests that COP28 is a vital platform for world leaders to devise pathways and agreements to reverse or at least mitigate the negative impacts of geoeconomic fragmentation on climate change.

As renewable energies emerge as key components of national security and economic strategy, understanding the role of major global powers, such as China, in this domain becomes increasingly essential. The following section delves into China’s strategic investments in renewable energy and their implications for Latin America.

2.3 Latin America as an Emerging Market

Latin America has increasingly gained attention as a vital region for renewable energy investments, driven by its rich endowment of natural resources and the growing need to transition to sustainable energy. The combination of geopolitical interests, progressive policies, and innovative financing mechanisms has positioned the region as a promising emerging market for energy investment. According to OCDE et al. (2023), renewable energy is one of the fastest-growing sectors in Latin America, with projected investments surpassing USD 50 billion by 2030, driven by demand for sustainable energy solutions in light of global climate goals.

The growing interest in Latin America's renewable energy market is closely linked to its geopolitical relationship with China. China's engagement in the region, traditionally focused on fossil fuels, has begun to extend to renewable energy sectors, marking a significant shift in its strategy. Between 2015 and 2023, China directed more than USD 200 billion towards investments in Latin America, with nearly 40% of these funds allocated to renewable energy projects (Costa, 2024). This transition is part of China's broader objective to diversify its energy investments and solidify economic ties with Latin America (Vásquez, 2018). For countries in the region, China represents a critical source of capital and a strategic partner for advancing renewable energy goals.

The creation of the China-CELAC Forum in 2015 institutionalized this relationship, establishing a platform that promotes dialogue and long-term cooperation in infrastructure, energy, and

technology (Costa, 2024). Through this forum, China has channeled significant investments into the region's renewable energy, fostering a partnership that holds mutual benefits: for Latin America, the inflow of Chinese capital brings essential technological expertise and financial resources necessary for infrastructure development; for China, the region offers abundant resources and an opportunity to expand its influence and markets (Vásquez, 2018; Costa, 2024). China's strategic investments also reflect its interest in securing access to critical materials like lithium, which is essential for its electric vehicle and energy storage industries (SELA, 2024).

Latin America's rise as an emerging market is driven by a combination of economic, demographic, and resource-based factors that have drawn significant attention from global powers. The region's economic potential is substantial, supported by a young and growing population, an expanding middle class, and a wealth of natural resources that are critical for global industries. Latin America's GDP growth, while variable across countries, has shown resilience, especially in sectors like agriculture, mining, and renewable energy. Countries like Chile, Argentina, and Brazil have all reported significant GDP growth tied to investments in renewable energy, with Brazil's wind energy market alone expected to grow by 20% annually until 2030 (OCDE et al., 2023).

As noted by OCDE et al. (2023), Latin America's economic potential is rooted in its natural resource wealth, which includes some of the world's largest reserves of lithium, copper, and rare earth elements—resources that are essential for the global energy transition (SELA, 2024). For instance, Bolivia, Chile, and Argentina, known as the 'Lithium Triangle,' collectively hold more than 60% of the world's lithium reserves, crucial for the development of batteries and electric vehicles. In 2022 alone, Chinese firms invested over USD 1.5 billion in lithium extraction projects in Argentina, solidifying the region's role in the global energy transition (CEPAL, 2024).

China has recognized this potential and positioned itself as a key player in the region through strategic economic ties facilitated by the China-CELAC Forum. Since its establishment, the forum has been pivotal in strengthening China's economic foothold across the continent. It provides a structured platform for high-level dialogues, cooperation agreements, and long-term investment strategies. China's relationship with Latin America, as formalized through CELAC, transcends traditional trade, focusing instead on infrastructure development, energy investment, and the exchange of technology and expertise. The Belt and Road Initiative, which formally extended to Latin America through this forum, is a critical tool in China's broader geoeconomic strategy. Under the BRI, China has committed to large-scale infrastructure projects, including renewable energy plants, positioning Latin America as a key player in its global supply chains for clean energy technologies (Duarte et al., 2023).

Latin America's strategic importance to China is largely centered around its vast natural resources, which are essential for China's industrial and technological sectors. China's investment in Latin American oil, minerals, and agriculture has been substantial, but the focus has recently shifted towards renewable energy and critical minerals such as lithium. Bolivia, Argentina, and Chile, known as the 'Lithium Triangle,' hold more than 60% of the world's lithium reserves, a resource vital for

electric vehicles and energy storage systems. In response, Chinese companies have aggressively pursued investment opportunities in these countries, securing mining rights and establishing joint ventures aimed at extracting and refining lithium (CEPAL, 2024). For instance, in 2022, Chinese firms committed over USD 1.5 billion in new lithium extraction projects in Argentina alone, a strategic move to secure access to this critical resource (SELA, 2024).

However, China's growing influence has sparked competition, particularly with the European Union, which also views Latin America as a critical partner in the global energy transition. The EU's Global Gateway initiative aims to counter China's growing dominance by promoting sustainable investment and infrastructure projects in the region. According to Szczepański (2023), the Global Gateway is designed to foster closer economic ties between Europe and Latin America, with a particular focus on digital infrastructure and renewable energy (SELA,2024). In contrast to China's extensive financial commitments, the European Union has pledged EUR 3 billion, illustrating a more cautious approach compared to China's larger and more flexible investments (Szczepański, 2023).

From a geopolitical perspective, the competition for resources in Latin America is not merely an economic contest but a strategic one. China's Belt and Road Initiative, as implemented through the China-CELAC Forum, enables China to secure long-term access to natural resources while deepening its geopolitical influence across the continent. In contrast, the EU's strategy under the Global Gateway seeks to build alliances based on shared values, particularly in the areas of sustainable development and democratic governance (García & Arana, 2022). This strategic rivalry has elevated Latin America's importance on the global stage, transforming it into a key battleground for influence between the world's largest economic powers.

2.4 Chinese Investments in Renewable Energy

China's renewable energy strategy and its international implications, particularly in Latin America, have been the focus of significant academic attention in recent years. Amy Myers Jaffe's article "Green Giant: Renewable Energy and Chinese Power" (2018) provides a comprehensive overview of China's ambitious renewable energy strategy aimed at reducing its dependence on foreign oil, improving national security, and positioning itself as a global leader in green technology. According to Jaffe, China's strategy includes substantial investments in renewable energy and electric vehicles, supported by significant government subsidies. China's renewable energy sector, already a global leader, is set to invest over $6 trillion by 2040 (Jaffe, 2018).

China's new energy strategy has both economic and strategic goals. Economically, China seeks to avoid dependence on foreign oil and gas and instead focus on becoming an energy exporter rivalling the United States. Strategically, by leading in green energy, China aims to enhance its influence in regional alliances and trading relationships (Jaffe, 2018).

The transition is driven by several factors: high import dependence, with China currently importing about 70% of its oil, a figure expected to rise to 80% by 2030, making China vulnerable to global oil market fluctuations and geopolitical risks (Jaffe, 2018). Domestic production challenges include declining oil production due to mismanagement, depleted fields, and low prices (Jaffe, 2018). Strategic competition is also a factor, as the Trump administration's focus on fossil fuels and withdrawal from international climate agreements has opened opportunities for China to become the global leader in renewable energy (Jaffe, 2018).China's investments in green energy technologies include solar power, with China boasting 125 gigawatts of installed solar power, more than twice the capacity of the United States, and manufacturing 51 gigawatts of photovoltaic solar panels annually (Jaffe, 2018). Electric vehicles are heavily subsidized by the government, with over a million electric vehicles on Chinese roads and an aim to have five million by 2020. Companies like BYD are leading global production (Jaffe, 2018). Green finance is another area of focus, with China creating the world's largest carbon market and promoting green bonds to fund climate-friendly projects (Jaffe, 2018).

Jaffe (2018) also highlights that China's renewable energy push enhances its national security by reducing reliance on oil imports, which are vulnerable to geopolitical tensions and maritime disruptions. The development of flexible energy microgrids and multifuel transportation systems will help China withstand cyberattacks and natural disasters (Jaffe, 2018).

In addition to its domestic efforts, China is extending its influence through renewable energy cooperation with other countries, particularly in Latin America. Xie et al. 2018) examine this cooperation in their study "Renewable energy and power cooperation between China and six Latin American nations." This study provides insights into China's collaborative efforts with Brazil, Argentina, Chile, Mexico, Uruguay, and Costa Rica.

The authors highlight several key points: investment in infrastructure, with China investing heavily in renewable energy infrastructure in these countries, particularly in solar and wind power projects (Xie et al., 2018). Technology transfer and training, with China exporting its technology and providing training and capacity-building programs to support local industries (Xie et al., 2018). Financial support is also a key element, with China providing low-interest loans and financial support to enable these countries to develop their renewable energy sectors more rapidly (Xie et al., 2018).

Xie et al. (2018) emphasize that this cooperation is mutually beneficial. For Latin American countries, it means access to advanced technology and financial resources, while for China, it helps secure new markets for its renewable energy products and strengthens diplomatic ties in the region (Xie et al., 2018).

Rubio and Jáuregui (2022) explore the implications of Chinese overseas finance for renewable energy development in Argentina and Brazil, focusing on how these investments promote the countries' energy transition strategies and sustainable development goals. They note that China has accelerated its energy transition in the last decade as part of a strategy to rebalance its economy and enhance its influence in the global renewable energy market. The authors provide a theoretical framework based on

Ostrom’s postulates of energy transition, emphasizing the co-evolution of domestic and international factors in shaping energy policies and investments.

The article highlights China's significant role as a global economic player, noting its status as the largest official creditor and a major investor in renewable energy. Between 2005 and 2021, China's construction projects in Latin America amounted to nearly USD 66 billion (Rubio & Jáuregui, 2022). The authors argue that while China has become the largest global consumer of energy, with a consumption of 145.46 exajoules in 2020, it has also set ambitious targets to reduce its dependence on fossil fuels and increase the share of non-fossil fuels in its energy mix to around 20% by 2030 (Rubio & Jáuregui, 2022). Furthermore, during the 2020 UN General Assembly, President Xi Jinping announced China's commitment to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060.

Rubio and Jáuregui provide a detailed overview of the historical trajectory of Chinese investment in Latin America, particularly in the renewable energy sectors of Argentina and Brazil. Despite having profound economic ties with China, they emphasise that these countries have received significant investments in renewable energy without being part of the Belt and Road Initiative (BRI) until recently, with Argentina officially joining in February 2022 (Rubio & Jáuregui, 2022). The authors identify several challenges that Argentina and Brazil face in attracting and sustaining Chinese investments, including regulatory barriers, technological gaps, and the need for enhanced policy frameworks. They note that only a small fraction of the financing provided by Chinese policy banks has been allocated to renewable energy projects, with solar and wind accounting for just 1.5% of the total energy financing since 2000 (Rubio & Jáuregui, 2022).

The authors conclude that to maximize the benefits of Chinese overseas finance for renewable energy development, Argentina and Brazil must strengthen their regulatory frameworks and align their policies with foreign investments. They emphasize the importance of strategic cooperation between China and Latin America in achieving energy transition goals, particularly in the context of the ongoing challenges posed by the COVID-19 pandemic. The study underscores the need for tailored strategies that consider regional environmental variations and the significance of fostering local capacities to ensure the sustainability and effectiveness of energy projects (Rubio & Jáuregui, 2022). Overall, the authors highlight the potential for Chinese overseas finance to significantly impact the energy transition in Argentina and Brazil, provided that both countries effectively navigate the complexities of international investment and domestic policy alignment.

Castro's article "The Implications of Chinese Investment on Latin America's Energy Transition" (2024) delves deeply into the role and impact of Chinese investments in transforming the energy sector of Latin American countries. The study outlines that over the past decade, China has become a pivotal player in the region's shift from fossil fuels to renewable energy sources, driven by both global environmental commitments and national ecological goals. This transformation has broad economic, social, environmental, and political ramifications.

Chinese investments have been instrumental in launching large-scale renewable energy projects in Latin America, significantly aiding the region's transition to a low-carbon economy. The financial, technological, and expertise contributions from Chinese entities have been crucial for the realization of projects that might not have been possible otherwise. These investments are presented as part of a broader strategy of mutual exchange and solidarity, recognizing the shared developmental challenges between China and Latin American countries (Castro, 2024).

Central to Castro's analysis is the concept of a "just transition," which emphasizes the importance of achieving not only environmental sustainability but also economic viability and social equity. The study argues that the energy transition must consider economic sustainability, social justice, community welfare, and environmental balance. It notes the potential ecological benefits of Chinese investments, such as the rehabilitation of degraded environments through the development of renewable energy projects like wind farms and hydropower plants. However, it also stresses the importance of addressing potential ecological trade-offs to safeguard the region's sensitive ecosystems (Castro, 2024).

The political dimensions of Chinese investment are also explored, revealing motivations related to geopolitical influence and resource security. The study examines how global political dynamics, including rising nationalism and the effects of the COVID-19 pandemic, complicate the investment landscape and influence the strategic decisions of both Chinese investors and Latin American governments (Castro, 2024).

Specific examples from countries such as Argentina, Brazil, and Chile illustrate the significant impact of Chinese investment. For instance, the Cauchari solar plant in Argentina is highlighted as a case study of successful cooperation. Developed with Chinese partnership and supported by Argentina's RenovAr Program, this project is one of South America's largest photovoltaic solar power facilities. It exemplifies how Chinese investment can drive the development of large-scale renewable energy projects that align with national energy goals while also achieving economic, social, and environmental benefits (Castro, 2024).

Both sources indicate that China's renewable energy strategy has significant global implications. According to Jaffe (2018), China's investments are likely to reduce the costs of renewable technologies worldwide, aiding global efforts to combat climate change. Moreover, by offering cheap loans and green technology to other countries, China is increasing its geopolitical influence, competing directly with the United States and Russia (Jaffe, 2018).

Similarly, Xie et al. (2018) suggest that China's cooperation with Latin American countries is reshaping international relations and economic dynamics in the renewable energy sector. The shift towards renewable energy could challenge countries heavily dependent on oil exports, as global demand shifts towards more sustainable sources (Xie et al., 2018). In conclusion, Castro's article underscores the crucial role of Chinese investment in advancing Latin America's energy transition. It advocates for a balanced approach that ensures environmental sustainability, economic growth, and social equity. The study calls for an alignment with the principles of a just transition and degrowth, aiming to address the

broader global environmental crisis while fostering sustainable development in the region (Castro, 2024).

Chinese investments in renewable energy represent a transformative force in the global energy landscape, with profound implications for both China and the countries receiving these investments. The remarkable growth of the clean energy sector in China, driven by significant investments and government initiatives, underscores the importance of renewable energy in achieving economic and environmental goals. As China continues to expand its influence through renewable energy investments in Latin America, particularly in Argentina and Chile, the interplay between economic interests and geopolitical strategies will shape the future of energy in the region and beyond. The successful integration of these investments into local energy systems will be critical for realizing the full potential of renewable energy in addressing climate change and fostering sustainable development.

China's investments in renewable energy are not confined to its borders but are increasingly directed toward emerging markets rich in renewable resources. Latin America, with its abundant solar, wind, and hydroelectric potential, represents a key target for China's global energy strategy.

2.5 The Role of the *Belt and Road Initiative* (BRI)

The Belt and Road Initiative (BRI) has become a pivotal element of China's global strategy, emphasizing infrastructure development and economic integration across continents. Latin America, particularly Chile and Argentina, has increasingly become a focus of this initiative due to its strategic importance and resource wealth. The BRI's engagement in the region reflects a broader effort by China to expand its influence and investment footprint, particularly in the renewable energy sector.

The BRI has evolved into one of China's most significant international economic projects, launched in 2013 to develop global infrastructure and promote trade across over 60 countries. This initiative is central to China's ambition to reshape global economic dynamics, aiming to integrate developing regions through improved infrastructure. Officially, the BRI focuses on five key areas: policy coordination, infrastructure connectivity, unimpeded trade, financial integration, and fostering people-to-people bonds. These areas reflect China's intent to transition from a Western-led model of globalization toward one that is more inclusive and multipolar, integrating regions with traditionally limited infrastructure (Duarte et al., 2020).

From an economic standpoint, Chinese investments under the BRI framework are substantial, amounting to over USD 755 billion by 2020, with a large portion allocated to energy and infrastructure projects. Of this amount, USD 297 billion was invested in the energy sector alone, illustrating the initiative's focus on strengthening China's role in global energy markets (José & Duarte, 2023). For countries like Chile and Argentina, this influx of capital presents an opportunity to enhance their energy infrastructure, particularly in renewable energy projects, aligning with China's global energy ambitions.

