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# The Hualong-1 project in Argentina: a case study on the economic, technological, and geopolitical complexities of the belt and road initiative

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China's Belt and Road Initiative (BRI) offers major opportunities for trade, investment, and connectivity, yet these are accompanied by structural challenges such as debt sustainability, limited transparency, and uneven technology transfer. The Hualong-1 nuclear power project in Argentina illustrates these tensions, reflecting the interplay between domestic vulnerabilities and global geopolitical dynamics. Using grounded theory and in-depth elite interviews, this study analyzes Argentina's nuclear cooperation with China under the BRI through political, economic, and technological lenses. Findings reveal that Argentina's chronic macroeconomic instability, political fluctuations, and social-environmental opposition undermine project viability. The turnkey contract model further restricts technology transfer, resulting mainly in local assembly under Chinese supervision and limiting Argentina's pursuit of nuclear autonomy. Geopolitically, the Hualong-1 project is shaped by the intensifying U.S.-China rivalry, constraining Argentina's policy space and amplifying its dependence. The study concludes that Argentina's engagement under the BRI embodies a complex rationality where national ambitions, economic constraints, and external power competition continuously interact.

KEYWORDS

**belt and road initiative, nuclear energy, debt-trap diplomacy, technology transfer, geopolitics**

## 1 Introduction

The Belt and Road Initiative (BRI) stand as a monumental global infrastructure and connectivity strategy, offering substantial economic opportunities through enhanced trade, increased investment flows, and significant potential for poverty reduction. Anticipated outcomes, as projected by the Word Bank, include a notable reduction in transportation time and trade costs, alongside a positive impact on the Gross Domestic Product of participating countries (Maliszewska and Van Der Mensbrugghe, 2019). These projections are further supported by a number of academic studies. On the other hand, some scholars, using the elasticity between trade costs, infrastructure quality, and per capita income, argue that the BRI can generate significant benefits both for its member countries and for the rest of the world (Zhai, 2018). Another study applies sectoral estimates of the "value of time" to translate changes in transport duration into ad valorem trade costs at the country–industry level. The findings indicate that the BRI could substantially reduce transport time and costs, with global

transport times declining by 1.2–2.5% and overall trade costs falling by 1.1–2.2% (De Soyres et al., 2019).

However, these opportunities are often juxtaposed with a complex set of significant challenges that extend far beyond questions of financial feasibility. While concerns such as debt sustainability for host nations, the uneven effectiveness of technology transfer, and the long-term economic viability of individual projects remain central (Gangte, 2020; Buckley, 2020), they constitute only a subset of the broader structural and political dilemmas associated with the BRI. A comprehensive assessment must also take into account the intensification of geopolitical rivalries, particularly the strategic competition between China and the United States (Callahan, 2016; Rolland, 2017); the potential environmental and social externalities generated by large-scale infrastructure projects, including risks to biodiversity, community displacement, and labor exploitation (Ascensão et al., 2018; Huang, 2016); persistent difficulties in aligning governance structures and regulatory regimes across highly heterogeneous national contexts (Summers, 2016; Jones and Hameiri, 2020); and recurrent issues of transparency, accountability, and corruption in project financing and implementation (Hurley et al., 2018; Brautigam, 2020). Moreover, scholars have emphasized that, rather than fostering equitable partnerships, the BRI risks reinforcing existing asymmetries of power and dependency between China and recipient states, thereby shaping long-term patterns of political economy in ways that may constrain developmental autonomy (Dreher et al., 2018).

The BRI's stated aim to facilitate technology and knowledge transfer is a crucial component of its developmental promise (Deng et al., 2020). Yet the effectiveness of such transfer has proven highly variable and contingent upon a range of structural and institutional factors. A long-standing body of research highlights that the absorptive capacity of host countries—defined by their industrial base, human capital, and institutional robustness—plays a decisive role in determining whether external technologies can be effectively internalized and adapted (Cohen and Levinthal, 1990; Bozeman, 2000). A recent study evaluating China's clean technology transfer potential to 58 BRI countries across four dimensions found substantial cross-country variation, confirming that the effectiveness of such transfers differs widely across projects and national contexts (Zhang et al., 2023).

Furthermore, the nature of project delivery significantly shapes outcomes. The predominance of turnkey projects has often limited the scope for genuine capacity building, as local firms and workers are confined to low-skilled tasks while critical stages of design and engineering remain under the control of Chinese contractors (Fitria, 2021). This limited local integration is often a structural feature of the project's design, as seen in the frequent retention of core components or system-level intellectual property during the process of technology export (Ding, 2024). Similarly, a reliance on imported Chinese labor and technologies has constrained the development of localized expertise, thereby reducing long-term spillover potential (Eom et al., 2018). Taken together, these dynamics highlight that while the rhetoric of the BRI emphasizes technology transfer, its realization remains uneven and structurally conditioned, often reinforcing rather than alleviating patterns of technological dependency.

While domestic absorptive capacity undeniably shapes the effectiveness of technology transfer, attributing outcomes primarily to host-country limitations risks obscuring the strategic dynamics embedded within BRI project design. A growing body of research highlights those contractual modalities, particularly those structured under EPC and public–private partnership frameworks, frequently restrict the scope of local integration and systematically privilege the retention of technological control by Chinese firms (Tan-Mullins et al., 2010; Urban et al., 2015). In this context, limited technology transfer should not be understood merely as an unintended consequence but rather as a recurring structural feature, where intellectual property, high-value engineering functions, and operational expertise remain concentrated in foreign firms' hands. Such strategies hat consolidate asymmetrical dependencies and reinforce China's control over critical segments of infrastructure's value chains.

A post-completion evaluation of BRI projects reveals a mixed picture regarding their long-term economic viability. Certain projects have had a positive impact on trade facilitation and regional connectivity (Edi, 2023), they have also generated spillover effects that boosted neighboring countries' trade with China (WEI and Sukhotu, 2021). Others have faced underperformance, high operational costs, and insufficient integration into local economies (Weng et al., 2021). This uneven performance frequently translates into a failure to deliver the anticipated economic returns or to ensure an equitable distribution of benefits within host societies (Adeniran et al., 2021; Pencea, 2018). Importantly, these divergent outcomes should also be understood within individual dimensions. Connectivity, which mentioned by the BRI, demonstrates both positive and negative results depending on the specific project. While the Ethiopia–Djibouti railway and related industrial parks have strengthened cross-border linkages and facilitated trade flows, Kenya's Standard Gauge Railway has been hampered by high operational costs, debt sustainability concerns, and weak integration into local economies (Mboya, 2020). In addition, serious environmental, social, and governance concerns, ranging from labor rights violations to instances of ecological degradation, have further complicated project outcomes and raised doubts about the alignment of BRI initiatives with the long-term objectives of sustainable development (Halegua, 2020; Sattar et al., 2022).

