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CHALLENGES OF THE FOURTH ENERGY TRANSITION IN BRAZIL: the role of China

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Realizou-se, no dia 26 de novembro de 2024, às 08:00 horas, por videoconferência, a defesa da tese, intitulada "CHALLENGES OF THE FOURTH ENERGY TRANSITION IN BRAZIL: the role of China", elaborada e apresentada por LUIZ HENRIQUE DIAS DA SILVA - número de registro 2020678785 , graduado no curso de RELAÇÕES INTERNACIONAIS. A defesa é requisito parcial para a obtenção do grau de Doutor em CIÊNCIA POLÍTICA, e foi submetida e analisada pela seguinte Comissão Examinadora: Prof. Dawisson Elvécio Belém Lopes - Orientador (DCP/UFMG), Prof. Jinlong Liu (Renmin University of China), Prof. Lucas Carlos Lima (UFMG/DIREITO-DIP), Profa. Geraldine Marcelle Moreira Braga Rosas Duarte (PUC Minas), Prof. João Paulo Nicolini Gabriel (UFMG). A Comissão considerou a tese APROVADA. Finalizados os trabalhos, lavrei a presente ata que, lida e aprovada, vai assinada eletronicamente pelos membros da Comissão. Belo Horizonte, 26 de novembro de 2024.

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“Narratives do not begin with explicit theoretical assumptions. Rather, they begin with an interest in a particular phenomenon that is best understood narratively. Narrative inquiries then develop descriptions and interpretations of the phenomenon from the perspective of participants, researchers, and others” (Flyvbjerg, 2004).

RESUMO

Esta tese explora os desafios que o Brasil enfrenta para compartilhar equitativamente os benefícios da quarta transição energética com sua sociedade, particularmente à luz de sua dependência histórica da hidroeletricidade e da influência da China como ator tanto de mercado quanto político. A pesquisa é guiada por hipóteses primárias que identificam a dependência do Brasil em setores energéticos tradicionais e o alinhamento da China com esses setores estabelecidos como restrições à incorporação de redes de energia renovável de pequeno porte necessárias para uma transição socialmente equitativa. Em sua metodologia, a tese emprega uma abordagem de estudo de caso de unidade única, focando no Brasil enquanto utiliza a China como um quadro comparativo para analisar dinâmicas estatais mais amplas na política energética. Ela se engaja com conceitos e vocabulário técnico relacionados à energia, enfatizando os padrões sociotécnicos estabelecidos durante transições energéticas anteriores. A pesquisa destaca a reorganização do Sistema Nacional de Inovação da China, que tem promovido soluções endógenas para a segurança energética, posicionando a China como líder na atual transição energética. Os capítulos subsequentes examinam criticamente o papel das instituições financeiras internacionais e como a parceria estratégica entre China e Brasil navega pelas condicionalidades do sistema internamente, em vez de permitir que elas ditem a política energética do Brasil. Além disso, agências e organizações especializadas em energia costumam apresentar o Brasil como um modelo para a quarta transição energética. No entanto, essa representação contrasta fortemente com a realidade doméstica brasileira, onde os benefícios sociotécnicos da transição não são plenamente realizados por seus cidadãos. O capítulo analítico revisita quadros teóricos e dados empíricos, reforçando a conclusão de que uma capacidade energética robusta e uma matriz sustentável, como exemplificado pela China, são insuficientes sem redes de distribuição confiáveis. A complexidade da situação brasileira, caracterizada por dependências estruturais aos setores energéticos incumbentes, exige uma abordagem multifacetada para entender a quarta transição energética. A tese conclui com recomendações destinadas a transformar essa transição em uma realidade sociotécnica para os cidadãos brasileiros, desafiando a mentalidade dominante de que interesses corporativos nacionais e internacionais perdem lucratividade ao atender objetivos sociais.

Palavras-chave: quarta transição energética; capacidade estatal; China; Brasil.

ABSTRACT

This thesis explores the challenges Brazil faces in equitably sharing the benefits of the fourth energy transition with its society, particularly in light of its historical dependence on hydroelectricity and the influence of China as both a market and political actor. The research is guided by primary hypotheses that identify Brazil's reliance on traditional energy sectors and China's alignment with these established sectors as constraints to incorporating small-scale renewable energy grids necessary for a socially equitable transition. In its methodology, the thesis employs a single-unit case study approach, focusing on Brazil while utilizing China as a comparative framework to analyze broader state dynamics in energy policy. It engages with concepts and technical vocabulary related to energy, emphasizing the socio-technical standards established during previous energy transitions. The research highlights China's reorganization of its National Innovation System, which has fostered endogenous solutions to energy security, positioning China as a leader in the current energy transition. Subsequent chapters critically examine the role of international financial institutions and how the strategic partnership between China and Brazil navigates the system’s conditionalities from within, rather than allowing them to dictate Brazil's energy policy. Additionally, specialized energy agencies and organizations often present Brazil as a model for the fourth energy transition. However, this portrayal starkly contrasts with Brazilian domestic reality, where the socio-technical benefits of the transition are not fully realized by its citizens. The analytical chapter revisits theoretical frameworks and empirical data, reinforcing the conclusion that a robust energy capacity and sustainable matrix, as exemplified by China, are insufficient without reliable distribution networks. The complexity of Brazil's situation, characterized by structural dependencies and incumbent energy sectors, necessitates a multifaceted approach to understanding the fourth energy transition. The thesis concludes with recommendations aimed at transforming this transition into a sociotechnical reality for Brazilian citizens, challenging the prevailing mindset that national and international corporate interests lose profitability by addressing social objectives.

Keywords: fourth energy transition; state capacity; China; Brazil.

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

ABRADEE - Brazilian Association of Electric Energy Distributors
ABSOLAR - (Associação Brasileira de Energia Solar Fotovoltaica – Brazilian Photovoltaic Solar Energy Association)
AIIB - Asian Infrastructure Investment Bank
ANA - (Agência Nacional de Águas - National Water Agency)
ANEEL - (Agência Nacional de Energia Elétrica – National Electric Energy Agency)
APEX-BRASIL - (Agência Brasileira de Promoção de Exportações e Investimentos – Brazilian - Trade and Investment Promotion Agency)
ASEAN - Association of Southeast Asian Nations
AT - Agency Theory
BEV - Battery Electric Vehicle
BGCC - Beijing Gas Control Center
BH - City of Belo Horizonte – MG – Brazil
BMD - Belo Monte Dam – Brazil
BNDES - Bank for Economic and Social Development
BPP - Basic Production Process
BRI - Belt and Road Initiative
BRICS - Brazil, Russia, India, China, South Africa
BWS - Bretton Woods System
BYD - Build Your Dreams
CAE - Chinese Academy of Engineering
CAS - Chinese Academy of Sciences
CASS - Chinese Academy of Social Science
CCEE - (Câmara de Comercialização de Energia Elétrica – Electric Energy Trading Chamber)
CCHP - Combined Cooling, Heat and Power
CEMIG - Minas Gerais Energy Company
CF/88 - The Federal Constitution of Brazil
CIF - Cost Insurance and Freight
CO_2 - Carbon Dioxide
COFINS - (Contribuição para o Financiamento da Seguridade Social – Contribution for the Financing of Social Security)
CPC - Communist Party of China
CPPCC - National Committee of the Chinese People's Political Consultative Conference
CSI - China's Canadian Solar Inc
CTG - China Three Gorges
DER - Distributed Energy Resources
DES - Distributed Energy Systems
DES - Domestic Energy Supply
DG - Distributed Generation
DNG - Distributed Natural Gas
DOC - Declaration on the Conduct of Parties
DP - Development Plan
DRE - Distributed Renewable Energy
EAP - Emerging Average Power

EEZ - Exclusive Economic Zone
EMP - Emerging Middle Power
EMU - Economic and Monetary Union
ENEL - ENEL Distribution São Paulo – Brazil
ENN - Energy Network Private Company
ES - Energy Storage
EV - Electric Vehicles
EXW - Ex Works
FDI - Foreign Direct Investment
FHC - Fernando Henrique Cardoso
Finame - (Agência Especial de Financiamento Industrial – Special Agency for Industrial Financing)
FMGD - (Frente Mineira de Geração Distribuída – Minas Gerais Distributed Generation Front)
FYP - Five-Year Plan
G20 - Group of Twenty
GATT - General Agreement on Tariffs and Trade
GDP - Gross Domestic Product
GE - General Electric
GHG - Greenhouse gases
GW – Gigawatts
GZU - Guangzhou University
IBGE - (Instituto Brasileiro de Geografia e Estatística – Brazilian Institute of Geography and Statistics)
IBRD - International Bank for Reconstruction and Development
ICEV - Internal Combustion Engine Vehicle
ICT - Information Communication Technology
ID - Identity Student Card at RUC
IDA - International Development Association
IEA - International energy Agency
IFC - International Finance Corporation
IGC - Installed Generation Capacity
IMF - International Monetary Fund
INEL - (Instituto Nacional de Energia Limpa – National Institute of Clean Energy)
IP - Industrial Policy
IPE - International Political Economy
IPI - Imposto sobre Produtos Industrializados – Tax on Industrialized Products
ISO - International Students Office
kWh - Killowatt-hour
LA - Latin America
LED - Light Emitting Diode
LER - (Leilão de Energia de Reserva – Reserve Energy Auction)
MCTIC - Ministry of Science, Technology, Innovation and Communications
MDIC - Ministry of Development, Industry, and Foreign Trade
ME - Ministry of Economy
MG - State of Minass Gerais – Brazil
MIIT - Ministry of Industry and Information Technology
MME/EPE - Ministry of Mines and Energy/Energy Research Company