However, these heavy investments point to the economic leverage China gains through these initiatives. This significant capital inflow, particularly in energy and infrastructure, offers participating countries access to development funds that would be difficult to secure from Western institutions. Yet, this financial involvement also leads to concerns about debt sustainability and long-term dependency on Chinese capital, as countries increasingly rely on loans and investment packages tied to BRI projects. In Latin America, this dynamic is already visible in nations like Chile and Argentina, which have actively sought Chinese capital for the development of renewable energy and transport infrastructure (José & Duarte, 2023).

The economic consequences of these investments can be profound. As China strategically positions itself as a financier for key projects, countries like Chile and Argentina may experience shifts in their economic policies to align with Chinese interests. For example, investments in renewable energy, particularly in green hydrogen initiatives in Argentina, are increasingly aligned with China's goals of securing access to critical minerals and energy resources (Duarte et al., 2020). This alignment reflects a broader strategy wherein China uses economic investment to gain access to natural resources that are essential for its energy security and global competitiveness. While such investments bolster economic growth in the short term, they may also restructure local economies to prioritize Chinese needs over domestic economic diversification.

Additionally, the financial mechanisms underpinning the BRI raise important questions about long-term economic stability. Unlike investments from Western financial institutions, which often come with stringent conditionalities related to governance and fiscal responsibility, Chinese investments under the BRI typically offer more flexible terms. However, this flexibility can come at the cost of accumulating debt, as many nations accept large loans without the strict oversight typically associated with international lending bodies. For countries like Argentina, whose fiscal policy has historically been volatile, the risk of debt dependency becomes particularly acute as their engagement with the BRI deepens (José & Duarte, 2023). As these countries rely increasingly on Chinese capital, the economic power dynamic may shift, leading to concerns about China's ability to influence domestic policy and economic decision-making.

Geopolitically, the BRI extends beyond economic development, functioning as a critical tool for China to assert global influence. The initiative fosters diplomatic ties by encouraging economic reliance on China, particularly in developing regions that are often underserved by Western financial institutions like the World Bank and International Monetary Fund (Duarte et al., 2020). This shift in economic dependencies positions China as a key player in regions previously dominated by Western influence, allowing it to extend its geopolitical reach. However, concerns over "debt-trap diplomacy" have emerged, as countries accumulating significant debt to China may face political and economic pressures in the future (José & Duarte, 2023). For Chile and Argentina, participation in the BRI offers infrastructural benefits but also introduces risks related to long-term financial reliance on China.

Culturally and diplomatically, the BRI promotes a model of engagement that goes beyond economics, emphasizing "people-to-people" exchanges as part of China's soft power strategy. These exchanges, including academic partnerships and cultural programs, are intended to foster stronger international ties and present an alternative to Western narratives. This aspect of the BRI aligns with China's broader global strategy of promoting its model of globalization, which advocates for collective development and mutual respect (Duarte et al., 2020). In Latin America, these cultural exchanges, paired with economic investments, could potentially shift regional alliances, further embedding China within the local political and economic landscape.

Li and Zhu (2019) offer a comprehensive analysis of how the BRI aligns with the 2030 Agenda for Sustainable Development in Latin America and the Caribbean. Their study underscores that the BRI is designed to promote sustainable development goals (SDGs) through targeted investments in infrastructure and renewable energy. For Chile and Argentina, Chinese investments in renewable energy, including green hydrogen, are integral to this strategy. Li and Zhu argue that these investments are not just about economic gain but also about supporting regional sustainability objectives and integrating these countries into China's global developmental framework.

The alignment with the SDGs is particularly relevant for understanding the strategic intent behind Chinese investments. By focusing on renewable energy projects, China aims to contribute to global environmental goals while enhancing its influence in Latin America. This investment strategy positions Chile and Argentina as critical partners in achieving shared sustainability goals, reflecting a mutual benefit in the global context of environmental stewardship.

Moreover, Li and Zhu highlight that the BRI's emphasis on infrastructure and renewable energy aligns with international sustainability frameworks, enhancing the appeal and legitimacy of Chinese investments. For Chile and Argentina, this means that participating in the BRI not only helps meet local energy needs but also aligns with broader global sustainability agendas, reinforcing their commitment to environmental and economic development. Hiratuka (2018) provides valuable insights into Chinese infrastructure projects in Brazil, offering a comparative perspective that is applicable to Chile and Argentina. Although the focus is on Brazil, Hiratuka's examination of the structure and impact of Chinese investments provides a relevant context for understanding similar projects in other Latin American countries. His analysis details how Chinese investments are managed and implemented, revealing patterns that are likely observable in Chile and Argentina as well. Hiratuka's work sheds light on the scale and scope of Chinese infrastructure projects, including their financing mechanisms and strategic objectives. This perspective helps to contextualize the nature of Chinese investments in renewable energy in Chile and Argentina, highlighting both the opportunities for economic growth and the potential challenges. Understanding these dynamics is crucial for analysing how Chinese investments impact local economies and societies, providing a framework for evaluating their broader implications.

Furthermore, Hiratuka's analysis identifies key opportunities and challenges associated with Chinese investments. While such investments can drive economic development and infrastructure improvements, they also raise concerns about dependency on Chinese capital and the influence of Chinese companies. This comparison helps to frame the discussion around Chinese investments in renewable energy in Chile and Argentina, providing a nuanced view of their benefits and potential drawbacks.

Robertos Matsushima (2023) explores the broader implications of the BRI for Latin America, focusing on its economic and geopolitical effects. Their research emphasises that the BRI is a strategic tool that extends beyond mere economic development to influence regional geopolitics. For Chile and Argentina, this means that Chinese investments in renewable energy are intertwined with broader geopolitical considerations, affecting regional power dynamics and international relationships. Robertos Matsushima argues that the BRI can shift regional economic dependencies and enhance China's geopolitical leverage. This analysis is crucial for understanding the strategic dimensions of Chinese investments in Chile and Argentina. By influencing regional power structures and diplomatic relations, these investments play a role in reshaping the geopolitical landscape of Latin America.

Their research provides a framework for analysing how Chinese investments in renewable energy might affect regional dynamics. It highlights the dual role of the BRI in driving economic development while also influencing geopolitical alignments, offering insights into the broader implications of Chinese engagement in the region.

Merino, Ramiro, and González Jáuregui (2023) examine the challenges and proposals for integrating Latin America into the BRI framework, focusing on issues of economic dependency and strategic alignment. Their work addresses the complexities of aligning regional development with Chinese interests, providing a critical perspective on the implications of such integration for Chile and Argentina.

The authors discuss the need for a balanced approach to integrating with the BRI, where the benefits of increased investment are weighed against potential risks. For Chile and Argentina, this means navigating the opportunities presented by Chinese investments while addressing challenges related to economic dependency and regional power shifts. Their analysis highlights the importance of managing these complexities to ensure that the benefits of Chinese investments are maximized while mitigating potential drawbacks.

In conclusion, the Belt and Road Initiative is a pivotal element of China's strategy to enhance its investments in renewable energy in Latin America, particularly in countries like Argentina and Chile. By facilitating significant investments in renewable energy infrastructure and securing access to critical minerals, the BRI aligns with China's objectives of promoting sustainable energy solutions and enhancing its global influence. While the initiative presents opportunities for economic development and technological advancement, it also poses challenges related to environmental sustainability and geopolitical dynamics. As Latin America continues to engage with China through the BRI, it must

develop robust policies and frameworks to maximize the benefits of these investments while ensuring a sustainable and equitable energy future.

Having established the theoretical context and the strategic importance of the BRI in Latin America, this study now turns to a methodological approach tailored to analysing the nuances of Chinese investments in Chile and Argentina's renewable energy sectors.

CHAPTER 3

Methodology

This chapter delineates the research methodology employed in the study, encompassing the approach, data analysis techniques, and inherent limitations. Understanding these elements is crucial for grasping how the research was conducted, how data was interpreted, and the constraints encountered throughout the study.

The research utilizes a qualitative approach, which is well-suited for probing the intricate economic relationships and dynamics inherent in Chinese investments in renewable energy. This methodological choice facilitates a nuanced exploration of the economic strategies, interactions, and impacts associated with these investments. By employing qualitative methods, the study aims to provide a comprehensive understanding of how these investments affect the economic landscapes of Chile and Argentina and their broader geoeconomic implications.

Central to the research is the case study approach. This method thoroughly examines specific projects and partnerships between China and Latin American countries, such as Argentina and Chile. Case studies are particularly effective in this context as they offer in-depth insights into the operational mechanisms of these investments, including the strategies employed by Chinese firms, the nature of economic engagements, and the outcomes for both investors and host countries. Through a thorough analysis of these case studies, the research explores the implementation of these investments and their direct and indirect economic effects.

In addition to case studies, a comparative analysis is employed to contrast the experiences of Chile and Argentina. This method facilitates the identification of similarities and differences in how each country engages with Chinese renewable energy projects. By evaluating factors such as government policies, investment strategies, and technological advancements, the study provides a broader perspective on the economic impacts of these investments within different national contexts.

Data for this research are sourced from a range of materials, including academic literature, industry reports, and government publications. The literature review establishes a theoretical framework and contextual background, positioning the case studies within the broader academic and policy discussions on renewable energy investments and geoeconomics. Industry reports and government publications provide insights into current trends, policy details, and specific project information.

The data analysis involves several key steps. Initially, data from case studies and secondary sources are compiled and systematically coded to identify recurring themes and patterns. Thematic analysis is then applied to interpret these themes, offering a detailed understanding of the economic interactions and outcomes associated with the investments. This approach elucidates the motivations behind Chinese investments, the nature of economic relationships, and the overall impact on the economies of Chile and Argentina.

The selection of data involved several critical steps. First, the focus was on gathering information specifically related to Chinese investments in renewable energy projects in Chile and Argentina from the years 2010 to 2023, with data projections spanning up to 2050. This timeframe was chosen to effectively capture the emergence and evolution of these investments. Second, sources include international organizations such as the International Renewable Energy Agency (IRENA) and the International Energy Agency (IEA), alongside reports from national governments and industry bodies, ensuring that perspectives from both countries and neutral, reputable organizations were included. Third, the data analysed were compared across both countries to identify similarities and differences in project types, investment amounts, and policy responses, allowing for a nuanced understanding of each country's engagement with Chinese renewable energy projects. Finally, the literature review establishes a theoretical framework and contextual background, positioning the case studies within broader academic and policy discussions on renewable energy investments and geoeconomics.

Comparative analysis is used to assess the economic effects of projects in both countries. This involves evaluating government policies, investment strategies, and technological advancements to understand how each country's approach to renewable energy, particularly green hydrogen, influences the results of these investments.

The research acknowledges several limitations. A primary limitation is the availability and reliability of data. Access to detailed and current information on specific projects can be restricted due to commercial confidentiality and political sensitivities, which may impact the depth and accuracy of the case studies and the overall analysis. Additionally, potential biases in the sources of information must be considered. The research relies on various sources, including government reports and industry publications, which may reflect specific perspectives or interests. Efforts have been made to cross-verify information and consult multiple sources to mitigate these biases.

Another significant limitation is the relatively recent emergence of the field of renewable energy projects. The scientific investigation into these projects is still developing, and many recent initiatives are only beginning to be documented and studied. This novelty means that there is limited historical data and fewer comprehensive studies available, potentially affecting the completeness of the analysis and the ability to draw long-term conclusions.

Furthermore, the focus on Chile and Argentina may limit the generalizability of the findings to other Latin American countries. While the study offers valuable insights into these specific cases, caution should be exercised when extrapolating the results to broader contexts.

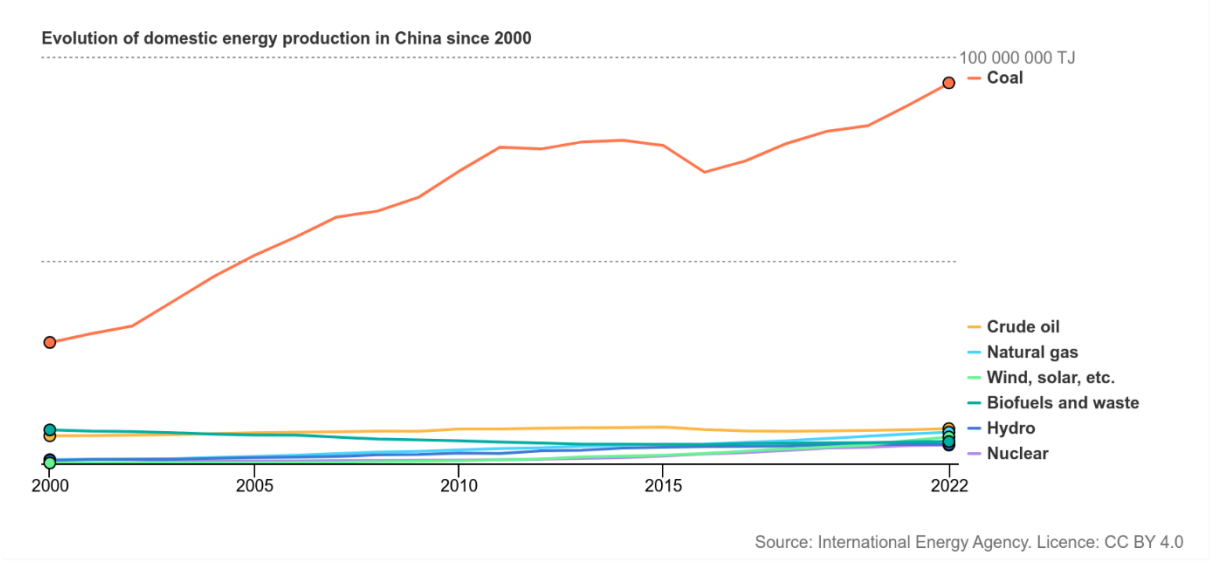
The methodology employed in this research provides a robust framework for analysing the economic implications of Chinese investments in renewable energy in Latin America. Despite its limitations, the approach and analysis offer significant insights into the economic relationships and impacts of these investments, contributing to a deeper understanding of the evolving dynamics in global energy economics.

CHAPTER 4

Chinese Investments in Renewable Energy in Latin America

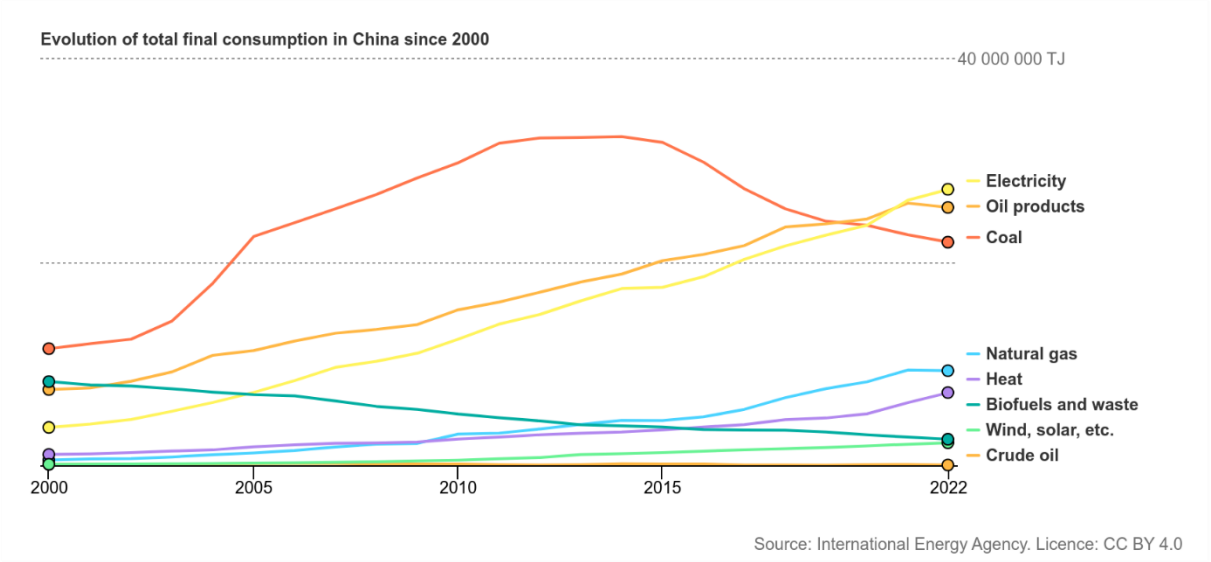
China's global economic expansion, particularly through investments in the renewable energy sector, cannot be fully understood without examining the country's profound dependence on external energy resources (see table 1 and table 2). Although China has made strides in increasing its domestic energy production, it remains heavily reliant on imported energy to sustain its rapidly growing economy and urbanizing society (IEA, 2024). This energy insecurity is central to China's motivation for seeking alternative energy sources abroad. The strategic importance of these investments becomes clear when one considers that China's domestic energy mix, dominated by coal, is neither sustainable nor sufficient to meet its future demands. As a result, securing access to renewable energy resources—such as solar, wind, and green hydrogen—through foreign investments has become a key priority, as discussed in previous chapters.