China's Hualong-1 project in Argentina, while not yet completed, serves as a pivotal case study for comprehending the complexities inherent in large-scale project implementation within an international context. Its significance stems from the intersection of multiple analytical dimensions, rendering it an ideal subject for exploring challenges and opportunities in transnational cooperation. The project clearly exemplifies how macroeconomic instability and political shifts can directly impact the long-term viability of critical infrastructure initiatives (Jedwab and Storeygard, 2019). Concurrently, the Hualong-1 project provides a unique lens through which to examine the dynamics of technology transfer. Debates surrounding the turnkey model and the actual extent of knowledge transfer highlight the dual factors that shape outcomes. On the one hand, the absorptive capacity of recipient countries, including institutional robustness, industrial development, and human capital, remains a key determinant of whether external technologies can be effectively internalized (Lall, 1993). On the other hand, technology transfer is equally conditioned by the willingness of the supplier. Through contractual design, the retention of intellectual property, and the monopolization of high-value engineering processes, BRI actors may intentionally limit or withhold knowledge flows, thereby hindering technology transfer. Moreover, this project is situated within a broader framework of

geopolitical pressures, rendering it an ideal scenario for analyzing how international relations and power dynamics influence bilateral cooperation. The intricate interplay of these economic, technological, and geopolitical factors, coupled with recurrent shifts in political leadership, elucidates the rationality underlying the decisions of involved actors and the inherent complexities of implementing projects of this magnitude.

Existing scholarship on China-Argentina energy cooperation has predominantly concentrated on international relations theories and quantitative economic analysis (Rubio and Jáuregui, 2022; Ugarteche et al., 2023). However, a notable lacuna has been identified in the extant literature: a dearth of qualitative research exploring the rationality of actors engaged in nuclear cooperation. This gap is particularly crucial given Argentina's adherence to the Treaty on the Non-Proliferation of Nuclear Weapons and the present study's focus on the peaceful utilization of nuclear technology for energy production, a frequent point of contention in bilateral discussions.

For the purposes of this study, rationality is defined as the logic and motivations guiding the decisions of actors in China-Argentina nuclear cooperation, particularly concerning the Hualong-1 reactor project. Building on earlier conceptualizations of rationality in international relations (Keohane, 2005), we adopt a grounded theory approach that interprets rationality through observed actions, official statements, and policy choices. This perspective underscores the context-specific and bounded nature of decision-making, rather than assuming universal or priori logic. Accordingly, rationality in this study is not confined to the maximization of economic efficiency, but also incorporates strategic, cultural, and political objectives that shape foreign policy and technological cooperation outcomes.

To address these objectives, the study employs in-depth interviews with stakeholders engaged in China–Argentina nuclear cooperation The interviews focused on the period from 2011 to 2023, which respondents identified as the relevant timeframe for bilateral engagement. This span covers the initial phase of cooperation and agreements for new power reactor construction and extends up to the end of the Fernández administration, immediately before President Milei took office. Employing this qualitative, process-tracing approach, the study aims to examine the Hualong-1 project under the BRI as a case study through which to explore broader structural dynamics in China's engagement with the Global South. It is important to note that the Hualong-1 project is not presented as a universally representative case. Instead, given the remarkable diversity of BRI projects across various sectors and contexts, it is selected as a strategic case to provide deep insights into the specific political and economic dynamics of China's high-tech infrastructure cooperation in South America. Specifically, this research endeavors to uncover how issues of debt sustainability and effective technology transfer are negotiated and perceived in practice, thus moving beyond macroeconomic modeling or official policy narratives to capture the tangible challenges and expectations articulated by national actors. By concentrating on the micro-dynamics of this cooperation, the research endeavors to contribute to a more empirically grounded understanding of whether Chinese-led infrastructure and technology initiatives promote long-term developmental autonomy or reproduce novel forms of dependency within a South–South cooperation framework.

The remainder of this paper is organized as follows. Section II traces the historical trajectory of China–Argentina nuclear cooperation, with particular attention to the evolution of the Hualong-1 project. Section III outlines the qualitative methodology employed in this research, including data collection procedures, informant profiles, and the coding process, before presenting the key findings on the project's structural constraints. Section IV extends the analysis beyond the specific case to examine three core structural challenges and their associated developmental trade-offs in the broader context of BRI infrastructure cooperation: debt sustainability, the effectiveness of technology transfer, and geopolitical dynamics. Finally, Section V argues that the outcomes of both the Hualong-1 project and BRI cooperation more broadly cannot be reduced to simple judgments of success or failure, but depend on how these challenges are negotiated within asymmetrical partnerships.

## 2 The development of China–Argentina nuclear cooperation

Argentina possesses a long and well-established history in nuclear energy development, commencing in the mid-20th century with the creation of the National Atomic Energy Commission (CNEA) in 1950. This institution centralized nuclear activities for decades, thereby consolidating its role as a pivotal actor not only within the nuclear field but also across the broader national science and technology system. During the 1990s, as part of a comprehensive sector reorganization, CNEA relinquished its monopoly, leading to the establishment of the National Regulatory Authority (ARN) and the state-owned company Nucleoeléctrica Argentina Sociedad Anónima (NA-SA), which subsequently focused on nucleoelectricity production.

Among Argentina's significant accomplishments in nuclear energy are the commissioning of the region's first research reactor, RA-1, in 1958; the inaugural power plant, Atucha I, in 1974; and the mastery of the nuclear fuel cycle (Hurtado, 2014; Rodríguez, 2020). Currently, Argentina operates three atomic centers dedicated to research and development, five research and radioisotope production reactors, and three power reactors, collectively contributing approximately 4% of the country's installed electrical generation capacity (OLADE, 2023). The country also plans to construct new reactors, including the completion of CAREM, a nationally designed small modular reactor. This deep-rooted expertise, coupled with significant uranium reserves, positions Argentina as a leader in nuclear technology within Latin America, distinguishing it as one of the few countries in the region possessing both research and power reactors.

The more recent history of technological collaboration in the nuclear field between China and Argentina traces its origins to the 2012 visit of Chinese Premier Wen Jiabao to the Latin American nation. During this meeting, a nuclear energy cooperation agreement was signed between China's National Energy Administration and Argentina's Ministry of Federal Planning, Public Investment, and Services, with then-President Cristina Fernández de Kirchner also present. In July 2014, the Joint Declaration on the Establishment of a Comprehensive Strategic Partnership between Argentina and China stipulated a commitment to further promote collaboration in science and technology, nuclear energy, space, and defense, within the framework of their joint action plan. Among the most notable agreements was the signing of an $11 billion currency swap agreement between China's Ministry of Commerce and Argentina's Central Bank (Casa Rosada, 2014). The motives attributed to the Chinese central government in establishing currency swap lines have been

summarized as the pursuit of political influence, the promotion of trade, the reduction of dependence on the US dollar, the mitigation of foreign exchange risks, and the limitation of excessive foreign reserve accumulation (Arnold, 2023). For Argentina, it provided a critical alternative to the U. S. dollar, easing its chronic foreign reserve shortage and facilitating the payment for Chinese technology and imports. From China's perspective, the agreement was a key component of its broader strategy toward South America, which it deepened Argentina's financial dependence on China, provided a practical avenue for the internationalization of the yuan, and secured a vital foothold for Chinese enterprises in a key regional market. In this context, the currency swap agreement became the financial bedrock that transformed bilateral nuclear cooperation from a rhetorical commitment into a tangible project. Finally, in February 2015, CNNC formalized a commercial contract for the construction of both reactors in Argentina, in collaboration with Nucleoeléctrica Argentina S. A.