MOE - Ministry of Education
MOF - Ministry of Finance
MOHURD - Ministry of Housing and Urban-Rural Development
MOST - Ministry of Science and Technology
MOU - Memorandum of Understanding
MSL - (Movimento Solar Livre – Solar Entrepreneur Association)
MUC - Minzu University of China
MW - Mega-Watts
MW/h - Megawatt-hour
NATO - North Atlantic Treaty Organization
NDRC - National Development and Reform Commission
NEA - National Energy Administration
NIS - National Innovation System – China
NOx - Nitrogen Oxide
NSFC - National Natural Science Foundation
OECD - Organization for Economic Co-operation and Development
ONS - (Operador Nacional do Sistema Elétrico – National System Operator)
PA - State of Pará – Brazil
PAT - Principal-Agent Theory
PHEV - Plug-in Hybrid Electric Vehicle
PIS - (Programa de Integração Social – Social Integration Program)
PKU - Beijing University
PNAD - (Pesquisa Nacional por Amostra de Domicílios – National Household Sample Survey)
PNP - Progressive Nationalization Plan
PRC - People Republic of China
PT - (Partido dos Trabalhadores – Workers' Party)
PUC Minas - Pontifical Catholic University of Minas Gerais
PV – Photovoltaic
R – Reform
R&D - Research and Development
Reidi - Regime Especial de Incentivos para o Desenvolvimento da Infraestrutura – Special Regime for Infrastructure Development Incentives
RMB - Renminbi
RUC - Renmin University of China
S&T - Science and Technology
SAJ - (Subchefia para Assuntos Jurídicos – Sub office for Legal Affairs)
SASAC - State-owned Assets Supervision and Administration Commission
SDCI - (Secretaria de Desenvolvimento da Indústria, Comércio, Serviços e Inovação – Secretariat of Industry, Commerce, Services and Innovation)
SDG - Sustainable Development Goals
SGC - State Grid Shanghai Electric Power Company
SGCC - State Grid Corporation of China
SOEs - State-Owned Enterprises
SP - State of São Paulo – Brazil
SWW - Second World War
TGD - Three Gorges Dam
THU - Tsinghua University

TSCS - Time-series Cross-sectional
UK - United Kingdom
UN - United Nations
UN_HABIT - United Nations Human Settlements Programme
UQLI - Urban Quality of Life Index
US - United States
USA - United States of America
USD - United States Dollar
USS - Missouri United States Ship Missouri
W – Watts
WB - World Bank
WTO - World Trade Organization
WUF - World Urban Forum
WWII - World War II
XII FYP - XII Five-Year Plan
XIII FYP - XIII Five-Year Plan
ZTE - Zhongxing Telecommunication Equipment

TABLE OF CONTENTS

CHALLENGES OF THE FOURTH ENERGY TRANSITION IN BRAZIL:
the role of China

Luiz Henrique Dias da Silva[1]

1. INTRODUCTION

The research problem of this thesis refers to the main difficulties Brazil faces in providing its citizens with the benefits of transitioning to renewable energy sources—henceforth, the fourth energy transition (OECD/IEA, 2017), considering that the process requires a large-scale political-economic rearrangement which deals with the infrastructure and electricity consumption patterns in the country (Hochstetler, 2021). In order to necessary structural changes to happen in Brazilian energy landscape, large sums of reliable, preferably non-conditioned money, are needed. At first, a positive piece in the Brazilian energy transition game refers to access to financial resources. Emphasis on the "strategic partnership" with the People's Republic of China (PRC), hereinafter referred as to China, (Carvalho; Veras Steenhagen, 2023: 10 – 11; Maia, 2023: 65), with large investments in energy and infrastructure in Brazil[2].

The strategic partnership, "so named by the then Chinese Premier Zhu Rongji" (Maia, 2023, p. 65), was established between March and November 1993. This period coincides with the signing of Chamber of Deputies Resolution No. 47, 1993, which created the Brazil–People's Republic of China Parliamentary Group. This document laid the foundation for bilateral parliamentary diplomacy between the Brazilian parliament and the Chinese legislature, which has remained in effect since then (Maia, 2023, p. 65).

[1]Doctoral student in the Graduate Program in Political Science at the Federal University of Minas Gerais (PPGCP UFMG). Sandwich PhD candidate at the School of Agricultural Economics and Rural Development, under the Chair Agreement between Renmin University of China (RUC) and the Federal University of Minas Gerais (UFMG). Contact: Luizcomze2023@gmail.com, luizhds@ufmg.br.
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This study was financed by The Division of China Studies (Department of Sinology and China Studies) and the Center for Language Education and Cooperation (CLEC), Ministry of Education of China, as part of the China Studies Program - CSP Joint Research Ph.D. Fellowship 2023. 129 Deshengmenwai Street, Xicheng District, Beijing 100088, P.R. China.
[2] "Official diplomatic relations between the Federative Republic of Brazil and the People's Republic of China were established in 1974, the same year the Federal Senate approved the nomination of Aluísio Napoleão de Freitas Rego, a Minister of First Class in the Diplomatic Career, as Brazil's ambassador to China" (Maia, 2023: 60). In turn, the strategic partnership was signed in 1993.

Technically, Brazil has been reaping significant benefits from this strategic partnership, at least at first glance: i) It has the largest installed energy capacity in Latin America (LA). ii) It holds a dominant position in the proportion of renewable resources in its energy matrix, as reflected in the Domestic Energy Supply (DES = 48.4%), compared to 12.1% for Organization for Economic Co-operation and Development (OECD) countries and 14.9% for the rest of the world. iii) Brazil emits less carbon dioxide (CO_2) in electricity generation, both by source and by production sector—37% less than the OECD block and 41% below the rest of the world (MME/EPE, 2021, p. 6).

It is also interesting to note that, despite the strong bilateral collaboration, China and Brazil have very different paths regarding energy transition. China invests more in small energy grids, resulting in a more decentralized system, while Brazil, despite being a federation, remains concentrated in a large, centralized energy system. We highlight these differences in energy governance by applying disaggregated concepts of state capacity and federalism to both countries (fragmented authoritarianism for China[3] and federalism for Brazil) (Sheng, 2020; Teng F.; Wang P., 2021)[4]. The conclusion in this particular context is that these different arrangements do not pose a problem for the countries in utilizing themes and products of the fourth energy transition to strengthen their cooperative relations.

Moreover, in addition to financial factors, Brazilian partisan politics also plays a significant role in the institutional arrangements for Brazil-China cooperation, whether in the context of Brazil's non-formalized accession to the Belt and Road Initiative (BRI) or the strategic partnership established and strengthened since 1993. Notably, between 2019 and 2022, partisan opposition to China managed to undermine the institutional framework that had been developed and reinforced since the 1993 strategic partnership (Maia, 2023, pp. 55–91). Nevertheless, there

[3] According to fragmented authoritarianism and entrepreneurship theory, entrepreneurs have made significant (and largely unacknowledged) contributions to decarbonization in China and the rest of the world. This stands in contrast to environmental authoritarianism, which positions state support as the primary driver of decarbonization (Sheng, 2020: 1).

[4] On the complexity, specificities, and endurance of this system, see Xu (2011), Gilli, Li, and Qian (2014), Malesky (2021), and Tjia (2023). We also recommend authors such as Teng Fei and Wang Pu (2021) for deeper exploration of important accessory Weberian concepts like 'ideological legitimacy' and 'procedural legality' to explain Chinese institutions in energy governance, particularly in the context of China's fragmented political system and regime legitimacy.

remains a diplomatic effort to facilitate the construction of infrastructure necessary for Brazil's internal development and the potential for regional integration (Maia, 2023)[5]. This effort has been instrumental in strengthening the Brazil-China bilateral partnership and bolstering both countries in multilateral arrangements.

However, in Brazil, internal debates on energy policy represent an obstacle to social advances in the sector, especially when potential changes threaten the country's incumbent energy sectors. Despite the favorable financial situation, there are discrepancies in energy policy coordination between the Brazilian Federation and its subnational entities. These institutional complexities reveal the strength of entrenched sectors and the persistence of consumption patterns shaped by the structures these sectors have created. Notably, the internal Brazilian debate on energy transition revolves around the country's energy matrix, which is widely recognized as sustainable (Hochstetler, 2021; MME/EPE, 2021; 2023; Mendes & Viola, 2022; Maluf, 2023). However, as this thesis argues, neither the strategic partnership with China nor the predominantly sustainable energy matrix has brought the benefits of the fourth energy transition to the Brazilian population.