Table 1: Evolution of Domestic Energy Production in China since 2000 (until 2022)



Retrieved from IEA. (2024). *Energy System of China - Energy Mix*. International Energy Agency. https://www.iea.org/countries/china .

Table 2: Evolution of Total Final Energy Consumption in China since 2000 (until 2022)



Retrieved from IEA. (2024). *Energy System of China - Energy Mix*. International Energy Agency. https://www.iea.org/countries/china .

In Latin America, the abundance of renewable energy potential, particularly in countries like Chile and Argentina, aligns perfectly with China's long-term energy strategy. However, while this partnership may seem mutually beneficial, it is crucial to consider the power dynamics at play. China's investments are often framed as a means of promoting sustainable development, but a critical examination reveals that they are also driven by China's urgent need to reduce its dependency on fossil fuels while securing access to critical materials like lithium and copper, which are essential for the global energy transition.

The scale of Chinese investments in Latin America's renewable energy sector raises important questions about the long-term implications for both sides. While these investments bring much-needed capital and technological expertise to Chile and Argentina, they also come with potential risks. The significant control that Chinese companies often acquire in local energy projects could lead to a situation where the energy policies of these nations are increasingly influenced by external interests. This control is not only economic but can also extend into political influence, especially when projects are linked to large-scale loan agreements that may put the host country in a vulnerable position if repayment becomes difficult. Such a scenario has played out in other regions involved in the BRI, raising concerns about whether LAC countries might face similar risks of dependency (José & Duarte, 2023).

Furthermore, the strategic timing of China's pivot toward renewable energy raises additional critical points. China's increased focus on renewables coincides with global pressure to reduce carbon emissions. However, while China's international image benefits from its investments in clean energy abroad, it continues to grapple with its own reliance on coal domestically, making it the largest global emitter of greenhouse gases. This duality suggests that China's renewable energy investments, particularly in regions like Latin America, may be part of a broader strategy to position itself as a global

leader in renewable energy, even as it struggles to make significant progress at home. The question then arises: are these investments in Latin America driven by genuine environmental concerns, and how much are they part of a strategic effort to secure resources and influence while mitigating domestic and international pressure on its carbon-heavy energy consumption?

4.1 Evolution of Chinese Investments

China’s engagement in Latin America's renewable energy sector has evolved rapidly over the past two decades, reflecting a broader strategic interest in securing resources and expanding geoeconomic influence. From 2015-2023, Chinese investments in Latin America reached USD 200 billion, with a 20% share in renewable energy by 2023 (SELA, 2024). This surge in investment can be seen as part of China’s BRI, which Costa (2023) describes as a 'geoeconomic tool' designed to secure China's access to key markets and resources while bolstering its global leadership in clean energy technologies.

The evolution of these investments mirrors China’s growing focus on diversifying its energy imports while positioning itself as a leader in the global renewable energy market. In Latin America, the investments target solar, wind, and increasingly, green hydrogen projects, aligning with China's broader goal of reducing its reliance on coal and oil (UNCTAD, 2021). As Jaffe (2018) highlights, China's strategy also aims to reduce vulnerabilities in its energy supply chains while extending its geopolitical influence in resource-rich regions like Latin America.

According to Joffe (2018), the rapid growth of China's renewable energy sector is not only a response to domestic environmental issues but also part of a strategic effort to increase its international standing. He notes that China "views its dominance in renewables as a way to enhance both its energy security and its international influence" (Joffe, 2018, p. 86). This expansion into renewables reflects China’s broader ambitions to assert itself on the global stage, both economically and geopolitically. By heavily investing in solar and wind power, China has managed to address its pressing environmental concerns while simultaneously positioning itself as a key player in the clean energy market. This dual focus on domestic needs and international influence has been crucial in shaping China’s renewable energy strategy (Joffe, 2018).

In parallel, as Hilton (2024) highlights, China’s dominance in the renewable energy sector is not only driven by domestic considerations but also by its expansive international agenda. China is not only the world’s largest producer of solar panels and wind turbines but also the largest investor in renewable energy abroad. This shift reflects a broader strategic move to reduce dependence on fossil fuel imports and secure energy resources while reinforcing China’s economic and geopolitical influence globally. As part of its BRI, China has directed significant investment toward Latin America, Africa, and Southeast Asia, building renewable energy infrastructure and establishing long-term partnerships

with emerging economies (Hilton, 2024). This strategy has solidified China's role as a leader in global renewable energy while helping to facilitate energy transitions in developing regions.

Further emphasising China’s strategic approach, Ma and Ma (2023) argue that the transition away from coal has become central to China’s overseas investment policies. Historically known for its investments in coal-powered projects, China has redirected capital toward renewable energy projects as part of its broader climate goals. This shift reflects both internal pressures to decarbonize and external demands from partner countries seeking to transition to clean energy. For example, China's investments in solar and wind projects across Africa and Latin America have not only generated economic opportunities for these regions but have also positioned China as a key player in their energy transition efforts. Ma and Ma (2023) note that these investments represent China’s commitment to global sustainability and economic leadership in the post-coal era.

The growing focus on renewable energy has been part of a broader global trend. According to the International Institute for Sustainable Development (IISD), from 2010 to 2019, global renewable energy investments surpassed USD 2.5 trillion, as revealed in a UNEP report (IISD, 2019). China contributed a substantial portion of this figure, reflecting its role as the largest investor in clean energy worldwide. China's focus on large-scale investments in renewable energy has helped solidify this trend, particularly in emerging markets. The report underscores how China’s push for clean energy globally aligns with broader international sustainability goals, particularly the push to meet the Paris Agreement’s climate targets (IISD, 2019).

The results of China’s investments in renewable energy have had significant economic ramifications. Myllyvirta (2024) highlights that clean energy was the top driver of China’s economic growth in 2023, underscoring the economic benefits of the country’s shift toward renewable energy. "Clean energy growth added 0.8 percentage points to the overall 3% growth of China’s GDP in 2023" (Myllyvirta, 2024). As traditional energy markets shrink due to decarbonization efforts worldwide, China's renewable energy sector has emerged as a major economic driver. Solar and wind energy industries have generated jobs domestically and contributed to China’s growing export market for clean energy technologies. This economic impact extends beyond China’s borders, as Chinese companies continue to invest in and build renewable energy projects abroad, including in Latin America (Myllyvirta, 2024).

4.2 Main projects and partnerships

China has emerged as a major player in Latin America’s renewable energy sector, with its investments and partnerships driving significant growth across the region. Latin America, known for its vast natural resources in solar, wind, and hydropower, presents a strategic opportunity for China's global energy ambitions. Through state-backed companies, China has entered into long-term agreements with Latin American countries, helping them achieve their sustainability targets while advancing its BRI.

China's investments in renewable energy in Latin America span a range of high-impact projects, with solar and wind farms being key areas of focus. In Argentina, the Cauchari Solar Park stands as a symbol of China's deep involvement in the region's renewable energy development. This 315 MW facility, located in the high plains of Jujuy province, was made possible through a USD 331 million loan from the Export-Import Bank of China (Ellis, 2024; IEA, 2023).

In addition to solar energy, China has heavily invested in wind power, particularly in Argentina's Patagonia region, which boasts some of the most consistent wind conditions globally. Chinese firms such as Goldwind have financed and constructed multiple wind farms, with a combined capacity exceeding 500 MW. These investments align with Argentina's goal of generating 20% of its energy from renewables by 2025 (Ellis, 2024).

According to Ellis (2024), Chile, with its rich solar resources, has also benefited from significant Chinese investments. The Atacama Desert, home to some of the world's largest solar plants, has attracted Chinese companies like Trina Solar and Envision Group. Trina Solar's involvement in developing a 392 MW solar project (Ellis, 2024) exemplifies China's commitment to integrating itself into Chile's energy landscape. By 2030, Chile aims to generate 70% of its electricity from renewable sources, and China's financial and technological support will be instrumental in achieving this target (Ellis, 2024).

Garrison (2019) further underscores the significance of the Cauchari Solar Park in Argentina, highlighting how Chinese expertise and financing have enabled the project's development in a remote part of the country. As Garrison notes, "Chinese companies supplied 1.2 million solar panels for the project," which sits in the high-altitude plains of Jujuy province. This solar farm, which supplies power to more than 160,000 homes, has been a game-changer for Argentina's renewable energy landscape and showcases the breadth of Chinese involvement in Latin America's clean energy push.

Cimmino (2024) further highlights that in 2023 alone, Chinese companies committed over $12 billion to Latin America's renewable energy sector, with a significant focus on wind and solar power. In Argentina, China's Goldwind has developed multiple wind projects in the southern region of Patagonia, which offers some of the world's most consistent wind conditions. Cimmino (2024) emphasizes that the capacity of Chinese-backed wind projects in Argentina now exceeds 500 MW, a significant portion of the country's renewable energy generation. These projects align with Argentina's goal of achieving 20% of its energy from renewables by 2025.

Moreover, in Brazil, Chinese firms have been heavily involved in constructing wind farms, such as the Lagoa do Barro Wind Complex, which generates 195 MW and provides power to thousands of homes. This growth is part of a broader trend, with wind energy capacity in Brazil increasing by over 14% annually, largely due to foreign investments, including China's (Cimmino, 2024).

Bloomberg Financial (2023) reports that China's contributions to Latin America's renewable energy transition are significant in terms of volume and crucial for the region's path toward net-zero emissions. By the end of 2023, Chinese companies had financed or built renewable energy projects

across 10 Latin American countries, contributing to nearly 25% of the region's renewable energy capacity. The Bloomberg report also cites that China has become one of Mexico's largest foreign investors in renewable energy, financing solar installations with a combined capacity of over 1 GW in just the past five years. These investments are helping Mexico meet its ambitious target of generating 35% of its energy from clean sources by 2024.

Bloomberg further highlights the broader significance of Chinese investments, noting that from 2010 to 2019, global renewable energy investments totalled $2.6 trillion, with China playing a leading role. Due to its abundant natural resources, Latin America received a significant portion of these investments, particularly in large-scale solar and wind farms. In Brazil, for instance, Chinese energy companies account for nearly 20% of the country's total renewable energy investment (Bloomberg Financial, 2023).

China has become a significant player in the renewable energy sectors of Brazil and Argentina, employing distinct strategies in each country to enhance its influence. In Brazil, Chinese companies focus on acquiring existing assets, particularly in hydropower. Currently, Chinese entities control over 15 GW of hydropower capacity, showcasing a preference for consolidating influence by acquiring and managing large segments of Brazil's renewable infrastructure (Ungaretti, Nunes, & Mendonça, 2024, p. 59). This approach enables Chinese firms to rapidly integrate into Brazil's energy market without the time-intensive processes required for new project development.

In contrast, Argentina has seen more Chinese investments in greenfield renewable projects. Chinese banks, such as the Industrial and Commercial Bank of China, have financed natural gas facilities with a combined capacity of 573 MW, which aligns with Argentina's energy security strategy. These projects demonstrate China's adaptability in addressing the specific energy needs of each country, while simultaneously increasing its strategic presence in Argentina's energy sector (Ungaretti et al., 2024, p. 60).

China's global leadership in renewable energy investments underscores its broader impact. In 2022, Chinese investments in renewable infrastructure exceeded $546 billion, complemented by its dominant role in manufacturing, accounting for 80% of global solar panel production and 60% of wind turbines (Ungaretti et al., 2024, p. 58). This manufacturing capacity enables China to export renewable technologies extensively, solidifying its influence in Latin America's shift towards green energy.

In Latin America, Chinese investments have diversified across solar and wind projects, totalling 2.25 GW in solar and 4.1 GW in wind capacities (Ungaretti et al., 2024, p. 67). This shift highlights China's alignment with global green energy trends and establishes its role as a key partner in Latin America's renewable energy landscape. These investments not only promote energy diversification within the region but also position China as a critical player in helping Latin American nations meet their climate objectives.

However, challenges accompany China's investments in Brazil and Argentina. Argentina's macroeconomic instability and political uncertainties raise risks that could affect the longevity of these

projects. Conversely, in Brazil, the focus on asset acquisition rather than new developments may limit renewable capacity expansion, raising questions about the transformative potential of China's involvement in Brazil's energy market (Ungaretti et al., 2024, pp. 65-66).

China's strategic engagement in Latin America extends beyond the energy sector, affecting broader geopolitical dynamics. By deepening energy ties with Brazil and Argentina, China enhances its geopolitical leverage in a region historically influenced by Western powers. This evolving relationship may influence the foreign policy orientations of both countries as they navigate local energy needs alongside broader geopolitical considerations (Ungaretti et al., 2024, p. 67).

The International Institute for Sustainable Development (2019) also underscores the scale of global investments in renewable energy. According to their report, renewable energy investments worldwide surpassed $2.5 trillion between 2010 and 2019, with China leading the way. In Latin America, Chinese companies have been particularly active in financing and building solar energy projects, such as the aforementioned Cauchari Solar Park and various projects in Brazil. This substantial financial commitment is key to Latin America's ability to scale its renewable energy infrastructure and meet global decarbonization goals.

While these investments bring substantial benefits to Latin American countries in terms of infrastructure development, technology transfer, and job creation, they also raise concerns about long-term dependency and the strategic leverage China gains. As Dominguez (2018) argues, China's financial dominance in key sectors like energy could lead to a form of economic dependency, where countries like Argentina and Chile may find themselves heavily reliant on Chinese financing and technology for their renewable energy ambitions.

This dependency is further complicated by the geopolitical implications of China's Belt and Road Initiative. According to Costa (2024), China's investments in Latin America are part of a broader geoeconomic strategy that seeks to secure long-term access to vital resources, including lithium, copper, and renewable energy infrastructure. While the influx of Chinese capital has enabled countries like Argentina to meet their renewable energy targets, it also shifts the balance of power in the region, potentially limiting the ability of Latin American nations to negotiate terms that fully align with their own long-term energy policies and goals.

Moreover, Chinese companies often acquire significant control over the projects they finance, as seen in Brazil's energy transmission network. This raises questions about the extent to which national governments retain sovereignty over critical infrastructure. The political and economic implications of this trend are profound, especially as these nations continue to navigate the delicate balance between fostering foreign investment and maintaining control over their energy futures.

While China's investments span various renewable sectors, green hydrogen has emerged as a particularly transformative focus, especially in resource-rich countries like Chile and Argentina. The next chapter explores the potential and strategic significance of green hydrogen within China's investment portfolio.

CHAPTER 5

Green Hydrogen Potential in Chile and Argentina

The growing importance of green hydrogen in the global energy transition cannot be overstated. As a clean alternative fuel, green hydrogen offers a promising pathway toward decarbonization, particularly in industries that are difficult to electrify, such as heavy transportation and steel production. Within Latin America, two key countries, Chile and Argentina, have emerged as frontrunners in leveraging their abundant renewable resources to develop green hydrogen. However, the role of external investments, particularly from China, is pivotal in realizing this potential.

As discussed in previous chapters, China's renewable energy investments have significantly shaped the energy landscape in Latin America, and green hydrogen development is no exception. In this chapter, we will explore the current state of green hydrogen projects in Chile and Argentina, the challenges and opportunities they face, and how these developments fit into China's broader geoeconomic strategies in the region. Furthermore, this chapter critically assesses whether these investments truly promote sustainable development for the host countries or if they primarily serve to advance China's energy security and geoeconomic influence.

5.1 Report on the Current Positioning of Green Hydrogen

While green hydrogen presents enormous potential for Chile and Argentina, the growing reliance on Chinese investments raises critical concerns. On one hand, these partnerships offer much-needed financial and technological support to kickstart large-scale hydrogen production. On the other hand, they risk creating economic dependencies that could compromise local autonomy over energy policy and infrastructure. The influx of capital from China also brings strategic interests, as China seeks to secure access to Latin America's abundant natural resources through renewable energy projects.

Thus, it is essential to critically examine whether these investments are aligned with the long-term sustainable development goals of Chile and Argentina or whether they primarily advance China’s global energy ambitions. The analysis of ongoing and upcoming projects will reveal the delicate balance between opportunity and risk for Latin America’s energy future, particularly as it navigates the broader dynamics of global competition for renewable resources.