Following Mauricio Macri's inauguration in December 2015, Argentina's approach to Chinese-financed infrastructure and energy projects shifted from uncritical endorsement to systematic review. This policy shift was driven by a combination of domestic political realignment, a pressing need to stabilize a fragile economy, and a strategic reorientation of Argentina's foreign policy toward greater integration with Western markets and institutions (Bernal-Meza and Zanabria, 2020). Macri's administration, departing from the more populist and China-friendly stance of his predecessor, sought to re-evaluate all major infrastructure agreements to ensure fiscal prudence and transparency. Among other objectives, this comprehensive evaluation aimed to assess the project's technical viability, its anticipated economic impacts, and the potential for developing domestic technology for nuclear electricity production. At that juncture, Macri's administration finally decided to approve and proceed with the agreement's guidelines, albeit with a significant reduction in the base investment financing from the original $9 billion to $7.9 billion. Bilateral tensions were addressed through high-level meetings at the 2016 Nuclear Security Summit, the G20 in Hangzhou, and Macri's 2017 state visit to China, where renegotiations reduced project costs and capacities but preserved cooperation. At the same time, Macri's pursuit of closer ties with the United States, which culminated in the 2018 IMF agreement supported by Washington, underscored the geopolitical balancing act that shaped Argentina's foreign policy, even as his government simultaneously sought an additional loan of US$2.5 billion from China (Dinatale, 2019).

During this period, Argentina's nuclear strategy reflected a multipolar approach, engaging with several international partners to secure its nuclear future, enhance bargaining leverage, and preserve a degree of technological independence. Argentina had entered into negotiations with both China and Canada for the construction of two new reactors, one Chinese-designed Hualong-1 light-water reactor and one Canadian-designed CANDU. The Canadian option was particularly attractive given Argentina's existing expertise with heavy-water technology and the potential for greater local integration, while the Chinese project aligned with global trends in reactor technology. In parallel, Argentina was also in discussions with Russia's state-owned Rosatom, culminating in the 2015 signing of a framework agreement for a plant based on Russian VVER-1200 technology. In earlier years, Argentina also pursued cooperation with India, signing a 2011 agreement on the peaceful uses of nuclear energy, including collaboration on power plant construction and uranium exploration, further underscoring its diversification strategy. The presence of multiple potential partners, including Russia, provided Argentina with strategic options beyond the Chinese proposal and formed an important backdrop to the Hualong-1 negotiations. At the same time, the parallel consideration of Chinese light-water technology and Canada's heavy-water design also reflected broader discussions within Argentina about possible technological pathways for its nuclear sector.

Unlike a centralized state, where project decisions are made solely at the national level, Argentina's federal structure grants provincial governments substantial authority over land use, natural resources, and local development (Monkkonen and Ronconi, 2013). This means that even if a national government agrees to a project, its implementation is highly dependent on provincial consent. This dynamic was evident in May 2017, when the governor of Río Negro province, Alberto Weretilneck, announced an agreement with China to locate the undertaking in Patagonia. However, following the emergence of resistance and multiple protest actions, Weretilneck announced its cancellation just a few months later. According to the governor, the initiative "did not have social acceptance or support." He ultimately declared: "We listened to the people: the people of Río Negro do not want a nuclear power plant and that is how we must proceed" (Alberto, 2017). The fragility of Argentina's nuclear agenda was further exposed one year later, when the CANDU project was abandoned amid the country's 2018 economic crisis (ARN, 2018). Provincial actors and their concerns exert significant influence over national decision-making in Argentina (Ardanaz et al., 2014), and the country's federal structure fundamentally constrains the design, negotiation, and implementation of Chinese investments.

The inauguration of Alberto Fernández in December 2019 notably impacted bilateral relations within the energy sector, particularly within the nuclear sphere. The contract for the Hualong-1 project was signed on February 1, 2022, symbolizing the reactivation of an agreement that had stalled during the Macri administration. According to scholars such as Blinder and Vila Seoane (2023), strong opposition to the project from the Trump administration played a significant role in this delay. This influence was expressed through direct political signals. For instance, Senator James Risch, then ranking member of the Senate Foreign Relations Committee, declared publicly: "I am concerned about plans to install unproven Chinese nuclear technology in Argentina and its implications for regional security and the sovereignty of Argentina" (Risch, 2022). In addition, U. S. delegations visiting Buenos Aires warned against deepening nuclear cooperation with China, citing both safety concerns and potential geopolitical risks (Ganzer, 2022). Yet domestic factors also contributed to delaying the project. As the Fernández administration faced severe budgetary constraints and the approach of presidential elections, rumors and denials intensified, focusing not only on intense debates regarding the project's technical viability but also on the risks of national debt that cooperation with China could entail. These debates exposed the absence of a clear strategic orientation in the government's nuclear policy, as well as evident shortcomings in inter-ministerial secrecy and coordination (Hurtado, 2022; Hurtado, 2023a). Subsequently, during Fernández's visit to China, Argentina reaffirmed its commitment to deepen the Comprehensive Strategic Partnership with the Asian nation, and both parties "encouraged the development of new projects in areas related to

the production of nuclear technology" (CANCILLERIA, 2022), in an effort to shed the "shelved" label often applied to the Atucha III project (Cayón, 2022). Nevertheless, no tangible progress toward the project's materialization was recorded during his administration.

It is worth noting that the contractual provisions of the Hualong One project have undergone multiple revisions. The initial framework of the Hualong-1 project involved a Chinese commitment, through the Industrial and Commercial Bank of China, to provide approximately USD 7.43 billion in loans for Argentina's fourth and fifth nuclear power plants. The project is located within the Atucha nuclear complex in Buenos Aires Province and is to be constructed with Chinese technology and engineering under the leadership of the China National Nuclear Corporation, which was granted priority in matters of technology transfer and on-site integration. Between 2015 and 2017, the financing structure was established, with the ICBC-led consortium covering 85% of the total investment, amounting to nearly USD 14 billion, under a 20-year repayment term with an 8-year grace period and an interest rate of 4.8%. Following subsequent renegotiations, a 2019 agreement revised the financing to USD 6.715 billion under slightly more favorable conditions. After several years of political shifts and the suspension of the project, on 1 February 2022 Argentina and China formally signed a turnkey engineering, procurement, and construction contract for the Hualong-1 reactor, with a total investment of USD 6.8 billion, of which 85% was again financed by Chinese banks.

Initially conceived in conjunction with a Canadian CANDU reactor, the project experienced postponement stemming from shifting national administrations and evolving strategic priorities. However, these delays are not solely attributable to internal dynamics. Accordingly, this article seeks to critically examine how the structural vulnerabilities of recipient countries intersect with the conditionalities and asymmetries embedded in the Belt and Road Initiative, and to analyze how these interrelated factors shape the development trajectory and long-term viability of projects such as Hualong-1.

# 3 Research methodology

Grounded theory provides a methodological bridge between the process-oriented nature of large, long-duration infrastructure projects and the structure-oriented questions that animate dependency and sustainability research. By insisting that concepts are generated from—rather than imposed on—empirical material (Glaser and Strauss, 1967; Strauss and Corbin, 1998), grounded theory allows the analyst to move inductively from interview fragments toward successively higher-order categories.