Regarding Brazil's energy mix, although the term "renewable" is a contested one when applied to hydropower—especially among critics of large dams like Belo Monte (Pará - PA)—Brazil is also well known for its rich hydropower resources that contribute to the energy transition. For clarification, the literature reviewed for this thesis does not differentiate between small and large dams in determining whether they are renewable. However, it consistently categorizes energy from dams as renewable energy[6]. We understand that what is being discussed through these divergent points of view are the environmental impacts on the lives of the communities that disappear to make way for the dams, and whether such impacts are justified. However, the thesis' discussion does not go so far. Instead, we assume hydroelectricity, biomass, biofuels, solar, wind, and nuclear energy are to be assessed by experts in agreement with the main

[5] For details on the timeline of relations between the parliaments of China and Brazil (institutional relations, so to speak), beyond the informality of personal relationships and party politics, an interesting book chapter by Clarita Costa Maia (2023: 55–91) is suggested.

[6] See: Theoretical framework 3: Own elaboration, based on Eletrobrás/Eletronuclear (2011), Andrews-Speed (2012), Zhaoyuan and Ishwaran (2020), Greenyellow (2023), Ministry of Mines and Energy/Energy Research Enterprise (MME/EPE, 2023). Figure 46: Installed Generation Capacity (IGC) in Brazil – 2020: Own elaboration based on *Resenha Energética Brasileira – Resultados de 2020* (MME-EPE, 2021: 10) and the National Water Agency (ANA) Metadata Catalog.

literature on energy and energy transitions (Eletrobrás/Eletronuclear, 2011; IEA, 2017; Greener; Greenyellow, 2023; MME/EPE, 2023). Thus, let's proceed, detailing better the main problems related to the social sharing of energy transition benefits.

Besides the issues around Brazilian energy matrix, currently, there is already discussion about reducing the participation limit in Distributed Generation (DG) from 30% to 10%, though neither of these has yet materialized. The Distributed Generation Legal Framework Agreement, whose final text of Law 14.300 was concluded with the Brazilian Association of Electric Energy Distributors (ABRADEE), details changes in the laws governing Brazil's electricity sector, a sector that suffers from serious institutional and structural problems (Brasil/SAJ, 2022)[7].

In the state of Minas Gerais (MG), which, according to the Ministry of Mines and Energy MME), dominates the Brazilian photovoltaic sector, *Companhia Energética de Minas Gerais S. A.* (CEMIG, Minas Gerais Energy Company), a state-owned company, has been accused of monopolizing the Distributed Generation sector, preventing the entry of other service providers or even end consumers interested in new opportunities (Neves, 2023). In São Paulo (SP), the privatization of *Eletropaulo*, now *ENEL Distribution São Paulo* (ENEL) , has shown, through frequent blackouts and energy shortages, that privatization needs better regulation to provide mechanisms to punish the service provider. Just as in Minas Gerais, where the population served by a state-owned company suffers from constant blackouts, the case of the private company ENEL in São Paulo shows that the lack of competition remains an unresolved issue.

The Minister of Mines and Energy, Alexandre Silveira, opened the meeting of the G20 Energy Transition Working Group in Belo Horizonte, Minas Gerais, on May 27, 2024, highlighting that "Minas Gerais is the largest producer of photovoltaic energy in Brazil, with the seven largest solar energy generation complexes in the country" (Agência Cenário Energia, 2024)[8]. Nevertheless, in response to critics, he admitted that CEMIG lacks investment in the sector and that there is no compatibility between substations.

[7] Available from: https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2022/lei/l14300.htm. Accessed Oct. 22, 2024.

[8] Available from: <https://cenarioenergia.com.br/2024/05/31/g20-grupo-de-trabalho-de-transicoes-energeticas-em-bh-conclui-debates-com-foco-no-combate-a-pobreza-energetica/>. Accessed Oct. 22, 2024.

The event, held behind closed doors as is customary for the G20, focused on the availability and social dimensions of the energy transition. The meeting was heavily criticized by electricity sector specialists who gathered outside Minascentro Convention Center (Minascentro BH) to protest (Agência Cenário Energia, 2024). The critics of Brazil's energy policy who joined the protests against the closed-door G20 meeting included the president of the *Movimento Solar Livre* (MSL) – Solar Entrepreneur Association, Hewerton Martins; the executive president of *Frente Mineira de Geração Distribuída* (FMGD) - Minas Gerais Distributed Generation Front, Wedson Silva; and the Secretary of Solar Energy of *Instituto Nacional de Energia Limpa* (INEL) - National Institute of Clean Energy, Gustavo Tegon (Canal Energia, 2024)[9].

According to electrical engineer Gleisson Barati, from FMGD, the problems in solar energy production in Minas Gerais include, for example, "companies closing their doors, people losing jobs, and a lack of investment by CEMIG in the sector" (Itatiaia Live, 2024)[10]. Regarding Barati's accusation that CEMIG was preventing the installation of solar panels in homes, Minister Alexandre Silveira acknowledged the issues and promised to involve *Agência Nacional de Energia Elétrica* (ANEEL) - National Electric Energy Agency in finding solutions. As the theoretical-methodological frameworks that will be detailed allow us to anticipate, the distribution of potential gains from the energy transition in Brazil faces severe macrostructural constraints:

i) Institutional constraints indicate that the agenda-setting power of the incumbent energy sectors in the country (hydroelectric, biomass, and gas sectors) is a major obstacle to the entry of renewable energies such as solar and wind into the national energy mix (even though they are already part of the energy matrix); ii) an important actor reinforcing the resilience of these incumbent sectors in Brazil against other renewable energies is China, as both its state-owned and private companies have shown a preference for investing in hydroelectric power (Maluf, 2023).

[9] Available from: <https://www.canalenergia.com.br/noticias/53279949/entidades-de-gd-cobram-de-silveira-acao-do-mme-contra-a-cemig>. Accessed Oct 22, 2024.
[10] Available from: <https://www.itatiaia.com.br/politica/2024/05/27/sede-do-g20-para-debater-energia-sustentavel-minas-enfrenta-problemas-de-investimentos-em-energia-solar>. Accessed Oct 22, 2024.

In technical terms, Brazil faces: i) a lack of technological compatibility for the reliable, affordable, and sustainable distribution of energy, even within conventional sectors, a result of insufficient technical support in energy auctions (Maluf, 2023); ii) paradoxically, the significant investment in securing the country's energy matrix is hindered by transmission towers and lines that cannot handle the energy load produced, forcing the *Operador Nacional do Sistema Elétrico* (ONS) - National System Operator to interrupt energy supply at critical moments; iii) additionally, on the technical front, another serious problem is related to the path dependence on incumbent sectors. In times of increasingly frequent and intense climate crises, such as water shortages, hydroelectric plants lose their capacity to generate energy.

As a result, ONS activates thermoelectric plants, whose operational costs drive up the final energy bill. This has been a recurring procedure and is tied both to the water crisis of 2014 and the national blackout of 2021. Thus, although there is much discourse around the climate crisis, Brazil's investments in energy resources such as ethanol and biomass are incomplete investments in energy security, not in the energy transition as they are intended to appear (Mendes & Viola, 2022).

Still on technical grounds, Brazil leads the world in blackouts, which demonstrates that the resilience of incumbent sectors against more efficient integration of solar and wind energy into the mix dominated by hydro, ethanol, and biomass is a significant barrier to a socially oriented energy transition that benefits the well-being of the population (Agência Brasil, 2022). Considering the climate crisis, unlike the pioneers of the energy transition and China, Brazil's major negative contribution in terms of greenhouse gas (GHG) emissions stems from deforestation by illegal logging, illegal mining, and the expansion of agribusiness, whether legal or illegal.

The discourse of being a champion of the sustainable energy matrix and a leader in the energy transition is disconnected from Brazil's socioeconomic reality. Although Brazilian legislation is comprehensive in terms of including small entrepreneurs and end consumers in the distribution of sustainable energy (Brasil/SAJ, 2022), the 30% participation limit for this inclusion has yet to be implemented. Therefore, to better understand the institutional intricacies of our research problem, we apply the combined theoretical lenses of Neo-Institutionalism and

International Political Economy (IPE), investigating energy transitions in a manner similar to the study of global economic transitions (Gilpin, 2002; Cox, 1981; Cox & Schechter, 2002; Hochstetler, 2021: Andrews-Speed, 2019). In doing so, we find that economic power alone is insufficient for constructing an energy transition model based on social equity (Bulkeley, Castán Broto, Hodson, & Marvin, 2011; IEA, 2017).

In addition to financial capacity, the state must invest in both formal and informal institutions that allow for the harmonization of corporate-type interests at both the national and subnational levels (Evans, 1993; 2004; Jaguaribe, 2016; Castro, 2016). In this sense, we understand that the industrial policy of a State which Weberianly equalizes different actors with agenda-setting power at the domestic level, can even be projected as foreign policy (Xu, 2011; Gilli, Li, & Qian, 2014; Malesky, 2021; Teng, F. & Wang, P., 2021; Tjia, 2023).

Thus, in order to understand how important actors in the energy transition address the inherent challenges of the fourth energy transition, we apply a single-unit case study as the ideal type research method (Gerring, 2004). In this context, China stands out not only for its ability to internationally apply solutions that are created, implemented, and strengthened endogenously but also for its prominence among energy transition pioneers in terms of international energy market numbers (Rongpin, 2004; Jaguaribe, 2016; Hochstetler, 2021).