Green hydrogen, produced through water electrolysis powered by renewable energy sources, has become a cornerstone in global strategies aimed at decarbonizing energy systems (Wang et al., 2024; IRENA, 2024). As a carbon-neutral alternative to traditional hydrogen production methods, such as grey and blue hydrogen, it holds significant potential to reduce greenhouse gas emissions, particularly in hard-to-electrify sectors like heavy industry and long-haul transportation (IEA, 2023). The development of green hydrogen technology is increasingly recognized as a major driver in the global energy transition

(IRENA, 2024). Its importance stems from its ability to offer a sustainable energy solution in sectors where direct electrification is more challenging, making it an essential component in the broader decarbonization effort.

However, the current share of green hydrogen in global production remains small, representing less than 1% of the total hydrogen supply as of 2023 (IEA, 2023). Despite its nascent stage, green hydrogen is expected to expand significantly by 2030, driven by advancements in electrolysis technology and the declining costs of renewable energy sources (Wang et al., 2024). Improvements in electrolyser efficiency and the decreasing costs of solar and wind energy have fostered a more favourable environment for scaling up green hydrogen production. As noted by Zhang & Li (2024), the integration of renewable energy into hydrogen production is opening new pathways for decarbonization, positioning green hydrogen as a viable solution to the global energy crisis.

In terms of global market trends, Lambert et al. (2024) emphasize Europe's leadership in green hydrogen development, underscoring the region’s proactive policies aimed at achieving climate neutrality by 2050. The European Union has set ambitious targets, including 40 GW of electrolyser capacity by 2030, positioning the continent as a frontrunner in the green hydrogen race. Europe’s strategy focuses not only on scaling production but also on integrating hydrogen into the existing energy grid. The region's efforts offer a blueprint for other countries looking to develop robust hydrogen markets. According to the European Hydrogen Observatory (2023), the hydrogen market in Europe is projected to grow significantly, with demand anticipated to reach approximately 15 million tons per year by 2030 and more than 60 million tons by 2050.

The favourable conditions for green hydrogen production extend beyond Europe, particularly in regions rich in renewable energy resources, such as Latin America. Chile and Argentina are emerging as key players in this market due to their geographic advantages and abundant renewable resources. Chile, in particular, stands out for its vast solar and wind energy potential, especially in regions like the Atacama Desert, which positions the country as a global leader in green hydrogen production. Chile's government aims to produce the world's cheapest green hydrogen by 2030, targeting a cost of $1.50 per kilogram (IRENA, 2024). Achieving this price point is expected to be possible through large-scale investments and the favourable renewable energy conditions, making Chile a hub for international hydrogen projects.

In contrast, Argentina is in an earlier stage of green hydrogen development but has significant potential, particularly due to its vast wind resources in Patagonia. Argentina's competitive edge lies in the low cost of wind power, which could enable the country to produce green hydrogen at prices competitive with other leading markets (Wang et al., 2024). While Argentina’s emerging hydrogen strategy is beginning to attract international investment, the country still needs to establish a comprehensive policy framework to fully capitalize on its green hydrogen potential. The European Hydrogen Observatory (2023) highlights that for countries like Argentina, developing a regulatory

framework that supports investment in hydrogen infrastructure will be crucial to facilitate the transition to a hydrogen economy.

On a global scale, the cost of green hydrogen remains high, currently ranging between $3 to $6 per kilogram, depending on local energy prices and production capacities (IEA, 2023). However, these costs are projected to decrease significantly in the coming years. For instance, Lambert et al. (2024) predict that in Europe, hydrogen prices could fall below €2 per kilogram by 2035 as technological advancements improve electrolyser efficiency and production scales up. Latin America, with its abundant renewable energy resources, is likely to follow similar trends, making the region highly competitive in green hydrogen production. According to the European Hydrogen Observatory (2023), the anticipated decline in production costs will play a pivotal role in driving market growth and attracting investments in green hydrogen initiatives.

A key challenge facing the green hydrogen sector is the need for international cooperation to harmonize regulations and accelerate deployment. IRENA (2024) highlights the importance of establishing a global certification system for hydrogen production, which would enable countries to verify the carbon intensity of their hydrogen exports. Such a system is critical for facilitating global trade, especially between renewable-rich regions like Chile and Argentina and high-demand markets such as Europe and Asia. Without a standardized certification framework, the development of international green hydrogen value chains may be hindered, limiting the ability of countries with surplus renewable energy to export hydrogen on a large scale (IRENA, 2024). The European Hydrogen Observatory (2023) underscores that a unified approach to hydrogen certification will not only support trade but also enhance market transparency, fostering investor confidence.

Furthermore, Lambert et al. (2024) argue that aligning policy frameworks with investment strategies is essential to accelerate the global deployment of green hydrogen. Europe’s approach, which includes aggressive targets for hydrogen integration and substantial financial support, could serve as a model for Latin American countries seeking to enhance their positioning in the global market. The European Hydrogen Observatory (2023) indicates that Europe's investments in hydrogen infrastructure are expected to reach approximately €10 billion by 2030, reflecting the region's commitment to becoming a global leader in the hydrogen economy. Without significant investment and a coordinated policy approach, countries with high potential, such as Chile and Argentina, risk lagging behind more organized and advanced regions in green hydrogen development.

The potential of green hydrogen as a cornerstone in the energy transition is evident in its ability to facilitate the decarbonization of various sectors, particularly those that are difficult to electrify. The International Energy Agency (2023) notes that green hydrogen can play a pivotal role in hard-to-abate sectors, including steel and cement production, by replacing fossil fuels with clean energy sources. This shift is crucial for achieving global climate goals and ensuring a sustainable future. Moreover, the European Hydrogen Observatory (2023) emphasizes that investments in hydrogen projects can generate

substantial economic benefits, including job creation and technological advancements, further reinforcing the case for green hydrogen development.

As the demand for green hydrogen grows, so too does the necessity for robust infrastructure to support its production, storage, and distribution. The European Hydrogen Observatory (2023) points out that building a comprehensive hydrogen infrastructure is paramount for achieving the EU's hydrogen goals. The report highlights the need for collaboration between governments, industries, and research institutions to develop the necessary infrastructure that will support the hydrogen value chain. In this context, Chile and Argentina must also focus on developing the requisite infrastructure to capitalize on their renewable energy potential and establish themselves as key players in the global hydrogen market.

In this line of thinking, Gómez and Castro (2024) emphasize that integrating hydrogen systems with existing renewable energy infrastructures will be crucial for optimizing energy use and ensuring a reliable supply of green hydrogen. They assert that effective integration strategies can facilitate not only the efficient production of green hydrogen but also its utilization across various sectors, driving down costs and enhancing overall energy system resilience.

The matter of importance of green hydrogen is that it stands at the forefront of global decarbonisation efforts, with its production through renewable energy sources offering a viable solution to reducing greenhouse gas emissions. While its current share in global production remains low, significant growth is anticipated in the coming years, driven by technological advancements and declining costs. As Europe leads the charge in developing a robust hydrogen market, Latin America, particularly Chile and Argentina, is poised to emerge as a key player in the global green hydrogen landscape. Collaborative efforts, supportive policy frameworks, and substantial investments will be essential to harness the potential of green hydrogen and ensure a sustainable energy future for all.

5.2 Projects and Promising Developments

The green hydrogen sector in the LAC is developing rapidly, buoyed by its rich renewable energy resources and strategic partnerships with Asian countries, particularly China and Japan. According to IRENA (2024), these partnerships are essential to LAC’s potential as a global leader in green hydrogen production, given the region's advantages in solar, wind, and hydroelectric power. With these resources, LAC countries are positioned to capitalize on Asia's growing demand for green hydrogen, which aligns with the international push for decarbonization.

China has established itself as a key player in LAC's green hydrogen landscape through significant financial investments and technology transfer. As highlighted by Brown and Grünberg (2022), Chinese companies are funding large-scale projects in various countries across the region, focusing on the construction and optimization of electrolysis facilities. For example, investments in proton-exchange membrane (PEM) electrolysis technology are a major part of China’s contribution, enhancing the efficiency and scalability of hydrogen production processes in Brazil and Mexico. This

focus on PEM technology is anticipated to reduce costs by 20% by 2028, making green hydrogen more accessible.

Japan is also investing heavily in LAC's hydrogen infrastructure, with projects aimed at facilitating the export of hydrogen to Asian markets. IRENA (2024) notes that Japanese firms are involved in developing ammonia-based hydrogen carriers, which allow for the safe and efficient long-distance transportation of hydrogen. This technology is crucial, as it enables Japan to import green hydrogen from LAC countries to meet its domestic clean energy requirements. Projections indicate that these carriers could transport up to 5 million tons of hydrogen annually to Japan, reducing its reliance on fossil fuels.

The hybridization of renewable resources—such as combining solar, wind, and hydroelectric power—is another key area where Asian countries are contributing to LAC's green hydrogen projects. According to Boese Cortés and Soto (2023), pilot projects in countries like Peru and Costa Rica integrate multiple renewable energy sources to stabilize hydrogen production and mitigate weather-related variability. These systems, supported by Asian technological expertise, reduce the costs of hydrogen production by approximately 15% while ensuring reliable and consistent output.

China is also playing an influential role in developing regulatory frameworks for green hydrogen in LAC. Brown and Grünberg (2022) detail how Chinese stakeholders are working closely with LAC governments to establish policies that align with global standards, facilitating exports to Asia and beyond. This regulatory assistance is crucial for LAC countries to attract further international investment and secure long-term contracts with Asian buyers, establishing the region as a reliable source of green hydrogen in the global market.

Infrastructure development, particularly around storage and export facilities, is a key focus of Asian investments in LAC. IRENA (2024) reports that Japanese companies have funded several storage facilities and port terminals in Brazil and Chile, which are essential for managing hydrogen exports to Asia. These facilities are expected to boost the region’s export capacity significantly, with projections suggesting that LAC could become one of the top hydrogen exporters to Asia by 2030. This infrastructure is designed to meet international safety standards, reinforcing LAC’s reputation as a reliable supplier.

China’s interest in importing green hydrogen from LAC is primarily driven by its goal to reach carbon neutrality by 2060. Brown and Grünberg (2022) estimate that China could import up to 10 million tons of green hydrogen from LAC by 2030, underscoring the strategic importance of LAC in China's energy transition. By diversifying its energy sources, China can reduce its dependence on domestic fossil fuels while supporting sustainable growth in LAC through long-term trade agreements.

The economic impact of these developments on the LAC region is substantial. IRENA (2024) projects that the green hydrogen sector could contribute over $30 billion to the regional economy by 2030, creating tens of thousands of jobs and driving technological advancements. This economic boost is further amplified by the influx of Asian investments, which foster local workforce development and

stimulate regional economies. The sustained interest from Asia positions LAC as a critical hub in the global green hydrogen market.

Asian investments also promote technological innovation in the LAC green hydrogen sector. Boese Cortés and Soto (2023) emphasize that China and Japan are introducing cutting-edge technologies, such as high-efficiency electrolysis systems and advanced hydrogen storage solutions, to the region. These technologies not only improve production efficiency but also enhance the sustainability of green hydrogen projects by reducing water and energy consumption, which is crucial in arid regions like northern Chile and Mexico.

The integration of green hydrogen into local industries is another benefit of Asian partnerships in LAC. According to Brown and Grünberg (2022), Asian firms are involved in projects that explore the use of hydrogen in heavy industries, such as steel production and transportation. These applications help LAC countries reduce their own greenhouse gas emissions and transition towards a greener economy. By supporting industrial uses for hydrogen, Asian investments contribute to the overall sustainability goals of LAC nations, aligning with global efforts to reduce carbon footprints.

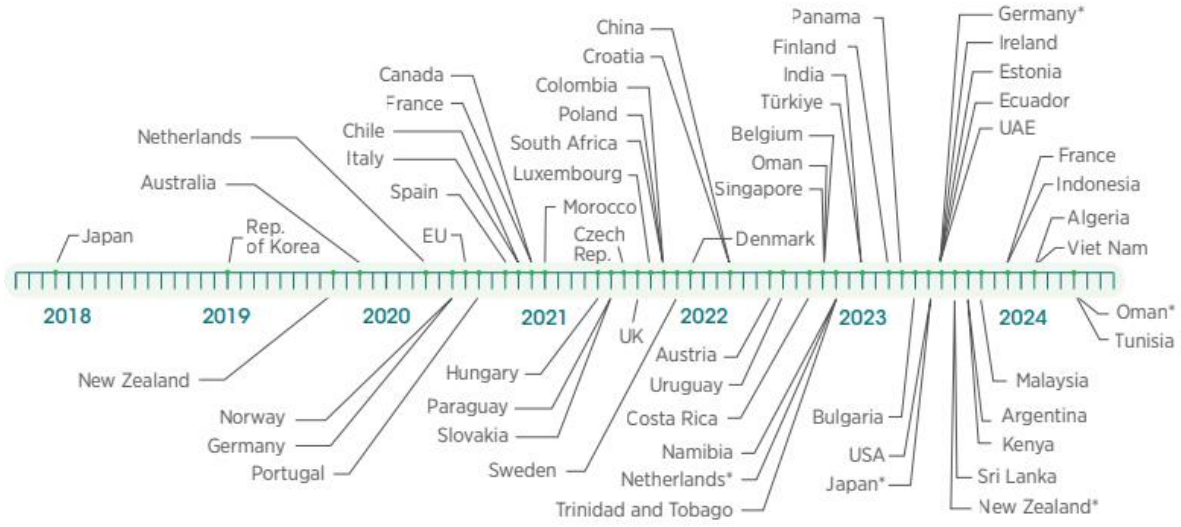
Beyond technology and infrastructure, Asian countries are also investing in capacity-building initiatives across the LAC region. IRENA (2024) highlights several programs funded by Japan and China that aim to train local engineers and technicians in hydrogen technologies. These programs ensure that LAC has a skilled workforce capable of managing and expanding green hydrogen projects independently. By promoting knowledge transfer, Asian countries help LAC nations develop local expertise, which is essential for the long-term sustainability of the green hydrogen sector.

The development of green hydrogen in LAC also holds significant geopolitical implications. Boese Cortés and Soto (2023) argue that by becoming a major exporter of green hydrogen to Asia, LAC could strengthen its geopolitical ties with Asian countries, enhancing its influence in global energy markets. This strategic relationship benefits both regions, as it provides Asia with a stable supply of green hydrogen while boosting LAC's economic and political standing on the international stage.

As Asian countries continue to invest in LAC's green hydrogen sector, there is potential for expanded partnerships beyond bilateral agreements. Brown and Grünberg (2022) suggest that multinational consortiums involving Asian, European, and LAC companies could emerge, pooling resources and expertise to scale up hydrogen production and distribution. These consortiums could facilitate large-scale projects, leveraging shared knowledge and resources to drive down costs and increase efficiency across the supply chain.

The future of green hydrogen in LAC is promising, with Asian investments laying the groundwork for sustainable development and economic growth. IRENA (2024) underscores that as LAC countries continue to attract Asian investors, they can expect increased access to advanced technologies, stable demand from Asian markets, and opportunities for further integration into the global energy economy. By aligning with Asia's energy transition goals, LAC has the potential to establish itself as a leading supplier of green hydrogen, contributing to a cleaner, more sustainable global energy landscape.

Table 3: Timeline of hydrogen strategies and roadmaps (as of May 2024)



Note: Updates are indicated with an asterisk; EU = European Union; Rep. of Korea = Republic of Korea; Czech Rep. = Czech Republic; UAE = United Arab Emirates; USA = United States of America.

Retrieved from IRENA (2024). Green hydrogen strategy: A guide to design. *International Renewable Energy Agency*, Abu Dhabi. ISBN: 978-92-9260-611-4.

On a more specific note of LAC projects, Chile's green hydrogen sector is underpinned by an ambitious Green Hydrogen Action Plan outlined by the Chilean government, which encompasses 81 specific measures aimed at establishing the country as a global leader in the production and export of green hydrogen by 2030 (Gobierno de Chile, 2024). The plan emphasizes the utilization of the country's abundant renewable resources, particularly in the Atacama Desert, known for its exceptional solar radiation levels. This geographic advantage positions Chile to produce green hydrogen at highly competitive prices, enhancing its attractiveness to international investors and companies looking to establish operations in the region.

A central focus of the action plan is the promotion of large-scale hydrogen production facilities powered by renewable energy sources. The government has identified the development of several electrolyser plants as crucial projects, which will leverage the declining costs of solar and wind power integral to the electrolysis process that generates green hydrogen (Gobierno de Chile, 2024). To facilitate this, the government has committed to establishing a favourable regulatory framework and streamlining permitting processes, designed to encourage investment and accelerate the deployment of green hydrogen infrastructure throughout the country. It states that the action plan aims to “mobilize public and private investments to establish a hydrogen economy,” indicating a collaborative approach to fostering investment (Gobierno de Chile, 2024).

Moreover, the action plan highlights the importance of developing a hydrogen export strategy, which is integral to Chile's vision of becoming a key supplier of green hydrogen on the global market.