Methodologically, grounded theory's constant-comparative logic is crucial for capturing that convergence. Axial coding makes it possible to juxtapose in-country "micros" with exogenous "macros," illuminating the feedback loops that push large projects toward delay or escalation. Selective coding then integrates these axes into a core category, which links three interrelated sub-processes: financial exposure, technological asymmetry, and geopolitical leverage. This synthesis not only theorizes why turnkey reactor contracts remain politically brittle but also indicates where institutional autonomy may be recaptured.

## 3.1 Data collection and informant profiles

The selection of elite informants for qualitative research necessitates both methodological rigor and strategic precision. In this study, 10 interviewees—comprising seven men and three women—were purposefully selected based on their positional relevance and reputational recognition. Each of them holds a professional trajectory directly or indirectly connected with nuclear energy development, ecological governance, or international cooperation within Argentina, thereby providing perspectives closely tied to the Hualong-1 project. The group includes government officials engaged in energy regulation and environmental oversight, academics specializing in nuclear physics and international relations, journalists with extensive coverage of energy and infrastructure issues, as well as environmentalists and social movement leaders who have been publicly involved in the nuclear energy debate. Their affiliations are not neutral, and in several cases their institutional or political contexts influenced their interpretations of the project, underscoring the need to situate their perspectives within broader power structures.

Recruitment was carried out primarily through institutional email invitations, which explained the objectives and scope of the research. This method ensured transparency and voluntary participation, while also enhancing credibility by maintaining professional communication channels. Interviews were conducted between August and October 2023, a politically sensitive period coinciding with Argentina's general election campaign, during which Javier Milei consistently polled ahead of Sergio Massa. This context influenced the interviews, as participants often framed their assessments of the Hualong-1 project in relation to broader concerns about fiscal austerity, foreign policy orientation, and democratic legitimacy.

The inclusion of environmentalists and social movement leaders was particularly relevant, as it introduced perspectives critical of nuclear expansion and highlighted the contested social legitimacy of large-scale infrastructure projects. At the same time, the study intentionally prioritized participants with demonstrable expertise or influence in shaping energy policy debates, while not systematically incorporating grassroots community actors. This choice reflects the analytical aim of focusing on policy-shaping and discursive actors rather than attempting to provide a fully representative survey of Argentine society.

The interviews averaged approximately 60 min in duration, and the collected data underwent textual analysis, relying on original, verifiable, and traceable sources. The interviews focused on several key areas: Argentina's national energy governance and perceptions of nuclear energy; Argentina's adoption of Chinese technology and financing for the development of its nuclear industry; and the expectations and suggestions from both Chinese governmental and corporate entities regarding power reactor construction projects in Argentina. Prior to each interview, a concise overview of the study's background, objectives, and interview outline was provided to participants. To ensure data accuracy and validity, information was gathered from diverse perspectives, and cross-validation was performed between internal and external data sources, as well as data obtained from the interviews, to guarantee the consistency and reliability of causal inferences. For privacy protection, the interviewees were renumbered in an altered sequence within the final document (Table 1).

## 3.2 Data coding process

### 3.2.1 Open coding

This initial stage involved breaking down the raw interview material and assigning concepts in the form of words or phrases, which were then grouped to form categories (Strauss and Corbin, 1998). The interview data was imported into MAXQDA software for this purpose. Through this process, a total of 317 reference points were identified, which were subsequently condensed into 36 conceptual tags. Based on these tags, 8 initial, relatively independent categories were extracted through successive comparisons, corrections, and abstractions. These categories included: "Reasons against nuclear energy," "Reasons support for nuclear energy," "Argentine Nuclear Policy," "Energy Transition," "Argentine Political and Economic Structure," "Technology Transfer," "Geopolitics," and "About the Role of Experts / Decision Making" (Table 2).

### 3.2.2 Axial coding

Building upon the open coding, this technique aimed to discover and establish various connections between the conceptual categories, thereby presenting the organic relationship between different parts of the data. In this stage, the concepts and categories derived from open coding were organized to identify and establish connections among the initial categories. This process resulted in the summarization of three main, more inclusive dimensions: "Perspectives on nuclear energy," "Perspectives on the internal situation of the Argentine State," and "Perspectives on the external situation of cooperation" (Table 3).

### 3.2.3 Selective coding

This final step involved selecting organized categories derived from axial coding and integrating them into meaningful and coherent expressions (Williams and Moser, 2019). Through an iterative examination of the relationships among the three main dimensions, the core research topic was defined as "A Feasibility Study on Nuclear Energy Cooperation Between China and Argentina Under the Belt and Road Initiative, Taking Hualong-1 as an Example." It was confirmed that external pressures and the country's economic, political, and cultural structure are significant factors identified as hindering the international cooperation of nuclear energy at various stages of the decision-making process. Finally, the research proceeded toward establishing an analytical framework of the development and influencing factors of Sino-Argentine cooperation in the field of nuclear energy, based on the outcomes of selective coding.

TABLE 1 Interviewee personal profile.

| Gender | Position | Interview format |
|---|---|---|
| M | Biologist, Environmentalist | Videocall (camera on) |
| M | Engineer, Environmentalist | Videocall (camera off) |
| F | Journalist, Environmentalist | Videocall (camera off) |
| M | Physicist | In-person |
| M | Physicist | Videocall (camera on) |
| F | Academic | Videocall (camera on) |
| F | Academic | Videocall (camera on) |
| M | Sociologist, Politician | In-person |
| M | Journalist | In-person |
| M | Academic | Videocall (camera on) |

## 3.3 Result: structural challenges in Argentina's nuclear cooperation under the BRI

Grounded theory coding of elite interviews identifies two distinct but interrelated sets of constraints shaping Argentina's nuclear cooperation: internal vulnerabilities and external conditionalities (see Tables 4, 5). Argentina's ambition to expand its nuclear energy sector, driven by national decarbonization goals and aspirations for technological leadership, is persistently undermined by a constellation of internal vulnerabilities. Despite possessing over five decades of operational experience and a robust scientific foundation, structural economic fragility remains a critical constraint. Chronic financial instability, reliance on natural gas, and persistent foreign currency shortages have collectively rendered the country incapable of independently financing large-scale nuclear projects. This economic precarity is further compounded by acute political volatility, characterized by pendular shifts in policy orientations across administrations, which generate uncertainty and deter long-term commitments—both foreign and domestic. Projects such as CAREM-25 and Hualong-1 have repeatedly been delayed or deprioritized owing to budgetary retrenchments and administrative turnover. Additionally, limited regulatory maturity, infrastructural gaps, and deficits in human capital further weaken implementation capacity.