Moreover, since the formal unit of analysis for this research problem is Brazil, China stands out once again due to the strategic partnership developed with Brazil since 1993—an unprecedented economic alliance entirely distinct from arrangements like the Belt and Road Initiative, led by China itself (Carvalho; Veras Steenhagen, 2023; Maia, 2023). As detailed in the theoretical section, the Brazil-China strategic partnership also strengthens both countries in their resistance to the neoliberal model and the economic-financial conditionalities that both nations, advocates of a multipolar order, contest (Vreeland, 2005; Pereira, 2009; Carvalho, 2023).

Thus, to address the research problem, we work with premises and assertions from International Political Economy that converge with the assessments of experts and agencies specializing in energy transition, in the sense that: i) energy transition is merely another economic transition (Hochstetler, 2021); ii) the economy (market) and politics (State) are inseparable and influence

each other within the institutional puzzle of real social life (Gilpin, 2002; Cox, 1981; Cox & Schechter, 2002); iii) although originating in national historical blocs (Gramsci, 1999), the actions of transnational elites—sometimes representing different and competing models of international political economy—must be analyzed for their global implications (Gill & Law, 1993; van Apeldoorn, 2001; Bieler & Morton, 2001; Robinson, 2002; Agnew, 2003; 2005; 2010; Bieler, 2006).

We employ the Gramscian notion that the nature of the State is defined by its class structure, not in the sense that the dominant classes use the State instrumentally for their projects or that specific private actors manipulate State policies (Cox, 1987, p. 6). The notion is that there is a structure, which is part of the State, that defines its limits and tasks. This structure is what Gramsci (1999; 2002) refers to as a historical bloc. Hence, the possibility of identifying hegemonic periods according to dominant classes and dominant States is crucial for understanding the economic world order in which Brazil and China are embedded and are simultaneously striving to change from within. This order is part of a larger economic transition, which, in turn, conditions the energy transitions. As with any other system transition, it "[…] is a social experiment on a massive scale" (Transition Network, 2010, as cited in Bulkeley, Castán Broto, Hodson, & Marvin, 2011, p. 1)[11]. That is to say:

> Complexes of production relations, classes, and historic blocs do not exist in isolated national compartments. They are linked to a world order that bears directly on them, as well as influencing them through their national states. There have been important qualitative and structural differences between successive world orders in the modern era (…) The qualitative differences between world orders touch the nature and incidence of wars, the manners of resolving disputes, and the creation and distribution of wealth and poverty (Cox, 1987: 6 – 7).

The aforementioned approach utilizes the same theoretical frameworks and methodological tools employed to assess, for instance, the economic transitions of the 19th and 20th centuries

[11] Thinking about the urban scale of any socio-economic transition (Schwartz-Shea, 2006; Bulkeley et al., 2011) and how they are projected to the international arena as themes and products of specific transitions, "there is therefore a pressing need to consider how system transitions take place within the city. Such systems, we suggest, should be conceived as socio-technical – that is, they comprise, and are co-produced by, social and technical elements. For example, a photovoltaic (PV) energy system comprises a form of energy conversion technology (photovoltaic cells), made from materials (e.g. silicon), installed through a particular configuration of technical artefacts (e.g. a building integrated system), in the context of political and legal institutions (e.g. planning requirements), processes of design (e.g. house building) and social practices (e.g. domestic use of electricity). The resulting system is considered socio-technical because it emerges through the conjunction and co-evolution of these 'technical' and 'social' entities and processes" (Bulkeley et al., 2011: 3).

(Cox, 1981; 1987; Cox & Schechter, 2002; Bulkeley et al., 2011; Hochstetler, 2021). This is why we dedicate one chapter to the Anglo-American hyper liberalism, a kind of embedded liberalism economic model against which Chinese Market Socialism either opposes or sometimes adapts itself (van Apeldoorn, 2001; Agnew, 2010).

In this reconstruction, we detail the micro and macro conditionalities of Bretton Woods institutions, such as the World Bank (WB) and the International Monetary Fund (IMF), emphasizing the importance of this framework for assessing the institutionalization of the China-Brazil strategic partnership and how both countries insert themselves into the neoliberal order[12]. The guideline is state capacity regarding energy policy formulation and implementation (Gomide, 2016; Castro, 2016; Goldstein, 2020; Barbosa, 2020; Costa & Vasconcelos, 2023; Maluf, 2023).

In addition to investigating institutional issues, we apply disaggregated concepts of state capacity to assess the role of the State in defining and implementing development strategies, especially when private interests may outweigh public ones. We seek to understand the role of renewable sources of energy, like wind and solar, which are strong in China but not as widespread in the Brazilian energy matrix. Although important in the context of the fourth energy transition (Andrews-Speed & Zhang, 2019; Hochstetler, 2021), these energy sources are perceived as threats to Brazil's incumbent energy sectors (Costa & Vasconcelos, 2023, p. 418).

In Brazil, hydro and biomass are the incumbent sectors (Santoro & Junqueira, 2023). Therefore, we attempt to provide answers to the factors that lead to the differences between the two types of energy governance while applying the convergences between neo-institutionalist and international political economy theories. This approach aims to enhance the understanding of the various conflicts among Brazilian central authorities, subnational governments, and other

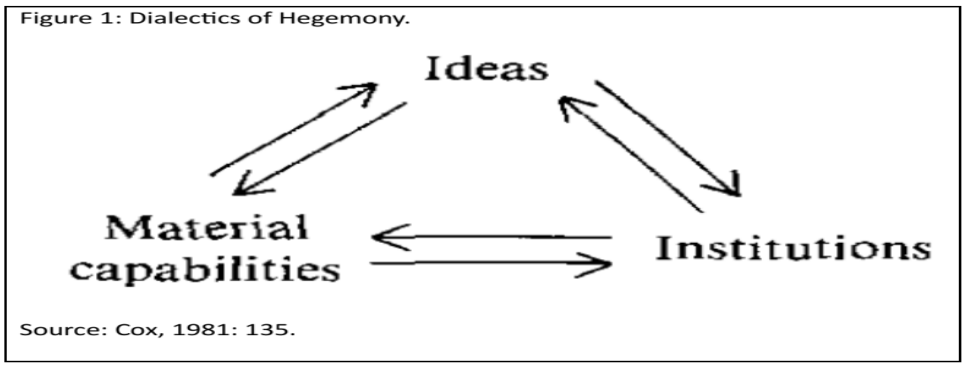
[12] Although we don’t discuss the Asian Infrastructure Investment Bank (AIIB) and the New Development Bank (NDB) in these specific sections, we do assess these important international and multilateral institutions in the appropriate section. The former is the first international institution led by China, and the latter is the first multilateral non-Western institution, initially considered for their inherent non-hegemonic potential (Oliveira, 2004). This approach allows us to maintain focus on assessing the AIIB and NDB regarding their roles in the strategic China-Brazil partnership and, consequently, their impacts on the neoliberal order and Brazilian energy policy. For more specific studies on Asian economic and financial matters, Chinese investments abroad, and foreign direct investment (FDI) in general, see Carvalho (2017), Barbosa (2020), Cariello (2021), Scissors (2021), Gonçalves and Brito (2021), and Jabbour and Gabriele (2021), as well as Carvalho, Veras, and Steenhagen (2023).

interested actors regarding the Brazilian energy matrix. The dispute over energy resources serves as the guiding thread for the narrative and analysis of the Brazilian phenomenon of energy transition, while China, as defended elsewhere in the thesis, is treated as an ideal type (Wallerstein, 1976; Weber, 1949; Gerring, 2004).

The general premise is that attempts to achieve economic self-sufficiency through natural resources—concepts that gave rise to the theories of the Prussian living space, the Eurasian heartland, and English naval power—could also be applied to the phenomenon of energy transition in a study of state capacities and natural resources (Strüver, 2017) through the lenses of IPE and neo-institutionalism. With the convergent perspectives of the neo-institutionalist debate, combined with Critical Theory IPE, it is possible to enrich the thesis with empirical examples demonstrating that the interests of dominant transnational groups are of an economic-corporate nature (Leysens, 2008). By illuminating empirical examples with theoretical debates, we aim to avoid the trap of constructing a merely teleological narrative.

Obviously, the aforementioned convergence of interests does not occur without conflicts, as illustrated by the framework of historical structures in Critical Theory—a triangular configuration (Figure 1) whose vertices are: 1) material capabilities; 2) ideas; 3) institutions (Cox, 1981). The relationships between these three concepts are neither preconditioned nor mechanical. On the contrary, they manifest as pressures and constraints that individuals and groups may resist or oppose but cannot ignore. In these reciprocal relations, the directions of the lines of force are historically determined (Cox, 1981, p. 135). Thus, both resistance and acquiescence to historical structures depend on the level of interaction and the strength of the material capabilities, ideas, and institutions involved.