The government has identified Europe and Asia as potential export markets where demand for green hydrogen is expected to surge as countries work to meet their climate goals (Gobierno de Chile, 2024). As part of this strategy, Chile aims to establish partnerships with international stakeholders to develop the necessary infrastructure for hydrogen transport and storage, including the construction of port facilities capable of handling large quantities of green hydrogen.

In line with its export ambitions, Chile is also focusing on the research and development of innovative technologies related to green hydrogen production, storage, and distribution. The government has launched initiatives to foster collaboration with universities and research institutions to enhance technological capabilities and drive advancements in hydrogen technologies (Gobierno de Chile, 2024). This collaborative approach aims to create a vibrant innovation ecosystem that can support the growth of the green hydrogen sector and position Chile as a leader in hydrogen technology development.

The action plan outlines specific targets for hydrogen production, aiming to reach 5 million tons of green hydrogen by 2030. This ambitious target underscores the government's commitment to scaling up production and fostering a robust hydrogen economy (Gobierno de Chile, 2024). The development of this sector is expected to generate significant economic benefits, including job creation and increased investment in renewable energy projects, contributing to Chile's overall economic growth. It emphasizes the importance of investments in “renewable energy projects that will support hydrogen production” (Gobierno de Chile, 2024).

Additionally, the government recognizes the critical role of public-private partnerships in advancing the green hydrogen agenda. The action plan emphasizes the establishment of joint ventures between public entities and private companies to accelerate the deployment of hydrogen technologies and infrastructure (Gobierno de Chile, 2024). These partnerships will be essential for overcoming challenges related to technology development, infrastructure investment, and market entry. Specifically, the plan mentions that “the role of the private sector is essential to enhance competitiveness and facilitate the energy transition” (Gobierno de Chile, 2024).

The Chilean government is also prioritizing the establishment of a regulatory framework that addresses environmental concerns and ensures sustainable hydrogen production practices. This includes guidelines for the use of water resources in the electrolysis process, particularly relevant given the country's arid climate (Gobierno de Chile, 2024). By implementing stringent environmental standards, Chile aims to ensure that its green hydrogen production is both economically viable and environmentally responsible.

Moreover, Chile is actively engaging in international cooperation efforts to share best practices and align its hydrogen policies with global standards. This engagement includes participation in international forums and collaborations with countries pursuing green hydrogen initiatives (Gobierno de Chile, 2024). By aligning its strategies with global efforts, Chile seeks to enhance its competitiveness in the international hydrogen market and contribute to global sustainability goals.

In terms of financing, the action plan outlines strategies to attract investment from both domestic and foreign sources. The Chilean government is exploring innovative financing mechanisms, including green bonds and public funding initiatives, to support hydrogen projects (Gobierno de Chile, 2024). These financing strategies aim to ensure that the necessary capital is available to realize the ambitious production targets outlined in the action plan.

To support workforce development, the action plan includes provisions for training and education programs focused on green hydrogen technologies. By investing in human capital, Chile aims to equip its workforce with the skills needed to thrive in the emerging hydrogen economy (Gobierno de Chile, 2024). This focus on education and training is crucial for ensuring that the country can meet the growing demand for skilled labour in the hydrogen sector.

Finally, the Chilean government is committed to monitoring and evaluating the progress of the green hydrogen action plan to ensure that it remains aligned with the evolving global hydrogen landscape. This continuous assessment will allow Chile to adapt its strategies as needed and maintain its position as a leader in the green hydrogen market (Gobierno de Chile, 2024). The action plan asserts that "monitoring and evaluation mechanisms will be established to track progress and effectiveness" in achieving the outlined goals (Gobierno de Chile, 2024).

Argentina has developed a comprehensive National Hydrogen Strategy aimed at positioning the country as a key player in the global hydrogen economy, a neighbouring competitor of Chile with a similarly extensive project. The strategy outlines a series of initiatives designed to harness Argentina's renewable energy resources, primarily from wind and solar power, to produce green hydrogen efficiently (Presidencia de Argentina, 2023). The government recognizes that leveraging its natural resources is essential for establishing a competitive hydrogen sector that can meet both domestic and international demand.

A significant aspect of Argentina's strategy is the emphasis on large-scale production of green hydrogen, particularly in regions with abundant renewable energy potential, such as Patagonia and the northwestern provinces. The strategy identifies areas like the southern provinces of Santa Cruz, Chubut, and Tierra del Fuego as optimal locations for hydrogen production due to their high wind and solar potential (Presidencia de Argentina, 2023). The government is committed to developing the necessary infrastructure to facilitate the production and transportation of hydrogen. This includes the construction of electrolyser plants that will convert renewable electricity into hydrogen, capitalizing on the country's vast wind and solar resources. For instance, the government plans to install a 1 GW electrolyser capacity by 2030, which is expected to enable the production of up to 1.5 million tons of green hydrogen annually (Presidencia de Argentina, 2023).

The strategy also sets ambitious production targets, aiming to produce 1.5 million tons of green hydrogen annually by 2030. This goal underscores the government's commitment to developing a robust hydrogen economy that can contribute significantly to Argentina's energy matrix. By achieving this target, Argentina aims to become one of the top five global exporters of green hydrogen, addressing the

projected global demand for hydrogen that is expected to reach 50 million tons by 2030 (Presidencia de Argentina, 2023). The plan highlights the importance of diversifying energy sources and enhancing energy security through the integration of hydrogen into the national energy system.

To attract investment, the Argentine government is focused on creating a favourable regulatory environment that encourages private sector participation. The National Hydrogen Strategy emphasizes the importance of establishing clear regulations and incentives for hydrogen projects to stimulate both domestic and foreign investment. The government aims to mobilize investments exceeding USD 15 billion in the hydrogen sector by 2030 (Presidencia de Argentina, 2023). The strategy indicates that "the legal and regulatory framework will be developed to promote investment in hydrogen technology" as part of its commitment to fostering a conducive investment climate.

In alignment with its hydrogen production goals, Argentina is pursuing partnerships with both public and private stakeholders. The strategy outlines the establishment of collaborative initiatives with local and international companies to share expertise and technology (Presidencia de Argentina, 2023). For example, Argentina has already engaged in partnerships with companies like Enel and Siemens Energy to develop hydrogen production facilities. By fostering these partnerships, Argentina aims to accelerate the development of hydrogen projects and ensure the transfer of knowledge necessary for building a competitive hydrogen economy.

Furthermore, the Argentine government recognizes the importance of technological innovation in driving the hydrogen sector forward. The National Hydrogen Strategy promotes research and development initiatives to enhance hydrogen production technologies and improve efficiency (Presidencia de Argentina, 2023). This includes investing in advanced electrolysis technologies, which are expected to reduce production costs to below USD 1.5 per kilogram by 2030. This focus on innovation is vital for positioning Argentina as a leader in hydrogen technology and ensuring that its production processes remain cost-effective and environmentally sustainable.

A key component of the strategy is the development of export capabilities to tap into the growing international hydrogen market. The Argentine government has identified potential markets in Europe and Asia, where demand for green hydrogen is projected to rise significantly. The strategy estimates that European countries could import between 8 to 10 million tons of hydrogen annually by 2030 (Presidencia de Argentina, 2023). To facilitate this, Argentina is working on establishing the necessary logistics and infrastructure for hydrogen export, which includes developing ports and transportation networks capable of handling hydrogen shipments. The plan outlines the construction of specialized export terminals in coastal provinces, ensuring efficient logistics for international shipments.

In terms of workforce development, the strategy outlines plans for educational programs and training initiatives focused on hydrogen technologies. By investing in human capital, Argentina aims to ensure that its workforce is equipped with the skills needed to support the growth of the hydrogen sector (Presidencia de Argentina, 2023). The government is collaborating with universities and technical institutions to create specialized training programs that will prepare graduates for careers in hydrogen

production and technology. This commitment to education is crucial for building a sustainable labour force that can adapt to the evolving energy landscape.

The National Hydrogen Strategy also places a strong emphasis on sustainability and environmental considerations. The Argentine government is committed to ensuring that hydrogen production adheres to strict environmental standards and promotes sustainable practices (Presidencia de Argentina, 2023). The strategy outlines measures to mitigate the environmental impact of hydrogen production, particularly concerning water use and land management. For example, the government aims to utilize desalination technologies for water supply in arid regions, minimizing the ecological footprint of hydrogen production.

Moreover, Argentina is engaging in international cooperation to align its hydrogen policies with global best practices. The strategy emphasizes participation in international forums and partnerships to enhance collaboration on hydrogen initiatives (Presidencia de Argentina, 2023). This engagement allows Argentina to share experiences, learn from other countries, and position itself as a significant player in the global hydrogen dialogue. Argentina is actively participating in the Clean Hydrogen Partnership, which facilitates collaboration among European and Latin American countries in hydrogen research and deployment.

To support the financing of hydrogen projects, the Argentine government is exploring various funding mechanisms, including public-private partnerships and international investments. The National Hydrogen Strategy highlights the need for innovative financing solutions to mobilize the necessary capital for large-scale hydrogen production (Presidencia de Argentina, 2023). By attracting investment, Argentina aims to ensure the successful implementation of its hydrogen initiatives and meet its production targets.

Lastly, the Argentine government is committed to monitoring and evaluating the progress of the National Hydrogen Strategy to ensure its effectiveness in achieving the outlined goals. Regular assessments will enable the government to adjust its strategies as needed and respond to emerging trends in the hydrogen market (Presidencia de Argentina, 2023). The strategy emphasizes that “continuous monitoring and evaluation will be essential for the effective implementation” of the hydrogen initiatives (Presidencia de Argentina, 2023).

In comparing the hydrogen strategies of Chile and Argentina, both countries demonstrate a strong commitment to leveraging their abundant renewable resources for green hydrogen production. While Chile's action plan outlines specific measures and an integrated approach to financing and technology, Argentina's strategy emphasizes creating a robust regulatory framework and fostering international collaborations. Both countries aim for ambitious production targets—Chile seeks to produce 25 million tons of green hydrogen annually by 2040, while Argentina aims for 1.5 million tons by 2030—indicating their strategic intentions to be major players in the global hydrogen market. Additionally, both nations are focusing on workforce development and sustainability, highlighting the importance of building a skilled labour force and ensuring environmentally friendly practices in hydrogen production.

5.3 Challenges and Opportunities

As previously stated, the status of green hydrogen has become widely elevated for its critical capability in the energy transition towards decarbonization. A sustainable energy future seems more likely when conjugated with international cooperation, structured policy making and investments in renewable energies, but not without facing the challenges presented by the available energy production methods. Green hydrogen is no exception: despite the many strengths and projects named in this chapter, it is important to acknowledge its limitations and its possible complications. This analysis explores the strengths, weaknesses, opportunities, and threats associated with green hydrogen, drawing insights from recent studies and reports.

One of the primary strengths of green hydrogen is its potential for significant environmental benefits. As a clean fuel produced from renewable energy sources like wind and solar, green hydrogen generates no greenhouse gas emissions at the point of use. Zhang and Li (2024) emphasize that integrating green hydrogen into energy systems can significantly reduce carbon footprints, aligning with global climate targets. Furthermore, green hydrogen can be produced domestically, reducing reliance on imported fossil fuels and enhancing energy security for many countries.

Another notable strength lies in the technological advancements in electrolyser efficiency and cost reductions. IRENA (2020) highlights the rapid development of electrolyser technologies, which have the potential to lower production costs and improve the overall viability of green hydrogen. As electrolyser technologies become more efficient, the economics of green hydrogen production will improve, making it more competitive with traditional hydrogen production methods. Such advancements can facilitate the scaling of hydrogen production, which is essential for meeting increasing global energy demands.

The versatility of green hydrogen is another strength, as it can serve various applications across multiple sectors. From transportation, where hydrogen fuel cells can power vehicles, to industry, where it can replace fossil fuels in processes like steelmaking, green hydrogen's adaptability enhances its attractiveness. As businesses and governments seek cleaner alternatives to fossil fuels, green hydrogen can fill a crucial gap, offering solutions across diverse industries.

However, despite these strengths, green hydrogen is currently challenged by significant weaknesses that impede its wider adoption. One of the most pressing issues is the high cost of production. According to IRENA (2020), while the costs of green hydrogen have been decreasing, they remain higher than those of traditional hydrogen production methods, such as grey hydrogen, which is derived from natural gas. The production costs of green hydrogen depend significantly on the costs of renewable electricity and the efficiency of electrolysis technologies. While exact pricing varies, the consensus is that without further advancements and economies of scale, green hydrogen may struggle to compete on price with fossil fuel-based hydrogen sources.

Furthermore, the limited infrastructure for hydrogen production, storage, and distribution poses a significant barrier. Rodríguez Castillo et al. (2024) detail the complexities involved in hydrogen logistics, noting that hydrogen must be stored under high pressure or at cryogenic temperatures, necessitating advanced and costly storage solutions. The lack of a comprehensive hydrogen infrastructure can result in higher operational costs and logistical challenges, deterring potential investors and slowing down project implementation. This infrastructure gap is particularly pronounced when compared to existing systems for natural gas and electricity.

The environmental impact of hydrogen production methods is another weakness to consider. While green hydrogen is produced using renewable resources, other forms of hydrogen production, such as grey and blue hydrogen, still rely on fossil fuels. If the shift towards green hydrogen is not managed carefully, there could be unintended consequences, such as continued reliance on fossil fuels for production. Ensuring that green hydrogen production scales sustainably is essential to maximizing its environmental benefits.

Opportunities for green hydrogen abound, particularly in the context of the global push for renewable energy sources. The International Renewable Energy Agency (IRENA, 2020) suggests that governments and businesses are increasingly investing in green hydrogen projects, spurred by supportive policies and the need to meet international climate commitments. The development of green hydrogen can create new jobs and stimulate economic growth, particularly in regions rich in renewable resources. As the technology matures and economies of scale are achieved, green hydrogen could become a cornerstone of future energy systems, driving innovation and enhancing energy resilience.

Moreover, international collaboration presents a significant opportunity for green hydrogen development. Boese Cortés and Soto (2023) note that countries rich in renewable resources can export green hydrogen to those with limited domestic production capabilities. This potential for cross-border trade could help diversify energy sources and reduce dependence on fossil fuels. Additionally, as countries ramp up their commitments to combat climate change, the demand for green hydrogen is likely to increase, further driving investment and development. Strategic partnerships between countries can enhance research and development efforts, allowing for knowledge sharing and the establishment of best practices in hydrogen production.

The integration of green hydrogen into existing energy systems is another opportunity worth noting. Zhang and Li (2024) highlight the potential for hydrogen to serve as a long-term energy storage solution, addressing the intermittency of renewable energy sources like solar and wind. By storing excess renewable energy in the form of hydrogen, countries can stabilize their energy grids and ensure a continuous power supply. This integration can also enable a more resilient energy system, capable of responding to fluctuations in demand and supply.

However, the green hydrogen sector also faces threats that could undermine its growth. One significant threat is the competition from alternative energy carriers, such as batteries and other renewable fuels. Zhang and Li (2024) argue that while green hydrogen has unique advantages, its

success will depend on its ability to compete with these alternatives in terms of cost, efficiency, and ease of use. If other technologies continue to advance at a rapid pace, green hydrogen may struggle to establish itself as the preferred energy solution.

Furthermore, geopolitical factors can also pose threats to the green hydrogen market. As nations compete for leadership in the renewable energy sector, the race for technological superiority may lead to trade disputes and regulatory challenges. Boese Cortés and Soto (2023) highlight that countries with established fossil fuel industries may resist the transition to green hydrogen, fearing job losses and economic disruptions. This resistance could slow the pace of policy reforms needed to support green hydrogen adoption and impede the sector's growth.

Market volatility is another threat that green hydrogen must contend with. The global energy market is subject to fluctuations in prices and demand, which can affect investment in green hydrogen projects. If traditional energy prices remain low, the economic incentive to switch to green hydrogen may diminish, slowing progress towards wider adoption. Additionally, the ongoing geopolitical conflicts and global supply chain disruptions can impact the availability of critical materials for electrolyser production, further complicating the green hydrogen landscape.

In conclusion, while green hydrogen presents a promising pathway toward a sustainable energy future, it faces a complex landscape of strengths, weaknesses, opportunities, and threats. As the market continues to evolve, stakeholders must navigate these dynamics to unlock the full potential of green hydrogen. With strategic investments, supportive policies, and international collaboration, green hydrogen can play a vital role in achieving global climate goals and transforming the energy landscape.