On the other side, Argentina's nuclear energy trajectory illustrates the persistent tension between its national aspiration for technological autonomy and the structural constraints of the international system. Argentina's longstanding institutional legacy, anchored in the CNEA and its subsidiaries, with accumulated expertise in reactor design, uranium enrichment, and fuel fabrication (Adler, 2014), functions as a counter-force within asymmetric cooperation frameworks. This technical foundation enables Argentina to press for local content

TABLE 2 Open coding example: reasons for nuclear energy.

| Example | Conceptualization (tagged) | Reference count |
|---|---|---|
| "the real danger is very low … then it depends on who analyzes it subjectively" | Safe Technology | 5 |
| "spent fuel can be transformed into other fuels and reused, and this generates even less waste" | Waste Management | 5 |
| "new nuclear drains use fuel much more efficiently" | Efficient Fuel | 4 |
| "nuclear energy provides many advantages or variables that wind and solar do not currently have" | Positive cost / benefit ratio | 5 |
| "I consider that it is indeed a clean energy and also a clean energy that is at the base" | Clean Energy (No GHG emissions) | 10 |

TABLE 3 Distribution of head code nodes.

| Dimension | Categories | Data classification |
|---|---|---|
| Perspectives on nuclear energy | Reasons against nuclear energy | Anti-Nuclear Movements, Proliferation, Distrust of Institutions, Security / Attacks, Construction / Work Times, Economic Reasons, Environmental Impacts (Impact on Future Generations; Radioactive Emission, Radioactive Waste, Accident Risk, Uranium Mining / Nuclear Fuels) |
| | Reasons for nuclear energy | Safe Technology, Waste Management, Efficient Fuel, Positive cost / benefit ratio, Clean Energy (No GHG emissions) |
| Perspectives on the internal situation of the Argentine State | Argentine Nuclear Policy | Large Reactors, Role of Public Official, SMRs (CAREM), Argentine Nuclear Sector, Hualong and technology transfer, Natural / Enriched Uranium, CAREM Project, Contribution to S&T development |
| | Energy Transition | The role of Renewable Energies, The role of Nuclear Energy, Argentina is Not an Environmental Debtor, Problems with the energy matrix |
| | Argentine Political and Economic Structure | Public Debt, Budgetary Pressures, Change of Political Parties, Public Opinion |
| Perspectives on the external situation of cooperation | Technology Transfer | On China's development and strategies, Challenges and Objectives of Transfer, Cooperation Strategies, Difficulties for the Transfer - Cooperation |
| | Geopolitics | Threats from the United States, China-US-Argentina trilateral relations, Cooperation intentions from countries such as Russia or Canada |
| | About the Role of Experts / Decision Making | Technical Advice and Evaluation, Policy and Regulatory Recommendations, Public and Social Participation, International Cooperation and Communication |

TABLE 4 Argentina's internal vulnerabilities and their impact on nuclear development.

| Vulnerability category | Specific factor | Influence on Argentina's nuclear cooperation |
|---|---|---|
| Economic fragility | Fiscal crises, hyperinflation, external debt | Project delays, financing demands (e.g., 100% upfront for Hualong-1), stalled construction (CAREM25) |
| | Limited domestic funding | Reliance on foreign financing, challenges in local content mandates |
| Political volatility | Frequent policy shifts, short-term political cycles | Inconsistent project commitment, disincentivizes foreign investors, lack of long-term planning consistency |
| | Governmental support inconsistency | Delays and uncertainties in project execution |
| Societal/cultural dynamics | Public opposition, environmental concerns | Cancellation of proposed sites (Rio Negro), broader skepticism about nuclear expansion |
| | Distrust of foreign investment, perceived military ties | Hindrance to cooperation in sensitive sectors, public backlash against foreign-led projects |

TABLE 5 External constraints and their influence on Argentina's nuclear cooperation.

| Constraint category | Specific constraint | Influence on Argentina's nuclear cooperation |
|---|---|---|
| Belt and Road Initiative | One-stop solution attractiveness | Initial appeal for financing large-scale projects beyond domestic budget capacity |
| | Debt trap concerns, long-term dependency on supplier | Increased financial risk, potential loss of control over critical assets, reinforces drive for autonomy, contributes to project stalling |
| | Security/proliferation risks | Heightened scrutiny, potential for internal and external opposition |
| International nuclear cooperation frameworks | Safeguards, non-proliferation norms (IAEA, IFNEC, NPT) | Guides regulatory frameworks, discourages sensitive technologies, ensures international compliance |
| Geopolitical competition | Influence of other major powers (US, Russia, EU) | Creates a delicate balancing act, impacts project viability, pushes for diversification of partnerships |

provisions, training programs, and access to sensitive technologies such as fuel cycle processes, thereby compelling foreign partners to concede to commitments that might otherwise remain marginal. At the same time, Argentina's chronic macroeconomic fragility has made it particularly receptive to initiatives such as the Belt and Road, which offer cooperation packages positioned as feasible solutions. Yet the coding also reveals that this dynamic cannot be reduced to a simple convergence of Argentina's needs with China's resources. Instead, it reflects a strategic interaction in which the BRI's rhetoric of "win–win cooperation" intersects with Beijing's broader geopolitical and commercial objectives—securing long-term markets for Chinese nuclear technology, promoting the internationalization of the yuan,

and consolidating strategic influence in South America. While such arrangements have delivered investment and access to advanced technologies, they simultaneously reinforce Argentina's vulnerabilities by deepening sovereign debt exposure and narrowing the space for autonomous technological development.

Equally significant are the socio-political barriers. Widespread public skepticism regarding nuclear energy, driven by environmental concerns, risk perceptions, and distrust in governmental institutions, has culminated in episodes of organized resistance, including the cancellation of the proposed Chinese-backed plant in Río Negro. Indeed, public acceptance introduces additional challenges to an already complex economic and political environment. As one environmental activist interviewed in September 2023 explained during a discussion about the siting of the Hualong-1 project:

> *"A nuclear program makes no sense, as the electricity it generates is monstrously, expensively, and dangerously produced, without taking into account future generations who will have to live in places affected by the resulting radioactivity".*

Similarly, an ecologist interviewed in October 2023 recalled the lessons of historical nuclear catastrophes and highlighted the particular risks of coupling nuclear energy with Argentina's fragile economic situation. As the interviewee emphasized:

> *"If a country with a severe economic crisis, like Argentina, faces its first nuclear accident, the lack of sufficient financial resources to manage a level 7 nuclear accident would represent a serious threat to the country's socioeconomic structure and public safety systems. This raises a critical question: Does the country have the financial capacity to handle the worst-case scenario? Because only by ensuring adequate response measures will the country be able to avoid the collapse of social order and the economic structure in emergency situations, guaranteeing the country's stability and the safety of its citizens".*

Furthermore, the Hualong-1 project encounters substantial public and environmental opposition, rooted in criticisms concerning the absence of comprehensive environmental impact studies prior to contract signing and unresolved issues pertaining to the treatment and location of radioactive waste. NGOs such as the Foundation for Environmental Defense (FUNAM) and the Foundation for Environment and Natural Resources (FARN) have publicly asserted that a thorough environmental impact study was not conducted prior to the signing of the bilateral contract with China, nor were public hearings held to gather citizen opinions (La Voz Del Interior, 2019). Greenpeace, furthermore, contends that the current contract does not precisely define the treatment and location of radioactive waste (Greenpeace Argentina, 2019). This aligns with a central criticism asserting that nuclear energy represents one of the most polluting energy sources globally, and that a completely safe method for managing nuclear waste has yet to be identified.

Anti-nuclear movements in Argentina, supported by various environmental organizations, argue that nuclear energy poses extremely complex control challenges, particularly concerning nuclear waste management and the potential ramifications of severe nuclear accidents (Saiz, 2022). The MARA (Argentine Anti-Nuclear Movement) advocates for the cancellation of the nuclear program and proposes a national debate focused on an "authentic energy transition." These factors collectively complicate project advancement and public acceptance, adding layers of complexity to an already challenging economic and political landscape.