Figure 1: Dialectics of Hegemony



The simplest of these forces is material capability, whose dynamic form is related to technology and organizational capacity. In terms of accumulation, it is associated with natural resources and how they can be transformed into industrial goods or war machinery. An example in which material capability carried significant weight is as follows:

> The liberal state and the liberal world order emerged together, taking shape through the establishment of the bourgeois hegemony in Britain and of British hegemony in the world economy. Britain's ability to manage the balance of power was the link between the one and the other. For the new form of state to become consolidated, a period of security and freedom from external intervention was required. The balance of power provided this respite. From at least the time of the Seven Years' War (1756 – 1763), British policy had not only recognized the balance of power as a fact of diplomatic life but had also used it to keep the European powers divided so as better to extend British commercial and imperial interests beyond Europe. Napoleon had destroyed that balance and had organized the continent under French suzerany. Britain's insular position and supremacy at sea together with Russia's expanse of land and abundant man power became the basis of a coalition that ultimately overturned French dominance (Cox, 1987: 123).

Apart from material capability, the example above also illustrates two types of ideas (Cox, 1981; 1987). First, intersubjective meanings or shared notions of social relations tend to perpetuate habits or expectations of behavior. The modern notion of sovereignty—where a state is a legal entity that commands a people within a given territory—is an example of this. Likewise, the horizontal relationship between states reflects these behaviors. These concepts pertain to the modern state and are historically conditioned, particularly post-Treaties of Westphalia (1648). The second type of idea encompasses the collective images of social orders held by diverse groups. "These are different views of both the nature and legitimacy of prevailing power relations, the meanings of justice, and the public good, and so on" (Cox, 1981,

p. 136). Conflict provides the basis for changing the institutional order or the emergence of a new structure.

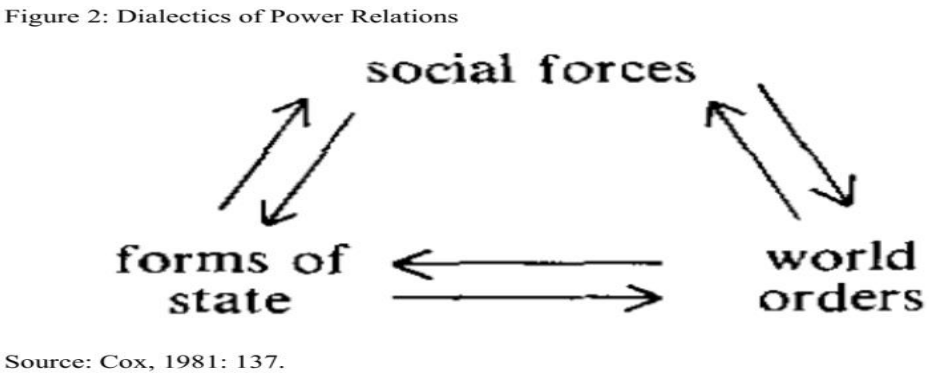
The third vertex of the theoretical triangle of historical structure refers to institutionalization as a means of establishing or perpetuating a given order (Bieler & Morton, 2006). Institutions not only reflect prevailing power relations but also encourage the reproduction of collective images in line with their values. In this sense, institutions acquire a life of their own, generating associated or rival offspring, making them arenas for debates of divergent tendencies. Thus, institutions should be viewed as an amalgam of ideas and material power that, in turn, influences the development of both ideas and material capabilities (Cox, 1981). In the hegemonic sense described by Gramsci (1999), institutions enable the management of internal conflicts without the use of force. In the external sphere, however, they can function as mechanisms of coercion and not just as tools for seeking consensus.

> There is an enforcement potential in the material power relations underlying any structure, in that the strong can clobber the weak if they think it is necessary. But force will not have to be used in order to ensure dominance of the strong to the extent that the weak accept the prevailing power relations as legitimate (Cox, 1981: 137).

This harmony can be achieved to the extent that the hegemon behaves as such, making concessions, rather than acting as a dictator or empire. The acquiescence of the weaker party will be secured, and the leadership of the stronger party will be established in a relationship where universal interests appear to be met, rather than where only the private interests of the stronger party are privileged. Institutions acquire strategic relevance by managing the private interests they represent, giving the impression of addressing universal demands. Consequently, the hegemonic function of institutions is to regulate conflicts while disguising the underlying structures of power (Cox, 1987). These hegemonic institutions govern production patterns in their broadest sense, encompassing state/society social relations (Bieler & Morton, 2006).

For the purposes of this study, we can resort to another analytical framework that establishes three levels of interrelated emerging rival structures: i) the organization of production, with a special focus on social forces; ii) forms of the state, derived from the study of state/society complexes; and iii) world orders, as particular historical configurations that define issues of war and peace for the international system (Figure 2) (Cox, 1981).

Figure 2: Dialectics of Power Relations



Taking the dialectical triangle of power relations into consideration, one of the most significant changes in the world order occurred when hegemony shifted from British to North American dominance. This transition involved the erosion of historical structures from the last quarter of the 19th century until the end of the World War II (WWII) in the 20th century[13]. British supremacy[14] was undermined, along with its dominion over the seas and its ability to tether the world economy to gold. The peaceful transition from Pax Britannica to Pax Americana resulted in tighter alliances and the establishment of strong institutions that represented the values of the new hegemon. Following the Bretton Woods agreements, liberal institutions were revised, and North American corporations were strengthened (Cox, 1981; 1987).

We do not need to delve further into the aforementioned theoretical frameworks. They are here to help illustrate the agent-structure interactions relevant to the theories mobilized in this thesis. For now, we will define the starting point of the thesis in terms of world order, state, and society (Cox, 1981; 1987). This definition will serve to understand how China positions itself within the international system and its strategic partnership with Brazil—both of which are necessary to assess Brazil's position in the global market of energy transition, the challenges to better

[13] Some examples that may help dispel the impression that total dominance did, in fact, exist in the international system can be found in a quick review by Viner (1948) on the various liberalisms practiced under the label of the liberal period; Weber (1978) in relation to the divergent metalisms practiced under the English gold standard; or contemporary authors such as Pereira (2009) and Vreeland (2005) on the combination of consensus and coercion that allows the hegemonic USA to exercise its contested supremacy in an increasingly multipolar world.

[14] For a geopolitical analysis strongly anchored in Realism but indebted to the sociological Gramscian notion of supremacy, see Spykman (2007). According to Gramsci (1999; 2002; 2007), supremacy precedes hegemony and can still prevail when a situation of hegemony is not apparent, allowing for the intellectual and moral leadership of allied groups (Gill, 1993). Also converging on this assessment are Brzezinski (1997), Cox (1987), Agnew (2005), Vreeland (2005), Pereira (2009), and Kaplan (2013).

manage its energy resources in favor of its citizens, and what China has to do with that (Carvalho; Veras; Steenhagen, 2023; Maia, 2023).

After this introduction, Chapter 2 presents the main objective, research question, and hypotheses that will guide our exploration of the challenges Brazil faces in sharing the benefits of the fourth energy transition with its society. We also examine China's role in this proposed energy transition in Brazil (Hochstetler, 2021), considering the social implications and how states distribute the transition's benefits to their citizens. Our primary hypotheses focus on Brazil's historical dependence on hydroelectricity and China's preference for this established sector as both market and political constraints to incorporating the small-scale renewable energy grids needed to share the fourth energy transition's benefits socially in Brazil.

Chapter 3 covers the essential concepts and technical vocabulary related to energy, including the energy and electricity matrix, renewable and non-renewable resources, installed capacity, and distributed energy. We begin by outlining the first of the four global energy transitions, which started in the 19th century and established socio-technical standards for electricity distribution through small-scale grids. This model not only reshaped urban environments but also set global energy consumption patterns (Acemoglu, 2012; Bhutada, 2022). With the Industrial Revolution, large-scale substantivist use of new energy sources emerged (Polanyi, 1976), leading to transformative changes in urban spaces, notably in the products and comforts linked to industrial energy applications.

Chapter 4 highlights the case of state capacity in China, emphasizing the reorganization of the national innovation system, which has focused on developing endogenous solutions to energy security issues as the basis for the current energy transition. This section reveals the primary social, political, and economic actors involved in China's energy transition, spotlighting the institutions created, reimagined, and/or dissolved in the process of building state capacity for this transition (Hochstetler, 2021). Our objective here is to illustrate how China's endogenous solutions have positioned the country among leaders in the fourth energy transition, especially those pioneering in this field. Additionally, we assess the unique role China plays in shaping Brazil's energy institutions. Theoretical frameworks and tables support our analysis of China's

position in the global energy market and underscore how these achievements are products of endogenous development efforts (IEA, 2017).

Chapter 5 outlines the methodological parameters guiding the choice of China as an ideal case and Brazil as the primary unit of study, characterizing this as a single-unit case study (Wallerstein, 1976; Gerring, 2004). With these units and subunits, we aim to generalize findings across a broader group of states that express an interest in sharing the social gains of the fourth energy transition. As units with defined spatial and temporal boundaries, they will be analyzed through theories and methods emphasizing the social dimensions of the fourth energy transition. This includes China's trajectory before and after the renewal of its National Innovation System (Castro, 2016; Jaguaribe, 2016; Hochstetler, 2021) and Brazil's process of deindustrialization and its entry into the group of Emerging Middle Powers (EMP) (Cano, 2012). To achieve this, we apply participant observation, practical and literature-based knowledge of each unit's history and energy policy, and interpretive analyses of how the built environment has been reshaped by the fourth energy transition. The goal is to make visible what is often overlooked (Yanow & Schwartz-Shea, 2006).