5.4 Impact on Host Countries

Green hydrogen projects create a range of economic impacts on host countries by stimulating local economies through direct investments and job creation. As Scita, Raimondi, and Noussan (2020) outline, green hydrogen initiatives require significant capital, translating into large-scale infrastructure projects like hydrogen production facilities, storage units, and distribution networks. These developments generate both short-term construction jobs and long-term positions in operation and maintenance. Additionally, the demand for specialized labour in fields such as engineering, chemistry, and renewable energy drives educational investments, leading to upskilling within the workforce. This evolution of local labour markets aligns with broader national strategies to create sustainable, high-tech employment opportunities.

Environmental benefits are central to green hydrogen’s role in host countries, primarily through emissions reductions and improved air quality. By substituting fossil fuels with green hydrogen, host countries can address local air pollution, which has direct health and environmental benefits. Gómez and Castro (2024) argue that the deployment of green hydrogen in industries like steelmaking, where alternatives to decarbonisation are limited, is particularly effective for reducing carbon emissions.

Furthermore, green hydrogen can help to decarbonize the transport sector, especially in heavy-duty applications where electric vehicles may be less feasible. These environmental improvements contribute to the host countries' compliance with international climate agreements and enhance their reputation as leaders in sustainability.

Water use for electrolysis poses a unique environmental challenge, especially for water-scarce regions. The electrolysis process required for green hydrogen production depends on substantial water resources, which can strain local supplies. Scita et al. (2020) highlight that some countries have responded by investing in desalination plants to supply water without impacting freshwater reserves. Although desalination provides a solution, it is energy-intensive and costly, potentially negating some environmental benefits if not powered by renewable energy. These dynamics necessitate careful water resource management and may influence the feasibility of green hydrogen production in certain regions, affecting the sustainability of these projects.

Green hydrogen's influence extends into geopolitical domains, as it reshapes energy alliances and dependencies. By positioning themselves as green hydrogen producers, host countries can gain strategic leverage as global energy suppliers. According to Scita et al. (2020), nations like Japan and Germany, which are committed to reducing carbon emissions, are looking to secure green hydrogen imports from countries with abundant renewable resources. This demand fosters new energy trade relationships that may reduce historical dependencies on oil and gas. However, the creation of green hydrogen supply chains also introduces new geopolitical complexities, as countries may vie for dominance over these emerging markets, potentially leading to new forms of energy-related influence and competition.

Beyond energy security, green hydrogen can support host countries in achieving energy independence. By converting renewable energy into hydrogen, countries with substantial solar and wind resources can store excess energy for later use, stabilizing their grids and mitigating reliance on imported fuels. Gómez and Castro (2024) emphasize that hydrogen's long-term storage capability allows for more consistent energy supplies, balancing out the intermittency of renewable sources. This energy independence enhances resilience to global market fluctuations and geopolitical tensions, making green hydrogen a crucial component in diversifying energy portfolios and securing sustainable energy access for the future.

Moreover, green hydrogen projects promote technological innovation and drive host countries to become leaders in the global energy transition. Countries investing in green hydrogen not only develop production and storage technologies but also advance the associated technologies, such as fuel cells and distribution infrastructure. Scita et al. (2020) note that countries engaging in the early adoption and development of hydrogen technologies position themselves as global leaders, contributing to their competitiveness in the renewable energy sector. This technological edge enables countries to participate in a growing international market for green hydrogen technologies, further stimulating domestic industries and strengthening economic resilience.

The societal impacts of green hydrogen are also noteworthy. By investing in clean energy infrastructure, host countries can improve their air quality and reduce public health issues related to pollution. In the long term, as green hydrogen becomes more integrated into public transport and industrial systems, there is potential for a broad-based improvement in quality of life. These projects often receive support from local communities, who recognize the environmental and economic benefits of transitioning to clean energy. As Gómez and Castro (2024) highlight, the social acceptance of green hydrogen is integral to its successful implementation, requiring transparent communication and community engagement to address concerns and maximize positive outcomes.

The exploration of green hydrogen's impact on host countries highlights its multifaceted benefits and challenges, reinforcing its potential to drive economic growth, enhance energy security, and promote environmental sustainability. Green hydrogen initiatives stimulate local economies through job creation and infrastructure development while simultaneously contributing to significant emissions reductions. As countries like Chile and Argentina embrace green hydrogen, they position themselves not only as key players in the global energy transition but also as potential exporters in the burgeoning hydrogen market.

Moreover, the geopolitical implications of these developments cannot be overlooked. As nations seek to secure energy supplies through green hydrogen, new trade relationships will emerge, fundamentally altering traditional energy dependencies. However, the path to realizing these benefits is fraught with challenges, including high production costs, the need for robust infrastructure, and the imperative for cohesive regulatory frameworks.

Given the strategic role of green hydrogen in both Chile and Argentina’s renewable energy plans, understanding how each country navigates this complex landscape reveals the broader implications of China’s investments. A comparative analysis offers insights into the distinct yet complementary approaches that each nation adopts in response to shared challenges.

CHAPTER 6

Comparative Analysis between Chile and Argentina

The renewable energy landscapes of Chile and Argentina offer valuable insights into how two neighbouring countries with abundant natural resources are pursuing green energy transitions. Both nations have been the focus of significant Chinese investment, particularly in green hydrogen and other renewable energy projects, but their approaches and outcomes differ due to distinct policy frameworks, regulatory environments, and economic conditions. This chapter will compare the current energy contexts of Chile and Argentina, their respective policies and government incentives, and how these factors shape the trajectory of their renewable energy sectors.

However, the similarities in resource availability share important differences in the political, economic, and strategic environments of both countries. As they both navigate the global push toward decarbonization, their reliance on Chinese investments raises critical questions about sovereignty, economic dependency, and the balance of power in the region. In this chapter, we will critically assess whether these countries are taking divergent paths that reflect different levels of autonomy and sustainability in their renewable energy agendas and whether the long-term geoeconomic consequences of Chinese influence are fully understood.

6.1 Current Energy Context

Chile and Argentina have emerged as key players in the Latin American energy transition, but the paths they have taken reveal distinct national strategies shaped by differing political and economic environments. Chile, with its clear regulatory frameworks and proactive renewable energy policies, has positioned itself as a regional leader, particularly in solar energy and green hydrogen production. Chinese involvement has been instrumental in this rise, as firms such as the State Grid Corporation of China and China Three Gorges Corporation have made strategic investments, especially in solar and hydropower sectors. Argentina, by contrast, faces challenges related to economic instability and a more fragmented regulatory environment, which have complicated its renewable energy ambitions despite its vast wind energy potential.

According to the International Renewable Energy Agency, China's overseas investments in renewables, including hydrogen, reached USD 22 billion in 2022, with Latin America being a key recipient (Ma & Ma, 2023). Chile and Argentina, as resource-rich countries with substantial renewable energy potential, are vital to China's strategic ambitions in the region. Chile’s Atacama Desert, for example, offers ideal conditions for solar energy production, and Chinese companies have taken

advantage of this to invest heavily in photovoltaic projects. While both countries have welcomed Chinese investments in their renewable sectors, the broader implications of this reliance differ. Chile's stable political and regulatory environment has attracted sustained Chinese interest, allowing it to dictate terms more confidently.

A study by Rubertos Matsushima and Felipe R. (2023) indicates that China's Belt and Road Initiative has intensified investments in Argentina, potentially leading to an over-reliance on foreign capital. This dependence is accentuated by the role of China's financial institutions, such as the China Development Bank and the Export-Import Bank of China, which have provided the loans necessary to finance Argentina's large-scale wind projects, including the Cauchari Solar Park and Miramar Wind Farm (Lewkowicz, 2024; Jáuregi, 2021). Argentina, with its weaker institutional framework and economic volatility, risks becoming overly dependent on foreign investments, particularly from China, to sustain its energy projects. This dependency raises concerns about economic sovereignty and control over critical infrastructure (Klement, 2021). These differing contexts highlight the importance of national policies and institutional strength in shaping the outcomes of foreign investments in renewable energy.

Chile and Argentina present contrasting energy landscapes influenced by their unique resources, policies, and economic conditions. As of 2022, Chile has emerged as a leader in renewable energy adoption, generating approximately 49% of its electricity from renewable sources (International Energy Agency [IEA], 2024). This success is partly due to Chinese investments in the country's solar sector, where projects like the Cerro Dominador Solar Plant, financed by Chinese banks, showcase how foreign capital has contributed to Chile's renewable energy growth (Lewkowicz, 2024). This impressive percentage is largely driven by the country's abundant solar and wind resources, particularly in the Atacama Desert, which boasts some of the highest solar irradiance levels in the world (Mavrokordatos & Stascinsky, 2020, p. 5). In fact, the Atacama Desert has been identified as one of the most optimal locations globally for solar energy production (IRENA, 2020). These conditions enable Chile to harness significant renewable energy potential, positioning it as a regional exemplar of energy transition.

In contrast, Argentina's energy matrix remains heavily reliant on fossil fuels, primarily natural gas and coal-generated hydroelectric power. According to EMBER (2022), fossil fuels accounted for around 70% of Argentina's electricity generation, with renewable sources contributing approximately 10%. Despite having significant wind energy potential estimated at 70 GW in the southern regions, Argentina has struggled to integrate renewables effectively into its energy mix (Santamaría, 2023). The reliance on natural gas is supported by domestic reserves, particularly from the Vaca Muerta shale formation, which offers a significant supply source. However, Argentina has substantial potential for wind and solar energy, particularly in the southern regions, which could be harnessed to diversify its energy portfolio.

The current energy consumption patterns in both countries reflect their economic structures and energy needs. In Chile, the energy demand has been rising steadily, driven by industrial growth and

increased electricity consumption. The IEA (2024) indicates that as of 2022, the country consumed approximately 80 terawatt-hours (TWh) of electricity. With projections showing a continued increase in electricity demand by 3.5% annually, Chile faces the need for robust renewable energy infrastructure to maintain energy security (IRENA, 2024). The increasing demand has necessitated investments in renewable energy infrastructure to ensure energy security and stability. Chinese firms such as State Grid have played a pivotal role in providing the necessary infrastructure to meet Chile's growing energy demand, highlighting the importance of foreign capital in Chile's renewable energy strategy.

Argentina, on the other hand, has faced fluctuations in energy consumption due to economic instability. The country consumed around 130 TWh of electricity in 2022, with energy demand often closely tied to economic performance. Due to inconsistent policies, Argentina's renewable energy share has stagnated, leading to missed opportunities for investments in renewables (Gómez & Castro, 2024). Argentina's reliance on Chinese loans to finance renewable energy projects has also led to concerns about economic vulnerability, especially if its financial commitments to Chinese banks become unmanageable in the face of its economic instability (Lewkowicz, 2024). The electricity sector has experienced periods of growth, but inconsistent policies have affected the pace of renewable energy integration, which could support the country's long-term energy needs.

In Argentina, the previously discussed Cauchari Solar Plant is an example of Chinese funding, as the China Machinery Engineering Corporation provided an investment of approximately USD 390 million. It is strategically located in Jujuy Province, contributing to the region's renewable energy goals and representing a key partnership between Argentina and China in solar energy development (Jáuregi, 2021; Myers & Ray, 2024).

Wind projects are of significant relevance when it comes to Argentina. The Miramar Wind Farm received an investment of USD 300 million from the Chinese firm Sinohydro, and involves the installation of 50 wind turbines with a combined capacity of 150 MW. It is expected to generate around 480 GWh annually, further contributing to Argentina's renewable energy landscape (Jáuregi, 2021; International Monetary Fund, 2024). The Cerro de Áspero wind farm has attracted USD 500 million in funding from the State Grid Corporation of China. This project will install 100 wind turbines with a combined capacity of 250 MW. The expected energy generation from this facility is around 450 GWh per year, which will significantly bolster Argentina's renewable energy supply and reduce reliance on fossil fuels (International Monetary Fund, 2024).

In Chile, the El Romero Solar Plant represents a major Chinese investment of approximately USD 1.5 billion. This facility incorporates around 800,000 solar panels and has a projected capacity of 246 MW. It is anticipated to supply power to over 100,000 households, demonstrating the large-scale impact of Chinese investments in the renewable energy sector (Koop, 2024). Another noteworthy project is the Los Cururos Wind Farm, which has received a USD 350 million investment from the China Development Bank. This wind farm will feature 50 turbines with a capacity of 210 MW, generating approximately 210 GWh annually. This project is indicative of the broader trend of Chinese

investment in wind energy, as Chile continues to expand its renewable energy portfolio (International Energy Agency, 2024; Lewkowicz, 2024).

Both Chile and Argentina have implemented policies aimed at enhancing renewable energy development, yet the effectiveness of these initiatives varies. Chile's Renewable Energy Law, established in 2005, has provided a solid regulatory framework, leading to significant investment in renewable technologies. The 2013 Energy Agenda set a target for 20% of the country's energy supply to come from renewables by 2025, a goal that has been surpassed (IEA, 2024). This proactive approach has positioned Chile as a regional leader in renewable energy, attracting foreign investment and fostering innovation in the sector.

A notable aspect of both countries' energy contexts is their potential for green hydrogen production. Chile is actively pursuing green hydrogen as a means to leverage its abundant renewable resources, with plans to become a global leader in hydrogen exports. Chinese investments in this sector are already materializing, as firms like China National Petroleum Corporation (CNPC) explore partnerships to develop green hydrogen projects in Chile. The government has established ambitious targets for green hydrogen production, indicating a significant shift towards a hydrogen economy. In contrast, Argentina is exploring its potential in green hydrogen, particularly in wind-rich regions, but has yet to fully capitalize on these opportunities.

The interdependence of energy systems in the region also warrants attention. According to Mavrokordatos and Stascinsky (2020), changes in energy policies or supply dynamics in one country can influence the other, especially in cross-border energy trade. For example, Argentina's energy policy instability can potentially affect Chile's access to hydroelectric resources from the Patagonia region (Klement, 2021). As both nations navigate their respective energy transitions, understanding this interconnectivity is crucial for shaping regional energy strategies.

The current energy contexts of Chile and Argentina reveal distinct trajectories in their approaches to renewable energy. While Chile has made significant strides in adopting renewables and positioning itself as a leader in the global green hydrogen market, Argentina's energy landscape remains heavily reliant on fossil fuels with substantial untapped renewable potential. This divergence highlights the broader geoeconomic implications of Chinese investments in the region, where Chile’s stability and proactive policies offer a more balanced partnership with foreign investors, while Argentina’s volatility risks leading to dependency and reduced sovereignty (Lewkowicz, 2024). This comparative analysis underscores the importance of tailored energy policies that leverage each country's unique strengths and resources.

6.2 Policies and Government Incentives

Argentina, on the other hand, faces a more complex dynamic. While the country’s vast renewable energy potential—particularly in wind and solar—makes it an attractive investment destination, its economic

instability complicates its relationship with foreign investors. This raises concerns about Argentina's ability to retain sovereignty over its energy assets, especially as Chinese companies often secure long-term control over critical projects through equity stakes and long-term agreements (Santamaría, 2023). This situation highlights the geoeconomic risk that Argentina faces, where short-term economic needs may compromise its long-term control over strategic energy resources.

While both countries aim to attract foreign investment, their ability to manage these investments and ensure they serve national interests varies significantly. Chile's robust institutional frameworks allow it to negotiate favorable terms that align with its long-term energy strategy, particularly in the renewable and hydrogen sectors. In contrast, Argentina's weaker regulatory environment leaves it more vulnerable to external influence, particularly from China. For example, the Miramar Wind Farm, financed by the Export-Import Bank of China, not only underscores the growing Chinese influence in Argentina's energy infrastructure but also highlights the country's increasing dependency on Chinese capital to achieve its renewable energy goals (Jáuregi, 2021).

Chinese financial institutions play a crucial role in facilitating these investments. The China Development Bank and the Export-Import Bank of China have been instrumental in providing funding for renewable energy projects in Latin America. In 2023, Chinese development finance for renewable energy in the region reached about USD 6.4 billion, with more than 60% directed toward wind and solar initiatives in both Chile and Argentina. This significant financial commitment underscores China's strategic focus on enhancing its renewable energy partnerships in Latin America (Myers & Ray, 2024; IEA, 2024).

The geoeconomic implications of these investments are critical. This control over critical resources not only supports China's renewable energy ambitions but also reinforces its strategic position in global supply chains for energy transition technologies, including batteries and electric vehicles.

In Argentina, the stakes are similarly high. The country's vast shale reserves, particularly in Vaca Muerta, combined with its wind energy potential, make it a critical player in the global energy market. This dynamic reflects a broader geoeconomic trend, where Chinese investments in Latin America are as much about securing strategic influence as they are about fostering economic development.