The Hualong-1 project operates within a complex geopolitical landscape, wherein its progress is significantly influenced by strategic competition. U. S. pressure, exerted through diplomatic interference, deceptive framings, and mediated public diplomacy, has been identified as a contributing factor to project delays and has exacerbated internal governmental divisions regarding cooperation with China, with the broader aim of curtailing collaboration on issues deemed sensitive to U. S. strategic interests (Blinder and Vila Seoane, 2023). Indead, an emerging global rivalry between China and the United States appears to exert a constraining influence on bilateral cooperation, although the degree of impact varies across specific domains.

An interviewee, a government official directly involved in Argentina's energy policy, elaborated on this dynamic:

> *"Within the Argentine government, there is a lack of cohesion in the vision toward China, with certain nuclei of the State adopting divergent attitudes. There have even been officials who resigned due to perceived pressures from the United States for Argentina to distance itself from China. In the midst of the electoral conjuncture in Argentina, where there are candidates with diverse positions, some openly advocate not maintaining relations with China. This position is associated with seeking the support of the United States and its interference in the electoral process. The signal transmitted is clear: if they win, China will be excluded. This geopolitical triangle, formed by the United States, China, and the Argentine right, is manifested in the signals sent to the United States from certain political sectors. Meanwhile, progressivism seeks to establish an agenda and send signals to China, expressing the need for collaboration"*

For Argentina, cooperation with China in the Hualong-1 project was not the only option on the table, but under the prevailing economic and geopolitical circumstances it became the most viable. As another government official directly involved in Argentina's energy sector explained in the interview:

> *"Western partners still remain important, but they are increasingly hesitant and slow to commit. China, by contrast, brings financing, technology, and a clear willingness to move forward. At this moment, China is the best alternative for Argentina, because it provides what others cannot…Argentina is open to working with everyone, but given our financial constraints, China is the partner that offers the most realistic path to implementation today."*

Overall, the evolution of Argentina's nuclear cooperation under the BRI illustrates the complex rationality underpinning national decision-making. On the one hand, Argentina seeks to preserve a measure of technological sovereignty by leveraging its institutional expertise and bargaining for local content and knowledge transfer. On the other hand, persistent macroeconomic fragilities limit the scope of autonomous policy choices and render foreign partnerships indispensable. These domestic dynamics unfold within a broader international environment shaped by asymmetric cooperation

frameworks and geopolitical rivalry, where the United States and China exert competing pressures that further constrain Argentina's strategic room for maneuver. The outcome is not a linear process of dependence or autonomy but a negotiated balance in which aspirations for sovereignty, structural economic vulnerabilities, and external influences continuously interact to shape the trajectory of Argentina's nuclear development.

# 4 Structural challenges and developmental trade-offs in BRI infrastructure cooperation

## 4.1 Debt sustainability under the BRI: a broader perspective

The BRI, while a significant source of infrastructure financing, has demonstrably contributed to debt accumulation and heightened vulnerabilities in many participating countries. A World Bank policy working paper estimates that in the 2019–2023 medium-term phase, roughly one-third of BRI-recipient countries will face elevated public debt-to-GDP ratios due to infrastructure financing, with some already exhibiting critical fiscal stress (Bandiera and Tsiropoulos, 2019). Similarly, research comparing 64 BRI participants to 40 non-participants over 2002–2021 using difference-in-differences shows heterogeneous effects: while some countries benefited from new financing channels, others experienced unsustainable debt accumulation (Zhang et al., 2024). According to the Center for Global Development, eight BRI pipeline countries were assessed as high risk for debt distress, often owing to loans from official Chinese creditors that exceeded manageable thresholds (Hurley et al., 2018). Complementary analysis reveals that by 2020, state-owned Chinese lenders had issued over US$800 billion to more than 150 countries, with more than 80% allotted to low- and middle-income nations already in or near debt distress (Horn et al., 2023). The situation has become more acute that the poorest 75 nations will face a collective US$22 billion in Chinese loan repayments—putting severe strain on budgets for health, education, and climate action (Duke, 2025). These empirical findings underscore how, despite its role in infrastructure financing, the BRI has also heightened debt accumulation and fiscal fragility among emerging economies.

The debt-trap diplomacy thesis, which posits that China intentionally burdens developing countries with unsustainable loans to gain strategic leverage or seize assets, has been a prominent and contentious narrative surrounding the BRI. This notion was popularized by Chellaney (2017), who asserted that China loans strategically to seize FOB-like assets upon default. However, Brautigam (2020) debunk this narrative, noting that evidence of asset seizures is scant; instead, China rescues or restructures loans in disputed cases, often without geopolitical quid pro quo. From a broader infrastructure-debt lens, Ansar et al. (2016) show that many large-scale projects deliver subpar returns, undermining economic viability and deepening debt load—implying a parallel risk in BRI investments.

While China has committed to providing loans to Argentina for the Hualong-1 project, substantial doubts remain about the country's ability to sustain its already fragile fiscal position. The project's total investment is approximately USD 6.8 billion, 85% of which is financed by a loan package from a consortium led by ICBC, reportedly featuring a 20-year repayment term, an eight-year grace period, and interest rates of 4.5–4.8%, with Argentina covering the remaining 15% through national funds. However, Argentina's macroeconomic instability—marked by hyperinflation and persistent fiscal imbalances—has not only delayed project implementation but also prompted demands for full upfront financing, further exposing its structural financial fragility. The resulting fiscal pressures are thus less a function of alleged Chinese predatory lending and more a reflection of Argentina's systemic economic mismanagement and chronic dependence on external financing. This endogenous vulnerability implies that any large-scale infrastructure initiative, regardless of the lender, would exacerbate the country's debt burden, as its weak fiscal institutions have historically failed to correct the persistent deficit bias (Dornbusch and De Pablo, 1989).

Prominent Argentine elites and institutions, including politologist Juan Belikow and the Argentine Energy Institute "General Mosconi," have voiced apprehensions that utilizing Chinese capital for nuclear power plant construction could plunge Argentina into a precarious economic situation (Memo, 2022; Diálogo Américas, 2023). This apprehension is fundamentally rooted in Argentina's current economic reality, where the imminent need to address voluminous debt repayments is deemed unsustainable given the country's prevailing financial conditions. Meanwhile, the IMF itself has confronted substantial financial and reputational risks stemming from its significant loans to Argentina (Setser and Gelpern, 2006), with a considerable portion of the disbursement utilized to support the peso and finance capital outflows rather than productive investment. This suggests that even traditional Western lenders have contended with Argentina's financial instability and the inherent challenges of lending to a chronically debt-prone economy. Given Argentina's elevated risk profile, its history of defaults, and the constrained alternative financing options available in the post-2008 global financial landscape, the financial terms offered by China might be considered competitive or reflective of market realities for a high-risk borrower, rather than uniquely predatory. China, in this context, appears to operate as a significant, albeit self-interested, lender of last resort, thereby filling a void left by traditional creditors.