Chapter 6 revisits empirical examples demonstrating that institutions act as the "rules of the game." Using theoretical frameworks that incorporate disaggregated concepts related to state capacity in federative-like structures, we highlight that in the realm of climate-related political issues—such as the energy transition—the central theoretical concerns revolve around state capacity in its classic sense (Evans, Rueschemeyer & Skocpol, 1985; Hochstetler, 2021: 12). Specifically, we address the state's ability to design and implement policies that achieve broad public goods, even when such policies may negatively impact certain influential societal actors (Meckling & Nahm, 2017; Hochstetler, 2021: 31).

In Chapter 7, we analyze the conditionalities imposed by the International Monetary Fund (IMF), the World Bank (WB), and the World Trade Organization (WTO), which form the basis of the Anglo-American hyper liberal model of international political economy (Pereira, 2009). This chapter aims to elucidate the structure of the global economic order in which Brazil and China operate, an order within which these strategic partners advocate for a multilateral system (Carmona, 2014). By examining the micro and macro conditionalities of the neoliberal order,

we gain a deeper understanding of how China and Brazil, as influential regional leaders, enhance their long-standing partnership while developing their own foundations for the fourth energy transition tailored to their unique circumstances (Carvalho, Veras & Steenhagen, 2023; Maia, 2023).

The primary objective of Chapter 8 is to trace the recent history of technological development in the People's Republic of China, emphasizing the building of state capacities aimed at reaching and eventually surpassing the technological frontier that has historically kept the country in a state of energy insecurity within its geographical region. Here, we revisit the concept of state capacity as essential to understanding the significance of public policies that enabled the PRC to reduce its external dependence on coal and oil (Zheng & Lye, 2015; Santana, 2016: 228; Strüver, 2017) in just thirty years.

This achievement is linked to the ongoing evolution of a unique form of mercantilism—market socialism (Cruz & Guimarães, 2021)—which predates and diverges spatially from the broader concept of capitalism (Jaguaribe, 2016). Our analysis of China’s reform period includes the pivotal changes of 1978, which initiated the eventual reformulation of the National Innovation System (NIS), culminating in the more assertive domestic and foreign policies of President Xi Jinping and the resilience of China’s distinctive fragmented authoritarianism (Tjia, 2023).

Considering the complex contradictions in Brazil’s trajectory within the fourth energy transition and the unique challenges the country faces in delivering the benefits of its celebrated sustainable energy matrix to Brazilian society, Chapter 9 revisits critical data on the country’s energy policy. Financially, China stands out as the leading investor in renewables in Brazil. Politically, partisan dynamics have played a constructive role in shaping the country’s institutional landscape and arrangements in energy policy (Maia, 2023; Carvalho, 2023). Similar to our analysis of China’s National Innovation System, we examine Brazil’s deindustrialization process, which coincides with the deepening of its strategic partnership with China and an increase in investments in Brazil’s energy matrix.

In comparison to the gaps, deficiencies, and inconsistencies in Brazil’s fourth energy transition outlined in the thesis introduction, we conclude that the corporate interests of China’s SOEs,

along with those of its international private companies, have strengthened the resilience of Brazil's traditional energy sectors (Andrews-Speed & Zhang, 2019). In sum, while Brazil's international reputation as a leader in the fourth energy transition is largely bolstered by data from the Energy Research Company (EPE) of the Ministry of Mines and Energy (MME) (MME-EPE, 2021), the contrast between this global image and the domestic social reality reveals two starkly different worlds. Unlike China, Brazil has yet to ensure that its population fully reaps the socio-technical benefits of the fourth energy transition.

The interpretive research design of this thesis makes it impractical to limit the analysis to a single chapter. However, in Chapter 10 (the analytical chapter), we revisit several theoretical frameworks and tables presented throughout the thesis. The conclusion reaffirms that under the ideal conditions observed, utilized, and documented in China, a robust installed energy capacity and a sustainable energy matrix alone are insufficient. Without reliable energy and electricity distribution through small grids (distributed energy), it is questionable whether citizens can genuinely benefit from the affordability and social advantages of the fourth energy transition (Andrews-Speed & Zhang, 2019). This incomplete transition path is not unique to Brazil—it is a potential issue for any political unit globally, as demonstrated even in our ideal type unit and subunit, such as Xiantao in Hubei Province, China (see Box 3).

Our concluding chapter (11) shows that the complexity of the fourth energy transition in Brazil is too intricate to be fully explained by one, two, or even three separate hypotheses. Structural and economic analyses reveal that Brazil's installed energy and electricity capacities follow dependency trajectories linked to the incumbent hydroelectric, biomass, and oil sectors. Although the predominance of sustainable sources like hydroelectric power and biomass may initially appear to support the energy transition, data on financial investments and installed capacity indicate that these incumbent sectors effectively hinder the growth of solar and wind energy within the national mix. Expanding these renewable sources is essential for Brazil to share the benefits of the fourth energy transition with its citizens (Andrews-Speed & Zhang, 2019; Hochstetler, 2021).

Following the conclusion, we offer recommendations to help Brazil make the fourth energy transition a socio-technical reality for its citizens, extending beyond the interests of national and international shareholders (Leysens, 2008).

2. OBJECTIVES, RESEARCH QUESTION AND HYPOTHESES

It is important to remember that the transition to renewables, also known as the fourth energy transition, or "the low-carbon energy transition," is one type of socio-technical transition defined as a gradual process of societal change spanning the economy, technology, organizations, rules, systems, values, and behaviors (Kemp & Loorbach, 2006; Meadowcroft, 2006 apud Andrews-Speed & Zhang, 2019: 33; Bulkeley et al., 2011). Since these interconnected themes make the fourth energy transition a broad and controversial topic in several aspects, and we need to focus our efforts on answering the research question, it is beyond the scope of the thesis to discuss some of the problems inherent to the fourth energy transition, such as:

The presence of oil in the structure of solar panels; the enormous amount of water needed to build the cement structures for wind turbines; the limitation on the use of energy from certain biofuels according to the concept that clean energy cannot compete with food production; the social occupation of space in the sense that large wind and solar farms make it impossible to use the land for any other type of productive activity; the potential for renewable resources to create new forms of social and environmental inequality, such as the controversial processes of the Belo Monte Hydroelectric Dam in Brazil and the Three Gorges Dam (TGD) in China; the disposal of lithium batteries in the event of mass production of electric vehicles (EVs); etc.

Therefore, as advanced at the beginning of the methodology section, we reiterate that the central objective of this thesis is to theorize about the challenges Brazil faces in sharing the benefits of the fourth energy transition with its society[15]. In other words, this goes beyond market

[15] For a deeper understanding of the specific arrangements that constitute certain institutional environments, it would be necessary to study each case (e.g., health, transportation, education, technology and innovation, energy) by comparing them within the same context (e.g., Brazil and/or China, and their specific institutional arrangements relative to the Brazilian institutional environment). However, there is no obstacle to listing such specific arrangements as examples whenever they are relevant to clarifying aspects of the arrangement that is the focus of this thesis. It should be noted, however, that there will be no further exploration beyond the theme of energy (Fiani, 2013; Pires; Gomide, 2014: 11).

objectives and institutional interests involving both national and international actors. Hence, the inclusion of China as an ideal-type unit (Weber [1913] 1949; Wallerstein, 1976; Gerring, 2004) and the interpretation of the role of this actor in the proposed fourth energy transition in Brazil (Hochstetler, 2021).

2.1 Research Question

When it comes to the social implications of the fourth energy transition and how the States share their benefits with its citizens, it is worth remembering that this thesis is not interested in the measurable aspects of quality of life from the positivist point of view proposed by the concept since the 1960s[16]. From the broader concept under the expression urban quality of life, this research is interested in the experience and observation of citizens' spatial access to goods and services related to the fourth energy transition in the urban environment.

According to the notion of *sustainability of human development* developed in the late 1960s, the concept of *quality of life* began to incorporate that of *environmental quality*, that is, *equity* in the distribution of goods and rights. Thus, quality of life began to designate *immaterial and intangible* aspects of human life, "standing as a counterpoint to the materiality of development assessments that until then had been restricted to economic indicators" (Nahas, 2015: 24, author’s emphasis).

> These new conceptual dimensions gave rise to experiences of measuring quality of life through social indicators that address living conditions, the distribution of goods and material resources to meet the basic needs of the population, and not just the economic performance of that society [...] This is how the concept of *urban quality of life* was configured. On the one hand, historically, it incorporated the concepts of quality of life, environmental quality, social inequalities, poverty, social exclusion, social vulnerability and sustainability. On the other hand, it is a *spatially located*

[16] Researchers interested in measuring urban resources would benefit from the Urban Quality of Life Index (UQLI), a measure of spatial access to urban resources that serves as an important methodology among various approaches to assessing quality of life—though this topic is outside the scope of this thesis. The UQLI methodology emphasizes the quantification of services, facilities, and other urban resources available in different regions of the city, as well as the spatial accessibility for the population to utilize these resources. Developed in the 1990s by the City of Belo Horizonte (BH - Minas Gerais) in collaboration with the Pontifical Catholic University of Minas Gerais (PUC Minas), the UQLI generates an intra-urban index composed of georeferenced indicators within the city's Planning Units (Nahas, 2015: 101). Since 2002, the UQLI methodology has been included in the International Institute for Sustainable Development's sustainability indicator bank, which is accessible for public consultation. It gained recognition as an international reference in February 2002 by UN-HABITAT during the World Urban Forum held in Rio de Janeiro (UN_HABITAT; AL-MADINAH AL-MUNAWARAH, 2010 apud Nahas, 2015: 102).