Thus, while both Chile and Argentina have implemented policies aimed at attracting foreign investment, the outcomes differ due to their respective institutional strengths. Chile's ability to attract and shape foreign investment to serve its national interests contrasts sharply with Argentina's more fragmented approach, where reliance on external capital, particularly from China, raises concerns about long-term economic sovereignty. he success of these investments will ultimately depend on the ability of each country to leverage foreign capital without compromising their control over critical energy infrastructure.

6.3 Shared Challenges and Divergent Approaches

Despite their differing approaches, Chile and Argentina face several common challenges in realizing their renewable energy potential, including technological upgrades, regulatory clarity, and infrastructure development. However, their responses to these challenges reflect broader geoeconomic trends, particularly in relation to Chinese investments.

Chile's focus on creating a stable investment environment has positioned it to attract sustained Chinese interest, enabling it to maintain some degree of control over its energy future. In 2022, Chile secured a $2 billion investment from a Chinese state-owned enterprise for solar and wind projects, highlighting the strategic nature of these partnerships (Gómez & Castro, 2024, p. 3110). In contrast, Argentina's more fragmented approach, compounded by its economic struggles, risks deepening its dependency on external powers, particularly China. According to the International Monetary Fund (2024), Argentina's reliance on Chinese financing for energy projects has increased by 40% over the past five years, which could shape the country's energy policy for years to come.

This chapter explores these shared challenges and the countries' divergent responses, offering a critical analysis of how Chinese investments are influencing their renewable energy landscapes. By comparing their trajectories, we can better understand the geoeconomic implications of foreign involvement in their renewable energy sectors, assessing whether these investments are ultimately beneficial for the host countries or if they reinforce existing dependencies and power imbalances.

Both Chile and Argentina face significant challenges in integrating renewable energy sources into their existing electrical grids. As both countries increase their renewable capacity, the International Energy Agency (2024) emphasizes the need for substantial investments in grid infrastructure to manage the intermittency associated with solar and wind energy. The estimated investment required for grid modernization in both countries is approximately $15 billion over the next decade (IEA, 2023). Without adequate infrastructure, the potential of renewables remains underutilized, hindering efforts toward a sustainable energy transition.

Economic stability is a critical factor influencing the pace of renewable energy development in both nations. Chile has enjoyed a relatively stable economic environment, facilitating consistent investments in renewable technologies and infrastructure. The OECD (2023) reports that Chile has effectively attracted foreign direct investment through policies encouraging private sector participation in renewable energy projects. This favourable economic climate has enabled Chile to achieve significant growth in its renewable sector, exemplified by its ambitious goal of reaching 100% renewable energy by 2040.

Conversely, Argentina has faced considerable economic volatility characterized by high inflation and currency devaluation, creating uncertainty regarding long-term energy investments. Mavrokordatos and Stascinsky (2020) highlight that Argentina's energy sector requires an estimated $10 billion annually to transition to renewable sources, yet the current economic instability complicates the

mobilization of such resources. The fluctuating economic conditions in Argentina often lead to delays in project implementation and reduced investor confidence, resulting in a slower transition to renewable energy compared to Chile.

Regulatory frameworks in both countries reflect divergent approaches to fostering renewable energy. Chile's government has established clear and supportive regulations that promote renewable energy investment. The Renewable Energy Law, enacted in 2005, has provided mechanisms for renewable energy certificates and favourable tariffs, significantly attracting investments (Gómez & Castro, 2024). This proactive approach has led to considerable growth in renewable energy capacity and foreign investment, allowing Chile to expand its renewable portfolio rapidly.

Conversely, Argentina's regulatory environment has been characterized by fragmentation and inconsistency, complicating investors' navigation. Despite the initial promise of the RenovAr Program, political instability has often undermined the effective implementation of renewable energy policies (Santamaría, 2023). As of 2023, only 10% of Argentina's total energy generation comes from renewable sources, indicating missed opportunities for harnessing the country’s abundant renewable resources (EMBER, 2022).

Public acceptance of renewable energy initiatives is another shared challenge that both countries must address. Engaging local communities and addressing their concerns about environmental impacts is critical for the successful implementation of renewable projects. In Chile, significant efforts have been made to involve local communities in decision-making processes, which has fostered support for renewable projects. According to the Chilean Ministry of Energy (2022), public consultation and stakeholder engagement are integral to the development of energy projects, ensuring that community interests are considered.

Conversely, Argentina has faced opposition from communities concerned about the implications of renewable projects on land use and local ecosystems, which has led to conflicts and delays. Local resistance can stem from concerns over environmental degradation and the potential displacement of communities, complicating the approval processes for renewable projects (Boese Cortés & Soto, 2023).

Both countries are increasingly recognizing the potential of green hydrogen as a transformative component of their energy strategies. Chile’s National Green Hydrogen Strategy emphasizes leveraging its abundant renewable resources to position itself as a leading exporter of green hydrogen. This strategy underscores the need for substantial investment in research, infrastructure, and international collaboration to develop a competitive hydrogen market (Gobierno de Chile, 2024). Chile aims to produce up to 25 million tons of green hydrogen annually by 2040, creating a market valued at approximately $12 billion (IRENA, 2024).

Argentina is also beginning to explore its potential in the green hydrogen sector, particularly in regions with significant wind resources. The government has initiated discussions to develop policies that would facilitate the production of green hydrogen, acknowledging its importance in achieving

energy independence and meeting international climate commitments (Presidencia de Argentina, 2023). Argentina has set a target to produce 2 million tons of green hydrogen annually by 2030, reflecting a growing recognition of its strategic importance in diversifying the energy matrix and reducing reliance on fossil fuels (Cimmino, 2024).

Technological innovation is essential for both countries as they strive to enhance their renewable energy capacities. Chile has invested significantly in research and development related to energy storage and grid integration technologies to optimize the utilization of its renewable resources (Gómez & Castro, 2024). As of 2024, Chile has allocated $500 million for R&D in renewable technologies, positioning itself favourably in the renewable energy market and enabling the effective integration of renewable sources into its energy system.

In contrast, Argentina's slower adoption of new technologies, influenced by regulatory uncertainty and economic constraints, has limited its ability to effectively integrate renewables into its energy system. The focus on attracting international expertise and investments is crucial for Argentina to advance its technological capabilities in the renewable energy sector. Increased collaboration with foreign firms and research institutions can help facilitate the transfer of knowledge and technology necessary for enhancing Argentina's energy transition, with recent efforts showing potential for growth in joint ventures and technology transfers (Cimmino, 2024).

International collaboration is increasingly important for both nations as they pursue renewable energy goals. Chile's proactive engagement with international stakeholders has positioned it to benefit from knowledge sharing and technological advancements in the renewable energy sector. Establishing strong partnerships enables Chile to enhance its competitiveness in the global green hydrogen market and renewable energy landscape. For example, collaboration with countries like Germany and Japan, which have advanced technologies in hydrogen production and storage, could provide significant benefits (Gobierno de Chile, 2024).

Argentina's international collaboration efforts have been less pronounced, but recent policy developments indicate a growing recognition of the importance of external partnerships in achieving renewable energy objectives (Cimmino, 2024). Establishing strong ties with international organizations and countries that have successfully implemented renewable energy projects can help Argentina gain access to necessary resources and expertise, with discussions underway to engage with EU countries for technical assistance in renewable projects (Santamaría, 2023).

Both countries must also align their energy policies with international climate commitments. As signatories to the Paris Agreement, Chile and Argentina are under pressure to reduce greenhouse gas emissions and enhance their renewable energy capacities. Chile's ambitious targets for renewable energy adoption and its focus on green hydrogen initiatives position it as a model for effective climate action in the region. In contrast, Argentina's progress will depend on its ability to stabilize its political and economic environment to meet similar commitments.

The implications of climate change are intricately linked to the energy strategies of both countries. The urgent need to address climate change drives the necessity for accelerated renewable energy deployment. Chile's commitment to achieving carbon neutrality by 2050 reflects its proactive stance on climate action, with significant investments planned in renewable energy infrastructure (Chilean Ministry of Energy, 2022). In 2024, Chile aims to invest an additional $8 billion in renewable energy projects to support this commitment (IRENA, 2024). Conversely, Argentina's policies need to align more closely with the urgency of climate objectives, requiring a robust and coherent framework for renewable energy adoption.

The increasing significance of green hydrogen as a renewable energy carrier represents a substantial opportunity for both countries. While Chile's strong emphasis on developing a hydrogen economy positions it to meet global demand for clean energy solutions, Argentina's potential in this sector remains largely untapped. The government is beginning to recognize the strategic importance of hydrogen, particularly in its efforts to diversify its energy matrix and reduce reliance on fossil fuels. As of 2023, Argentina has identified key regions for green hydrogen production, particularly in Patagonia, which could support the development of a robust hydrogen economy (Presidencia de Argentina, 2023).

Lastly, enhancing energy storage solutions will be critical for both countries to effectively manage the variability of renewable energy sources. Investing in advanced battery technologies and other energy storage systems is vital for ensuring grid stability and maximizing the benefits of renewable energy integration. Chile is already leading the way with several pilot projects focused on energy storage, with investments projected to reach $1 billion by 2025 (Gobierno de Chile, 2024). Meanwhile, Argentina is beginning to explore storage solutions, yet a cohesive strategy to implement these technologies remains necessary (Santamaría, 2023).

To conclude, while Chile and Argentina share common challenges in their transitions to renewable energy, such as grid integration and public acceptance, their approaches differ significantly. Chile's proactive policies and investments have allowed it to advance rapidly in renewable energy adoption, while Argentina's fluctuating economic conditions and inconsistent policies present barriers to its renewable energy goals. Understanding these dynamics is crucial as both countries navigate their respective paths toward sustainable energy futures, particularly in light of the growing significance of renewable energy and the urgent need for climate action.

Through this comparative exploration, the intricate dynamics of Chinese investments in renewable energy are revealed, illuminating the diverse ways in which Chile and Argentina are conduct their partnerships with China. These findings underscore the broader geoeconomic shifts discussed throughout this thesis, forming the basis for the final reflections on the future of renewable energy in Latin America.

CHAPTER 7

Conclusions

This thesis has provided an in-depth examination of the geoeconomic impacts of China's investments in renewable energy in Latin America, with a particular focus on green hydrogen initiatives in Chile and Argentina. Throughout the study, I sought to understand not only the motivations behind these investments but also their broader implications for the regional energy landscape and global geopolitical dynamics. China's Belt and Road Initiative (BRI) emerged as a significant framework through which these investments have been funnelled, facilitating the expansion of Chinese influence in Latin America while promoting renewable energy development in two countries rich in natural resources. The overarching goal of this research was to explore how these investments reshape energy dynamics, contribute to sustainability goals, and impact local economies.

In exploring the evolution of China's renewable energy investments, it is clear that this trend is both a reflection of and a response to China's strategic interests on the global stage. China has long recognised the need to transition away from fossil fuels and reduce its carbon footprint, and Latin America's vast renewable resources present a unique opportunity to support this goal while expanding China's economic reach. Chile and Argentina, as two of the region's most promising markets for green hydrogen, have become focal points for these investments, with projects that harness their natural potential in solar and wind energy. This combination of economic strategy and environmental responsibility underscores China's broader ambitions, revealing an intricate balance between national interests and global sustainability.

The Belt and Road Initiative plays a crucial role in these developments, serving as a strategic tool for China to extend its influence and foster economic ties with countries across the globe. In Chile and Argentina, BRI-backed projects have catalysed the development of renewable infrastructure, making these countries key partners in China's renewable energy strategy. Through these investments, China is not only facilitating the transition to clean energy but also embedding itself deeply into the economic fabric of Latin America. As such, the BRI's role goes beyond mere economic engagement, positioning China as a central player in the energy landscape of a region historically dominated by Western powers.

A major focus of this thesis has been the potential of green hydrogen, a promising alternative to fossil fuels that could play a pivotal role in the global energy transition. Green hydrogen, produced via renewable energy sources, is particularly suitable for sectors that are challenging to electrify, such as heavy industry and long-haul transportation. With an abundance of solar power in Chile's Atacama Desert and wind energy in Argentina's Patagonia region, both countries are well-positioned to lead the way in green hydrogen production. China's investment in these areas not only accelerates the

development of green hydrogen but also enhances each country's ability to participate in a future, decarbonised global economy.

Chile and Argentina, though both recipients of significant Chinese investments illustrate distinct approaches to developing their green hydrogen sectors. Chile, with its ambitious Green Hydrogen Action Plan, aims to become a global leader in green hydrogen production by 2030. The country's focus on creating favourable regulatory frameworks and facilitating public-private partnerships has attracted Chinese investments, particularly in large-scale solar projects. On the other hand, Argentina has pursued a strategy that leverages its wind resources, aiming to integrate green hydrogen into its broader energy matrix. By tailoring its investments to each country's unique energy profile, China demonstrates a flexible and strategic approach to renewable energy in Latin America.

The comparative analysis between Chile and Argentina reveals how China's investments are adapted to local contexts, showcasing the adaptability of its strategy within the region. While Chile's focus on solar power aligns with China's interest in large-scale projects and favourable investment conditions, Argentina's emphasis on wind energy provides a complementary dynamic. This nuanced approach not only helps China maximize its influence but also ensures that its investments are aligned with the specific energy needs and policy landscapes of each country. As such, these tailored investments highlight China's ability to navigate diverse regulatory environments, which is essential for maintaining long-term partnerships in the region.

Beyond the immediate economic impacts, China's renewable energy investments in Latin America carry significant geopolitical implications. By deepening its ties with Chile and Argentina, China is establishing a foothold in a region that has traditionally been within the sphere of Western influence. This shift could lead to a reconfiguration of international relations in Latin America, where China's presence offers an alternative to traditional Western alliances. As Latin American countries increasingly turn to China for economic partnerships, the region's geopolitical alignment may evolve, potentially altering its historical reliance on the United States and Europe.

However, these investments are not without challenges. While green hydrogen holds promise as a clean and versatile energy source, there are still significant barriers to its widespread adoption. The environmental implications, particularly concerning water usage for electrolysis, pose challenges in arid regions like northern Chile. Moreover, economic dependencies on Chinese capital could impact the autonomy of host countries, leading to concerns about long-term sovereignty and control over critical infrastructure. Despite these challenges, China's involvement has created a pathway for Latin America to accelerate its renewable energy transition and reduce its carbon footprint.

From a broader perspective, China's renewable energy investments represent a transformative force in the global energy market. By focusing on regions rich in renewable resources, China is strategically positioning itself as a leader in the green energy revolution. This positioning not only supports China's domestic climate goals but also enables it to shape the future of energy on a global scale. As more countries seek to reduce their reliance on fossil fuels, China's investments in Latin

America highlight its commitment to establishing a diversified, renewable energy portfolio that can drive sustainable economic growth in emerging markets.

Nevertheless, this study is not without its limitations. The analysis has primarily focused on Chile and Argentina, which, while offering significant insights, may not capture the full diversity of experiences across Latin America. Furthermore, access to detailed, up-to-date data on specific projects remains a challenge, as commercial confidentiality and political sensitivities often restrict transparency. These limitations suggest that further research is needed to explore the social and environmental impacts of China's investments across a broader range of Latin American countries and to better understand the long-term sustainability of these projects.

Future research could also investigate the potential for renewable energy initiatives in Latin America to foster regional cooperation. Given the shared environmental challenges and renewable resources across the continent, China's investments could provide a catalyst for Latin American countries to collaborate more closely on energy policy. Such cooperation could strengthen the region's collective bargaining power in international energy markets, potentially offering a counterbalance to the influence of major global players like the United States and China itself.

Moreover, as the global demand for green hydrogen and other renewable technologies grows, Latin America's role in the global energy transition is likely to become increasingly important. Countries like Chile and Argentina have the potential to become leaders in renewable energy production, contributing not only to regional development but also to global efforts to combat climate change. China's investments have positioned Latin America as a critical player in the energy transition, but realizing this potential will require careful management of resources and sustained policy commitment from host countries.

Ultimately, China's renewable energy investments in Latin America reflect a broader shift in global power dynamics. As these countries embrace green technologies, they are also embracing a new economic and geopolitical reality in which China plays an increasingly central role. The future of renewable energy in Latin America will be shaped by the interplay between Chinese investment, local policy frameworks, and global energy demands. As this thesis has shown, this interplay is complex and multifaceted, but it also offers a path forward for countries seeking to align economic development with environmental sustainability.

Looking ahead, Latin America stands on the brink of a renewable energy revolution, with the potential to become a global leader in green hydrogen and other renewable technologies. China's role in this transformation will be pivotal, as its investments provide both the financial resources and technological expertise needed to capitalize on the region's vast renewable resources. If managed wisely, these partnerships could pave the way for a more sustainable and equitable energy future, benefiting not only Latin America but also the global community as a whole.