## 4.2 Effectiveness of technological transfer in BRI projects

The theoretical underpinnings of technology transfer within the BRI are diverse, encompassing mechanisms such as the establishment of joint laboratories and research platforms, the provision of scholarships for students, and the implementation of technical training programs designed to upskill local professionals. These initiatives are ostensibly designed to build human capital and cultivate an environment conducive to technological absorption and innovation, aiming to spur sustainable development, local innovation, and achievement of Sustainable Development Goals (Liu et al., 2023; Peng et al., 2025). Proponents argue that such multi-faceted approaches can indeed facilitate the diffusion of knowledge and capabilities from China to host countries, thereby driving local technological progress, improving environmental quality in countries along the route, and promoting their long-term sustainable development (Cao et al., 2021). Meanwhile, empirical studies employing difference-in-differences methods confirm that BRI

engagement has led to measurable increases in China–partner joint patents, especially among countries with stronger initial economic foundations (Xiao et al., 2023).

However, a critical review of the existing literature reveals a more nuanced and often contentious picture regarding the actual effectiveness of technology transfer in BRI projects. One pervasive critique center on the prevalence of the turnkey model in many large-scale BRI infrastructure projects, including significant energy initiatives. Under this model, Chinese firms often undertake the entire project lifecycle, from design and construction to commissioning, with limited involvement from local enterprises or personnel in the more sophisticated stages of technological development. Critics argue that, to minimize post-completion risks, in turnkey projects, companies are paid to build projects and then hand them over to recipient countries. This leaves state-owned enterprises with little incentive to ensure the feasibility of projects. If recipient countries have weak planning processes, misguidance, or corruption, this often results in "white elephant" projects (Hameiri and Jones, 2024; Jones and Hameiri, 2020).

Furthermore, the effectiveness of technology transfer is intrinsically linked to the absorptive capacity of the recipient country (Danquah et al., 2018). Factors such as the existing institutional framework, educational standards, industrial base, and political stability significantly influence a nation's ability to effectively receive, adapt, and innovate upon transferred technologies (Singhai et al., 2021; Giorcelli and Li, 2021; Bozeman, 2000). In countries with weak governance structures, limited research and development ecosystems, or high levels of macroeconomic instability, the absorption of advanced technological knowledge from BRI projects can be significantly hampered, regardless of China's stated intentions or the provided mechanisms.

The Hualong-1 project is explicitly described as a turnkey project, implying that the ordering country has limited or no direct involvement in the construction process. This model inherently implies that the Hualong-1 reactor's design and construction are largely dependent on Chinese technology, thereby constraining the direct involvement of Argentina's domestic nuclear industry and engineers. The high cost associated with such transfers has emerged as a significant impediment, as noted by Julián (2018), then Undersecretary of Nuclear Energy (Notas Periodismo Popular, 2018). These costs stem not only from the financial valuation that China attaches to proprietary technologies, but also from the substantial investments required in domestic infrastructure, training, and regulatory adaptation to absorb and operationalize the transferred knowledge (OECD, 1984). In practice, this creates a dual burden for Argentina: paying premium fees for access to Chinese technology while simultaneously committing scarce fiscal resources to develop the institutional and industrial capacity necessary to utilize it effectively.

Moreover, some domestic experts contend that this model is suboptimal, especially given Argentina's ongoing development of its own small modular reactor technology (Caro, 2023). They further contend that the introduction of new, externally controlled technology could potentially jeopardize Argentina's existing technological autonomy in the nuclear field. Concurrently, while the *Agreement between the Government of the Argentine Republic and the Government of the People's Republic of China on the Cooperation in Construction of a Pressurized Water Reactor in Argentina* (2015)[1] included a commitment to "maximum local content," it remains ambiguous whether this commitment translates into complete technology ownership or primarily facilitates assembly and operations under Chinese oversight (Nakano, 2020).

Argentina's past technology transfer projects, such as the Pulqui II jet and Proyecto Huemul, faltered due to a confluence of structural challenges: an import-substitution industrialization strategy that undermined long-term viability, a state-centric innovation system with weak implementation capacity, and, critically, limited knowledge transfer from foreign experts to domestic personnel (Hagood, 2006). These historical experiences highlight the need for robust knowledge assimilation mechanisms and a supportive national ecosystem to ensure the success of any modern technology transfer initiative. Against this backdrop, Argentina's nuclear technology policy can be best understood through the lens of technopolitics, reflecting a long-standing national aspiration to achieve autonomous development in the nuclear sector. Within this framework, technology transfer is not conceived as a secondary by-product but as a central objective of Argentina's international nuclear partnerships. Cooperation initiatives—particularly with China—are thus assessed by their capacity to deliver substantive technological learning and institutional capacity building, both of which are seen as critical to strengthening national energy security and enabling a sustainable transition away from fossil fuels.

## 4.3 Geopolitical dynamics and sovereign control

The Hualong-1 project in Argentina is not merely a bilateral economic undertaking but is deeply embedded within a complex web of geopolitical dynamics, particularly the intensifying rivalry between the United States and China. Historically, the United States has viewed Argentina's nuclear policy with suspicion, particularly regarding its pursuit of autonomous nuclear capabilities, often suspecting it aimed at atomic weapons and seeing it as a proliferation risk (Hurtado, 2015). U. S. foreign policy has adopted an overtly coercive strategy to prevent semi-peripheral states such as Argentina from developing an autonomous nuclear capability (Taliaferro, 2019).

China has implemented a bold and proactive policy to export its nuclear technology globally, with the Hualong-1 reactor serving as its flagship export since 2015. This outward-looking strategy has received strong political support at the highest levels and leverages China's substantial economic and diplomatic influence. Argentina formally joined the BRI in February 2022, signaling its alignment with this strategic framework. As a highly competitive supplier, China has stood out by offering attractive pricing and exceptionally generous financing—often covering the majority of upfront project costs; in Argentina's case, the initial agreement provided approximately 85% of

1 https://tratados.cancilleria.gob.ar/tratado_archivo.php?tratados_id=kp2impo=&tipo=kg==&id=kp2pnpg=&caso=pdf

the financing. This financial leverage makes China a particularly appealing partner for developing countries facing capital constraints.

Contemporary US concerns regarding China's nuclear technology exports and non-proliferation record are extensive, including past reports of unsafeguarded exports and systematic theft of technology (Johnston et al., 1999). Washington views China's state-backed nuclear industry as a strategic instrument to expand its comprehensive national power, capture global market share, and extend geopolitical influence through predatory economics and military–civil fusion. U. S. officials have repeatedly highlighted the alleged risks of engaging with China in nuclear matters, framing such partnerships as potentially undermining U. S. influence in Latin America (Pu and Myers, 2022). Within this broader context of strategic rivalry, Argentina faces a complex geopolitical dilemma, seeking to balance its engagement with competing global powers while addressing pressing domestic development needs. This balancing act is especially sensitive given Argentina's vast reserves of critical minerals, such as lithium, and its growing dependence on external financing. The United States has intensified its scrutiny of Argentina's deepening economic and strategic ties with China, including the renewal of a major currency swap agreement, and has explicitly urged caution regarding the Atucha III nuclear project.