> *concept, referring to the urban environment, to cities*. In this way, moving away from a focus on the person, on the individual - to which the concept of "quality of life" refers - the focus of the concept became the city, that is, the quality that the city offers to its citizens (Nahas, 2015: 24 – 25, author's emphasis).

At first glance, Brazil appears to be reaping significant benefits since the signing of the 1993 strategic partnership with China, "a global clean energy champion" (Andrews-Speed & Zhang, 2019). It also seems that the fruits of this partnership could contribute to the universal distribution of small energy grids for the sake of materializing urban services and products related to quality of life in terms of Brazilian citizens' spatial access to the resources of the energy transition (Nahas & Esteves, 2015). Therefore, let us review some important data:

Between 2005 and 2021, Brazil attracted USD 64 billion of the total USD 140 billion that Beijing invested in Latin America and the Caribbean (American Enterprise Institute; Heritage Foundation, 2021; Carvalho, 2023: 45). Furthermore, in 2021, Brazil emerged as the leading global recipient of investments from the Belt and Road Initiative, accounting for "[...] 13.6% of the total" (Carvalho, 2023: 46). Alongside Indonesia and Pakistan, Brazil ranks "among the top three countries where the most power generation capacity has been constructed with Chinese investment and finance" (Ma, 2020, p. 8 apud C. Liu et al., 2022: 1123).

Since 2020, Brazil has maintained its position as the country with the highest installed energy capacity in Latin America. It demonstrates a significant advantage in the proportion of renewable resources within its energy matrix, evident in the Domestic Energy Supply (DES) of 48.45%, in contrast to 12.1% in OECD countries and 14.9% worldwide. Additionally, Brazil emits considerably less CO_2 from electricity generation across both sources and production sectors, achieving reductions of 37% compared to the OECD bloc and 41% below the global average (MME-EPE, 2021: 6)[17].

Nationally, the state of Minas Gerais is considered "the largest producer of photovoltaic (PV) energy in Brazil, with the seven largest solar energy generation complexes in the country" (MME, 2024)[18]. The modular nature of solar PV technology allows learning for large-scale systems to be directly applicable to small-scale installations, as both use the same solar panels.

[17] Available from www.gov.br. Accessed January 24, 2024.
[18] According to Alexandre Silveira, Brazil's Minister of Mines and Energy, at a G20 meeting held in Belo Horizonte, Minas Gerais, Brazil, on May 27, 2024.

This feature, being "highly unusual in the power sector," is one of the reasons for the rapid decline in the cost of solar PV compared to other renewable energy sources (IEA, 2017: 18).

However, an unusual event occurred on October 25, 2021, when the National Electric Energy Agency (Aneel) and *Câmara de Comercialização de Energia Elétrica* (CCEE) – Electric Energy Trading Chamber held the last emergency auction of reserve energy capacity for energy delivery in 2022 (Maluf, 2023, p. 378). During this auction, the thermal sector was prioritized, despite its energy delivery costs being five times higher than the photovoltaic solar source. Seventeen projects competed, and 14 gas-fired thermoelectric plants were selected at an average cost of R$1500.00/MWh, compared to R$345.00/MWh for the two contracted solar plants. The single biomass plant had an even lower cost: R$343.00/MWh. Not only was no technical justification provided for this preference for the gas-fired thermal electricity sector, but the decision also increased consumer costs by more than R$39 billion (Barros, 2022; Maluf, 2023: 378).

Given that: i) the energy transition process requires a large-scale political and economic reorganization that affects the country's infrastructure and electricity consumption patterns (Hochstetler, 2021); ii) having a great installed capacity system and a sustainable energy matrix is not sufficient (Andrews-Speed & Zhang, 2019) (Nahas & Esteves, 2015; IEA, 2017); and iii) public policies in Brazil remain within the conventional flow of installed capacity systems (Arretche *et al*., 2012; Meckling & Nahm, 2017: 741; Hochstetler, 2021: 31), stopping short of transforming urban spaces through affordable products and services related to the fourth energy transition (Bulkeley *et al*., 2011; Nahas, 2015; Zhaoyuan & Ishwaran, 2020), the research question arises:

If Brazil’s energy matrix is predominantly renewable, backed by the strongest global investor in renewables (Barbosa, 2020; Costa & Vasconcelos, 2023), and its installed capacity is the largest in Latin America (MME-EPE, 2021; American Enterprise; Heritage Foundation, 2021; Carvalho, 2023), what prevents the country from investing in small energy grids and connecting them to the larger ones to share the benefits of the fourth energy transition with its citizens?

2.2 Hypotheses

Building on the points mentioned above, several hypotheses are proposed to assess the relative significance of each in relation to the energy transition in Brazil, should one hypothesis dominate. This same reasoning applies if it is ultimately determined that the situation reflects a resilience mix, not solely represented by any single hypothesis, indicating that other potential explanations may exist for the challenges Brazil encounters in its pursuit of the fourth energy transition.

Hypothesis 1 (H1):
A trajectory of dependence linked to hydroelectricity, biomass, and oil makes other renewable sources, such as solar and wind, a threat to the incumbents in these sectors, leading to resistance to the energy transition in Brazil (Costa & Vasconcelos, 2023: 418). Under this hypothesis, even though the country already has strong production in sustainable energies such as hydroelectric, biomass, and natural gas, these sources, along with oil, will be treated as constraints on the energy transition. This is because they are associated with the trajectory of dependence that has hindered the national distribution of other forms of energy, especially solar and wind.

This hypothesis is anchored on the conceptual distinction between 'those who deliberate' and 'those who execute.' It suggests that due to the State's developmental trajectory in Brazil, "the Brazilian federative State has endowed the Union with normative authority and spending capacity, allowing it to decisively affect the agendas of subnational governments despite the political, fiscal, and competences' decentralization adopted from the 1988 Constitution" (Arretche, 2012; Almeida, 2012: 29). However, as mentioned earlier, a negative example of this decision-making power emanating from the Brazilian central government is seen in the Ministry of Economy issuing harmful ordinances regarding energy auctions (Maluf, 2023: 378).

In terms of agent-structure interactions, this hypothesis suggests that vested interests in established energy sources, particularly oil and hydroelectric power, wield the influence to shape the agenda. These actors may be behind certain seemingly inexplicable political decisions made by the Ministry of Economy, such as suspending energy auctions; prioritizing the hydroelectric sector in auctions where photovoltaic energy would be five times cheaper for the

country; and offering tax exemptions to foreign investors while Brazilian entrepreneurs are subject to PIS/COFINS[19] and other taxes and levies (Maluf, 2023: 378)[20].

This scenario could only change if the central government differentiated between policy making (the decentralization of competencies) and policy decision making (the decentralization of decision-making authority) to mitigate private interests that undermine public ones (Arretche; Vazquez; Gomes, 2012: 146). In other words, "While the risk of competition between jurisdictions is present, it is offset by the concentration of regulatory authority in the federal government" (Arretche; Vazquez; Gomes, 2012: 146). However, these analytical features and discrepancies regarding the Brazilian federative system and its empirical reality are better explored in the literature review section, where the thesis examines the divergences and highlights the convergences of New Institutionalism as a framework for studying state capacity and federalism, as proposed here. For now, let us move on to the second hypothesis.

Hypothesis 2 (H2):
Regarding economic interests and pressures from the international environment, China itself would be the biggest inhibitor of the energy transition in Brazil because of its preference for the hydroelectric sector. By 2020, 98% of the amount invested in energy projects in Brazil came from Chinese state-owned companies such as State Grid and China Three Gorges (CTG). Together, they are responsible for 83% of China's Foreign Direct Investment (FDI) in Brazil, with 81% of the capital invested in hydroelectric plants compared to 12% in the wind sector and 3% in the photovoltaic sector (Barbosa, 2020: 9–13; Costa & Vasconcelos, 2023: 418). An important observation is that, in the end, the preferences of the incumbent sectors and China for hydroelectric energy suggest that resistance to small energy grids in Brazil is more of a market issue, not simply a matter of China imposing barriers. Therefore, trade markets and investments should be considered the real constraints to the fourth energy transition in Brazil.

Therefore, if China is the largest investor in Brazil's energy sector, investing under conditions that prevent the country from incurring debt—unlike many cases associated with the Belt and

[19] PIS stands for *Programa de Integração Social* – Social Integration Program; While COFINS stands for *Contribuição para o Finaciamento da Seguridade Social* – Contribution for the Financing of Social Security.
[20] For a better understanding of these two among the 92 types of taxes levied by the Brazilian state, see Tasca (2023). Available from <PIS e COFINS: conheça esses tributos e entenda o funcionamento | Politize!>. Accessed February 2, 2024.