In conclusion, the renewable energy landscape in Latin America is rapidly evolving, driven by both local initiatives and international partnerships. China's strategic investments in Chile and Argentina

exemplify the potential for renewable energy to foster sustainable development and transform regional economies. By understanding the geoeconomic implications of these investments, we gain valuable insights into the future of energy and the shifting balance of power in a world increasingly defined by the pursuit of sustainability.

Bibliography

Blackwill, R. D., & Harris, J. M. (2016). *War by Other Means: Geoeconomics and Statecraft*. The Belknap Press of Harvard University Press.

Bloomberg Financial. (2023, November 21). *China's Contributions to Latin America's Push to Net Zero*. BloombergNEF. https://about.bnef.com/blog/chinas-contributions-to-latin-americas-push-to-net-zero/

Boese Cortés, I. & Soto, I. (2023). Renewable Hydrogen in Latin America and the Caribbean: Opportunities, Challenges, and Pathways. LAC Green Hydrogen Action. Santiago, 80.

Brown, A., & Grünberg, N. (2022). CHINA'S NASCENT GREEN HYDROGEN SECTOR: How policy, research and business are forging a new industry. In *MERICS CHINA MONITOR*. https://merics.org/sites/default/files/2022-06/MERICS_China_Monitor_No_77_Green-Hydrogen_EN_final.pdf

CASTRO, D. (2024). THE IMPLICATIONS OF CHINESE INVESTMENT ON LATIN AMERICA'S ENERGY TRANSITION. *Macau Journal of Brazilian Studies*, *7*(1). Research Gate. https://www.researchgate.net/publication/379823199_THE_IMPLICATIONS_OF_CHINESE_INVESTMENT_ON_LATIN_AMERICA'S_ENERGY_TRANSITION/

Chilean Ministry of Energy. (2022). "Transición Energética de Chile Política Energética Nacional". Retrieved from https://energia.gob.cl/sites/default/files/documentos/pen_2050_-_actualizado_marzo_2022_0.pdf

Cimmino, J. (2024, February 12). *Beijing's influence on Latin America's energy mix is growing—especially in renewables*. Atlantic Council. https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/beijings-influence-on-latin-americas-energy-mix-is-growing-especially-in-renewables/

Comisión Económica para América Latina y el Caribe (CEPAL). (2024). *Panorama de los recursos naturales en América Latina y el Caribe, 2023* (LC/PUB.2024/4). Santiago.

Costa, C. M. (2023). The globalizing discourse of the Belt and Road Initiative. In P. A. B. Duarte, F. J. B. S. Leandro, & E. M. Galán (Eds.), *The Palgrave handbook of globalization with Chinese characteristics* (pp. 55–66). Singapore: Palgrave Macmillan.

Costa, C. M. (2024). China: o Encontro entre a Geografia, a Economia e a Segurança. *Nação E Defesa*, *166*, 31–46. https://revistas.rcaap.pt/nacao/article/view/37199

Costa, C. M. (2024). LA UNIÓN EUROPEA Y CHINA EN AMÉRICA LATINA Y EL CARIBE: LA ESTRATEGIA GLOBAL GATEWAY Y LA INICIATIVA BELT & ROAD in "Inteligencia Artificial y Diplomacia: Las relaciones internacionales en la era de las tecnologías disruptivas". *Sistema Económico Latinoamericano y del Caribe*. 101-112. ISBN 978-980-6458-28-4. https://www.sela.org/media/3231818/ia-diplomacia-ia-las-relaciones-internacionales-en-la-era-de-las-tecnologias-diruptivas.pdf

Duarte, P. A. B., Leandro, F. J. B. S., & Galán, E. M. (Eds.) (2023). *The Palgrave Handbook of Globalization with Chinese Characteristics: The Case of the Belt and Road Initiative*. Springer Nature.

Duarte, P., Leandro, F., & Martínez-Galán, E. (Eds.). (2023). *The Palgrave handbook of globalization with Chinese characteristics*. Singapore: Palgrave Macmillan.

Ellis, E. (2024, February 28). *Is China Cornering the Green Energy Transition in Latin America?* Diálogo Américas. https://dialogo-americas.com/articles/is-china-cornering-the-green-energy-transition-in-latin-america/

EMBER. (2022, March 28). *Argentina | Electricity Trends*. Ember. https://ember-climate.org/countries-and-regions/countries/argentina/

European Hydrogen Observatory. (2023). The European hydrogen market landscape. In *European Hydrogen Observatory, co-funded by the European Union*. https://observatory.clean-hydrogen.europa.eu/sites/default/files/2023-11/Report%2001%20-%20November%202023%20-%20The%20European%20hydrogen%20market%20landscape.pdf

Francisco, & Santos. (2024). A SWOT Analysis of the Green Hydrogen Market. *Energies*, *17*(13), 3114. https://doi.org/10.3390/en17133114

García, M. J., & Arana, A. G. (2022). *Latin America – European Union relations in the twenty-first century*. Manchester University Press.

Garrison, C. (2019, April 23). *On South America's largest solar farm, Chinese power radiates*. Reuters. https://www.reuters.com/article/business/environment/on-south-americas-largest-solar-farm-chinese-power-radiates-idUSKCN1RZ0B1/

Gobierno de Chile. (2024). *Plan de Acción de Hidrógeno Verde 2023-2030*. Gobierno de Chile | Plan Hidrógenio Verde Chile. https://www.planhidrogenoverde.cl/

Gómez, J. & Castro, R. (2024). Green Hydrogen Energy Systems: A Review on Their Contribution to a Renewable Energy System. *Energies*, *17*(13), 3110. https://doi.org/10.3390/en17133110

González-Ruiz, J. D., Mejía-Escobar, J. C., Rojo-Suárez, J., & Alonso-Conde, A.-B. (2023). Green bonds for renewable energy in latin america and the caribbean. The Energy Journal, 44(5), 5. https://doi.org/10.5547/01956574.44.4.jgon

Hilton, I. (2024). *How China Became the World's Leader on Renewable Energy*. Yale School of the Environment. https://e360.yale.edu/features/china-renewable-energy

Hiratuka, C. (2018). *Chinese infrastructure projects in Brazil*. In *Building development for a New Era*. Asian Studies Center. Retrieved from ResearchGate.

IEA (2023), Global Hydrogen Review 2023, IEA, Paris https://www.iea.org/reports/global-hydrogen-review-2023, Licence: CC BY 4.0

IEA. (2024). *Energy System of China - Energy Mix*. International Energy Agency. https://www.iea.org/countries/china

IEA. (2024). *Overview and key findings – World Energy Investment 2024 – Analysis - IEA*. International Energy Agency. https://www.iea.org/reports/world-energy-investment-2024/overview-and-key-findings

International Energy Agency. (2024). *Argentina - Countries & Regions*. IEA. https://www.iea.org/countries/argentina

International Energy Agency. (2024). *Chile - Countries & Regions*. IEA. https://www.iea.org/countries/chile

International Institute for Sustainable Development. (2019, September 11). *Renewable Energy Investment to Surpass USD 2.5 Trillion for 2010-2019, UNEP Report Finds*. SDG Knowledge Hub; SDG Knowledge Hub. https://sdg.iisd.org/news/renewable-energy-investment-to-surpass-usd-2-5-trillion-for-2010-2019-unep-report-finds/

International Monetary Fund. (2024). Argentina: EIGHTH REVIEW UNDER THE EXTENDED ARRANGEMENT UNDER THE EXTENDED FUND FACILITY, REQUESTS FOR MODIFICATION OF PERFORMANCE CRITERIA, WAIVERS OF NONOBSERVANCE OF PERFORMANCE CRITERIA, AND FINANCING ASSURANCES REVIEW—PRESS RELEASE; STAFF REPORT; AND STATEMENT BY THE EXECUTIVE DIRECTOR FOR ARGENTINA. In *International Monetary Fund*. *24*(167).

IRENA (2020), Green Hydrogen Cost Reduction: Scaling up Electrolysers to Meet the 1.5ºC Climate Goal, International Renewable Energy Agency, Abu Dhabi. Retrieved from https://www.irena.org/publications/2020/Dec/Green-hydrogen-cost-reduction

IRENA (2024), International co-operation to accelerate green hydrogen deployment, International Renewable Energy Agency, Abu Dhabi. ISBN: 978-92-9260-592-6.

IRENA (2024). Green hydrogen strategy: A guide to design. *International Renewable Energy Agency*, Abu Dhabi. ISBN: 978-92-9260-611-4.

Jáuregi, J. G. (2021). *How Argentina Pushed Chinese Investors to Help Revitalize Its Energy Grid*. Carnegie Endowment for International Peace. https://carnegieendowment.org/research/2021/12/how-argentina-pushed-chinese-investors-to-help-revitalize-its-energy-grid?lang=en

Joffe, A. M. (2018). Green Giant: Renewable Energy and Chinese Power. *Foreign Affairs*, *97*(2), 83–93. http://www.jstor.org/stable/44822083

José, F., & Duarte, P. A. B. (Eds.) (2020). The Belt and Road Initiative: an old archetype of a new development model. Palgrave Macmillan, Singapore.

Julián Gómez, & Castro, R. (2024). Green Hydrogen Energy Systems: A Review on Their Contribution to a Renewable Energy System. *Energies*, *17*(13), 3110. https://doi.org/10.3390/en17133110

Klement, J. (2021). Chapter 8: The Geopolitics of Renewable Energy. In *Geo-Economics: The Interplay between Geopolitics, Economics, and Investments* (pp. 206–247). CFA Institute: Policy and Research Center. https://doi.org/10.56227/22.1.4-9 .

Koop, F. (2024, September 3). *Q&A: "Chinese companies are making progress, while Europe lags."* Dialogue Earth. https://dialogue.earth/en/energy/qa-chinese-companies-are-making-progress-while-europe-lags/

Lambert, M., Barnes, A., Marcu, A., Imbault, O., Bhashyam, A., Tengler, M., Cavallera, C., & Romeo, G. (2024). 2024 State of the European Hydrogen Market Report. In *The Oxford Institute for Energy Studies*. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2024/06/2024-State-of-the-European-Hydrogen-Market-Report.pdf

Lewkowicz, J. (2024, July 18). *How is Chinese investment in Latin America changing?* Dialogue Earth. https://dialogue.earth/en/business/how-is-chinese-investment-in-latin-america-changing/

Li, Y., & Zhu, X. (2019). The 2030 Agenda for Sustainable Development and China's Belt and Road Initiative in Latin America and the Caribbean. *Sustainability*, *11*(8). https://doi.org/10.3390/su11082297

Ma, Z., & Ma, Y. (2023). *What's After Coal? Accelerating China's Overseas Investment in Renewables*. World Resources Institute. https://www.wri.org/insights/whats-after-coal-accelerating-chinas-overseas-investment-renewables#

Majano, A. M., Flavin, C., Gonzales, M., Ochs, A., Rocha, M. da, & Tagwerker, P. (2014). Study on the Development of the Renewable Energy Market in Latin America and the Caribbean. *WorldWatch Institute*, *14*(2). Inter-American Development Bank. https://doi.org/10.18235/0009227

Mavrokordatos, P., & Stascinsky, S. (2020). A Statistical Analysis of the Economies of Argentina and Chile, and a Measurement of their Interdependence. In *3rd International Conference on Business, Management and Economics*, Hungary. https://www.dpublication.com/wp-content/uploads/2020/03/1009.pdf

Merino, G. E., Víctor Ramiro, F., & González Jáuregui, M. J. (2023). Argentina and Latin America under the rise of China and the Belt and Road initiative: Challenges and Proposals for a Constructive Integration. In *Development and Cooperation: Perspectives from China and Argentina* (pp. 225–236). China Social Sciences Press. https://doi.org/978-0-367-49221-2

Mohseni-Cheraghlou, A. (2023, November 30). *Geoeconomic fragmentation is threatening the green energy transition*. Atlantic Council. https://www.atlanticcouncil.org/blogs/econographics/geoeconomic-fragmentation-is-threatening-the-green-energy-transition/ .

Myers, M., & Ray, R. (2024). CHINA-LAC REPORT FEELING THE STONES:* CHINESE DEVELOPMENT FINANCE TO LATIN AMERICA AND THE CARIBBEAN, 2023 Chinese DFI Lending in LAC. In *The Dialogue: Leadership for the Americas*.

https://www.thedialogue.org/wp-content/uploads/2024/06/Chinese-Development-Finance-in-Latin-America-and-the-Caribbean-2023-Update-Final.pdf

Myllyvirta, L. (2024, January 25). *Analysis: Clean energy was top driver of China's economic growth in 2023 - Carbon Brief*. Carbon Brief. https://www.carbonbrief.org/analysis-clean-energy-was-top-driver-of-chinas-economic-growth-in-2023/

OCDE, et al. (2023). *Perspectivas económicas de América Latina 2023: Invirtiendo para un desarrollo sostenible*. OECD Publishing. https://doi.org/10.1787/5cf30f87-es

OECD. (2023). Policies to harness FDI for Chile's sustainable development. In *FDI Qualities Review of Chile: Boosting Sustainable Development and Diversification*, OECD Publishing, Paris. 59-96. https://doi.org/10.1787/98bf1829-en.

Presidencia de Argentina. (2023). Estrategia Nacional para el Desarollo de la Economia del Hidrogenio. In *Secretaría de Asuntos Estratégicos*. https://www.argentina.gob.ar/sites/default/files/2023/07/estrategia_nacional_de_hidrogeno_-_sae.pdf

Ritchie, H., Roser, M., & Rosado, P. (2020, May 11). *CO_2 and Greenhouse Gas Emissions*. Our World in Data. https://ourworldindata.org/energy/country/argentina?country=ARG~CHL#citation

Robertos Matsushima, Felipe R. (2023). One Belt One Road Initiative and Its Implications for Latin America. *BCP Business & Management MEEA*, 48. DOI: 10.54691/bcpbm.v48i.5260

Rodríguez Castillo, C. A., Yeter, B., Li, S., Brennan, F., & Collu, M. (2024). A critical review of challenges and opportunities for the design and operation of offshore structures supporting renewable hydrogen production, storage, and transport. *European Academy of Wind Energy*, *9*(3), 533–554. https://doi.org/10.5194/wes-9-533-2024

Rubio, T. G., & Jáuregui, J. G. (2022). Chinese Overseas Finance in Renewable Energy in Argentina and Brazil: Implications for the Energy Transition. Journal of Current Chinese Affairs, 51(1), 137-164. https://doi.org/10.1177/18681026221094852

Santamaría, G. (2023). *Argentina: Renewables and Energy Transition - Policy and Latest Developments*. Latin Lawyer. https://latinlawyer.com/insight/renewables-and-energy-transition-hub/2023/article/argentina-renewables-and-energy-transition-policy-and-latest-developments

Scita, R., Raimondi, P. P., & Noussan, M. (2020). Green Hydrogen: The Holy Grail of Decarbonisation? An Analysis of the Technical and Geopolitical Implications of the Future Hydrogen Economy. *SSRN Electronic Journal*, 13. https://doi.org/10.2139/ssrn.3709789

SELA. (2024). Inteligencia Artificial y Diplomacia: Las relaciones internacionales en la era de las tecnologías disruptivas. *Sistema Económico Latinoamericano y del Caribe*. ISBN 978-980-6458-28-4. https://www.sela.org/media/3231818/ia-diplomacia-ia-las-relaciones-internacionales-en-la-era-de-las-tecnologias-diruptivas.pdf

Szczepański, M. (2023). The Global Gateway: Taking stock after its first year. *Servicio de Investigación del Parlamento Europeo*.

Ungaretti, C. R., Nunes, T. G. A., & Mendonça, M. A. A. de. (2024). As dinâmicas de transição energética no Brasil e na Argentina : potencialidades, limites e o papel da China. *Boletim de Economia E Política Internacional*, *38*, 55–101. https://doi.org/10.38116/bepi38art2

VASQUEZ, P. I. (2018). What Is in It for Latin America? In *China, Oil, and Latin America: MYTH VS. REALITY* (pp. 7–11). Atlantic Council. http://www.jstor.org/stable/resrep16769.8

Wang, L., Liu, W., Sun, H., Yang, L., & Huang, L. (2024). Advancements and Policy Implications of Green Hydrogen Production from Renewable Sources. *Energies*, *17*(14), 3548. https://doi.org/10.3390/en17143548

Xie, Yuetao & Yan, Bingzhong & Zhou, Shichun. (2018). Renewable energy and power cooperation between China and six Latin American nations. IOP Conference Series: Earth and Environmental Science. 121. 052058. 10.1088/1755-1315/121/5/052058.

Zhang, J., & Li, J. (2024). Revolution in Renewables: Integration of Green Hydrogen for a Sustainable Future. *Energies*, *17*(16), 4148. https://doi.org/10.3390/en17164148