Moreover, Argentina possesses one of the world's largest unconventional hydrocarbon reserves in the Vaca Muerta formation, a strategic asset, and even under the most optimistic projections of international organizations, oil and gas consumption is expected to remain high in the coming decades (Serrani and Barrera, 2023). These reserves play a decisive role in shaping the country's energy policy priorities, as they provide a relatively more cost-effective and politically viable pathway to meet domestic demand, particularly in a context of increasing penetration of renewable energies. Consequently, nuclear power is unlikely to secure a competitive position vis-à-vis shale gas and renewables, which are widely perceived as more capable of delivering immediate and higher returns on scarce public resources (Verbruggen, 2008). Moreover, substantial concerns exist among Argentine elites and institutions regarding the financial burden and repayment viability for the Hualong-1 reactor (Bañez, 2022).

Although President Javier Milei initially adopted a strongly ideological stance, expressing anti-communist sentiments and signaling a clear preference for alignment with the United States, he has since demonstrated pragmatic flexibility. Faced with pressing economic constraints, Milei renewed Argentina's key currency swap agreement with China, reflecting the tension between ideological positioning and immediate economic needs in Argentina's foreign policy. This same pragmatism is reflected in Milei's approach to the nuclear sector, where national development goals have taken precedence over purely geopolitical considerations. The cornerstone of Milei's Argentine Nuclear Plan, announced in December 2024, is a strong prioritization of revitalizing Argentina's domestic nuclear capabilities. At the heart of this new strategy lies the accelerated development and deployment of the domestically engineered ACR 300 SMR. Argentina plans to construct four ACR 300 units, each with a capacity of 300 megawatts, at the Atucha nuclear power site, aiming for a combined output of 1.2 gigawatts and an ambitious commissioning target for the first unit by 2030. The ACR 300 has been hailed as a technological milestone designed by Argentine engineers and was granted a patent in the United States in 2024. Reportedly backed by an undisclosed American investor, the project allows Argentina to participate as a key stakeholder without requiring direct fiscal investment (Financial Times, 2025).

By prioritizing domestic technologies, namely the ACR 300 and the ongoing CAREM 25 program, Argentina aims to regain greater control over its nuclear future, reduce its reliance on foreign partners, particularly in relation to the challenges posed by enriched fuel imports previously associated with the Hualong-1 project, and position itself as a global exporter of SMRs. This strategic pivot can be interpreted as a deliberate counterbalance to China's growing influence, allowing Argentina to assert greater autonomy on the international stage and to leverage its distinctive nuclear expertise beyond the role of a passive technology recipient. Ultimately, this transition reflects a deeper geopolitical calculus oriented toward reinforcing national sovereignty and enhancing Argentina's strategic flexibility within an increasingly multipolar global order.

## 5 Conclusion

The BRI's appeal is further amplified by offering an alternative development model for countries seeking diversified partnerships and greater agency in the global economic landscape. However, an in-depth analysis, particularly through the lens of the Hualong-1 project in Argentina and qualitative interviews, reveals that these opportunities are frequently accompanied by considerable challenges, especially concerning debt sustainability and the effectiveness of technology transfer.

While the debt-trap diplomacy narrative is often a geopolitical framing that oversimplifies complex realities, the underlying risk of heightened debt vulnerabilities for host countries is a genuine concern. In the case of the Hualong-1 project, the absence of comprehensive financial information complicates local assessments of the project's long-term sustainability, particularly in a context of Argentina's chronic debt vulnerabilities and constrained foreign reserves. Moreover, such project illustrates how domestic macroeconomic instability, frequent political shifts, public and environmental opposition, and geopolitical pressures can compound these financial and implementation challenges, making long-term project viability precarious. Based on the coded material, which was organized into Argentina's internal vulnerabilities and external constraints, the analysis shows that nuclear cooperation is shaped by a complex rationality guiding decisions, where national autonomy, economic constraints, and external influences constantly interact.

The effectiveness of technology transfer, a cornerstone of sustainable development, remains highly variable. While the BRI facilitates human capital development and skill enhancement in some instances, a persistent turnkey approach, coupled with Chinese firms' inclination to protect intellectual property and utilize their own labor, often limits deep local integration and the genuine absorption of advanced technologies. The Hualong-1 case highlights this paradox, where immediate infrastructure development might inadvertently hinder the host country's long-term autonomous technological capabilities. Argentina's historical pursuit of technological autonomy in its nuclear sector further complicates this dynamic, as the turnkey model of Hualong-1 contrasts sharply with its previous successful collaborations where significant local cont ent and human capital development were prioritized.

Ultimately, the long-term economic viability of BRI projects presents a mixed picture. While certain projects, such as the China-Laos Railway, has generated positive impacts on surrounding cities both during its construction and operational phases, fostering development benefits in transportation, tourism, as well as trade and investment gains (Kuik and Rosli, 2023; Li and Hu, 2025). Others projects have struggled to generate promised returns or integrate equitably into local economies (Gangte, 2020; McCartney, 2022). Furthermore, pervasive environmental, social, and governance concerns, including documented labor rights violations and environmental degradation, pose significant threats to the sustainable and inclusive development objectives of the BRI.

Argentina' efforts to advance its nuclear energy program are profoundly shaped by a constellation of external constraints embedded in international cooperation frameworks. BRI agreements, while offering access to much-needed capital and technology, often exhibit a relatively low degree of precision, particularly in areas such as environmental safeguards, social impact assessments, and transparency standards. Enforcement mechanisms typically rely on soft-law approaches rather than formal adjudication, leaving compliance largely dependent on the good faith of the parties involved. This institutional ambiguity, coupled with the pronounced asymmetry between China and its partners, means that Argentina, with its history of macroeconomic instability and urgent capital needs, engages in nuclear cooperation from a structurally disadvantaged position. China's dominant role as financier and sole contractor shapes loan terms, technology transfer, and project governance, while its development model favors the export of integrated technological solutions that may constrain Argentina' capacity for genuine knowledge absorption and local innovation. Moreover, Argentina must navigate the broader international nuclear governance regime, where non-proliferation norms and evolving safety standards further delimit the scope of autonomous policy choices.

Based on a qualitative in-depth study employing grounded theory, we find that the viability of the Hualong-1 project is intrinsically shaped by the intersection of three core dimensions: first, the designated role of nuclear energy within Argentina's long-term energy transition agenda; second, the country's broader macroeconomic conditions; and third, the political continuity or disruption of decision-making projects linked to strategic infrastructure cooperation. A noteworthy emerging consensus among national elites suggests that, if implemented, the project could enhance Argentina's technological capacity and contribute meaningfully to the autonomous development of its nuclear industry. However, this perceived potential is highly contingent upon the alignment of domestic strategic priorities with the structural and geopolitical conditions embedded within South–South cooperation mechanisms such as the BRI.

Learning from the layered and evolving dynamics of the Hualong-1 case enables scholars to move beyond binary assessments of project success or failure. Instead, it invites a more nuanced interrogation of how debt sustainability, technology transfer, and national sovereignty are negotiated in practice within asymmetrical partnerships. Fostering more equitable and developmentally beneficial outcomes in future BRI projects necessitates engaging critically with the micro-level complexities that define global infrastructure politics, wherein economic imperatives, technological configurations, and geopolitical strategies intersect with localized governance capacities and political agency.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

This study did not require formal ethical approval, given its non-interventional and voluntary nature. The research was conducted in accordance with local legislation and institutional requirements. Written informed consent was not required from participants or their legal guardians/next of kin, in line with national and institutional regulations.

## Author contributions

GG: Writing – original draft, Writing – review & editing.

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The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Publisher's note

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