Road Initiative—this should be regarded as a market opportunity rather than as China exerting control or influence over the Brazilian energy sector. Furthermore, these investments adhere to the country's environmental institutional framework (Santoro; Junqueira, 2023) and align with the guidelines of the strategic partnership established in 1993.

If the preference of Chinese investors for the hydropower sector aligns with the incumbent sectors, which remain resilient to the necessary investments in renewable sources beyond hydropower and biomass, this should be perceived as market constraining, further complicating the situation for Brazil. In principle, it is understood that the responses to these hypotheses can enhance our understanding of China's actual capabilities to reshape its institutions, focusing initially on energy security and subsequently on energy transition, both domestically and internationally.

Evaluating the ideal-type trajectory contributes to understanding the deficiencies in Brazil's state capacity to execute the energy transition, ensuring that energy transition services and products are reliably available to its citizens. Thus, in order to better understand the particularities of the fourth energy transition among the other three global energy transitions, the next section present the technical vocabulary related to our phenomenon of study.

3. THE INTERPLAY OF ENERGY TRANSITIONS AND ELECTRICITY SYSTEMS

> There have been three global energy transitions since 1800. The first was the rise of coal to fuel the Industrial Revolution; the second was the use of oil for mass transport; and the third was the rise of gas, hydropower and nuclear power in electrification. In recent years, a fourth energy transition has begun with the use of renewables to provide clean and sustainable energy (Zhaoyuan; Ishwaran, 2020: 2).

The first period of energy transition dates back to the second half of the nineteenth century, when, around 1880, coal began to be used on a large scale to fuel the Industrial Revolution (Figure 3). However, since the 16th century, England had been searching for ways to replace wood and dry manure, as well as human and animal muscle power, with the power of winds and watermills as engines of a revolution that was already in the offing and took almost two centuries to be realized (Bhutada, 2022)[21].

[21] Available from: Visual Capitalist. (n.d.). *Visualizing the history of energy transitions.* Retrieved September 20, 2024, from https://www.visualcapitalist.com/visualizing-the-history-of-energy-transitions/

Figure 3: Global Transitions in energy supply since 1800

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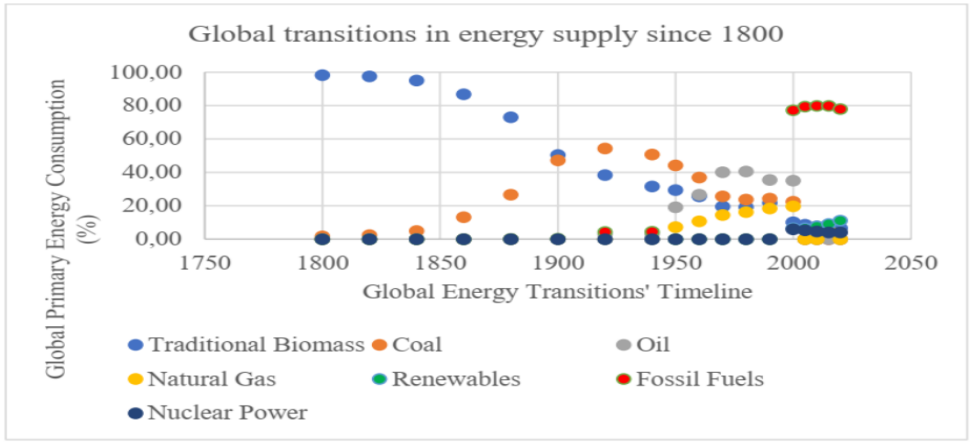


Source: Own elaboration based on World Nuclear Forum (WNF)_The 200-year history of mankind's energy transitions (WNF Apr 13 2022).

Once it began, the Industrial Revolution inaugurated not only the large-scale use of new forms of energy but also the possibility of transforming urban space, mainly in terms of products and comforts linked to the industrial domain of energy. Thomas Edison, founder of General Electric (GE) (Acemoglu, 2012: 40), added to this substantivist (Polanyi, 1976)[22] domain of nature the potential for transforming built space through the immediate use of electricity, a natural element essential to modern and contemporary life and communication, establishing the patterns followed for the subsequent transitions.

The first transition was characterized for a massive shift from biofuels to coal to fuel the Industrial Revolution in the United Kingdom (UK) and the rest of Europe (Zhaoyuan & Ishwaran, 2020: 2). At the European city level, societal demands and new consumer behavior patterns pressed for socio-technical changes in favor of this first significant changes. At national levels, different "cultures, infrastructures, regulations, and institutions" (Geels, 2011: 14) may have led to slightly different national styles in transport and energy systems. However, the

[22] For a broader understanding of how the artificial separation between the market and social relations influences the power dynamics between the state, the market, and civil society, see Polanyi (1978), *Our Obsolete Mercantile Mentality*. RTHI-Revista Trimestral de Histórias e Ideias, v. 1, p. 7–20. The reading of *The Great Transformation* (2000) is especially recommended, where the author innovates by addressing concepts of hegemony, elites, and transnational corporations, in addition to stating that land, labor, and capital were three factors of production artificially created to serve the market. See also *The Economic System as an Institutionalized Process: The Substantivist Approach* (Polanyi, 1976).

timing, speed, and causal mechanisms involved made it possible to identify that the First Industrial Revolution was attached to a phenomenon called the first global energy transition (Zhaoyuan & Ishwaran, 2020). As aforementioned,

> [an] historical example of this pattern is the transition towards electricity systems between 1880 and 1950. Although the phenomenon of electricity had been known for some time, diffusion proceeded slowly through an accumulation of niche applications. Electricity first played a role in sending messages, via telegraphy in the 1830s and telephony from 1876 on. The next niche was formed by arc lights (in the 1870s), which were used to illuminate important buildings and to create excitement at important festivities. But arc lights were expensive and cumbersome, because users had to generate their own power (using generators or batteries), which required a lot of expertise (Hughes 1983). Arc light therefore remained restricted to incidental demonstration projects (Geels, 2011: 22).

To cut a long story short, the patent system, systematized by the Statute of Monopolies of the English Parliament in 1623, was decisive both for the Industrial Revolution that began in England and for the registration of the electric light bulb in 1878 by Thomas Edison in the United States (US). This systematization, which aimed to protect the Kingdom's economy from the “arbitrary transfer” of patent letters, is of the same order of importance for economic and energy transitions as the English enclosures, which decreed the end of an agrarian society and the beginning of an industrial economy with a global vocation (Acemoglu, 2012: 40, author’s emphasis).

> Following the development of incandescent bulbs in 1878, Edison set out to create the first electric *system* where power was generated by producers, distributed via a grid to users who could power various appliances (initially light). Edison opened the first integrated electricity system in 1882 in New York (the Pearl Street station). This was a local system with a small grid that connected only a few users […] City governments subsequently became interested in street lighting, which improved visibility and feelings of safety at night. City governments also played a role in issuing permits for the creation of electricity grids (initially via overhead wires). But the main drivers of this transition were engineers, firms and various user groups. Electricity systems also spread geographically and popped up in various cities around the world (see Hughes 1983, who analyses in detail the creation and design of electricity systems in Berlin, Chicago and London). Electricity systems were gradually expanded within cities, linking up more neighborhoods (Geels, 2011: 23).

In the second phase of energy transition, around the 1940s, oil assumed prominence as a fuel for mass transport. The third transition period saw the rise of gas, hydroelectricity, and nuclear power in electricity supply, also occurring in the 20th century, around the 1960s. Currently, humanity is experiencing a fourth cycle of energy transition, favoring renewable resources.

These energy sources are considered environmentally friendly, contributing to the reduction of greenhouse gases and minimizing losses in energy production and distribution (Zhaoyuan; Ishwaran, 2020)[23].

Throughout the four transitions mentioned, traditional biofuels have remained relatively stable in terms of production and consumption. However, the transition to a lower-carbon energy system is now "[…] crucial for addressing global climate change" (Hochstetler, 2021: 1). The significant innovation of renewable sources lies in their independence from fossil fuel energy sources. This independence is essential, as renewable sources of energy exclude fossil fuels, which are major contributors to environmental problems. Issues such as pollution, global warming, melting polar regions, rising ocean levels, and health problems are some of the main concerns associated with non-renewable energy sources like petroleum and coal[24].

When it comes to nuclear energy, the biggest problem is the negative propaganda surrounding it since the atomic bombings of Hiroshima and Nagasaki on August 6 and 9, 1945, respectively (Heiferman, 1975, pp. 448–451). These events marked both the apex and the beginning of the end of WWII[25]; besides the nuclear accidents at Chernobyl (Soviet Union in 1986) and Fukushima Daiichi in 2011, there is ongoing negative propaganda about the risks associated with nuclear technology. Concerns include the potential leakage of nuclear secrets, the vulnerability of nuclear power plants to terrorism, and the dangers posed by a formal conflict between different political regimes—scenarios that could be catastrophic for humanity.

However, there is also positive discourse surrounding nuclear energy, particularly regarding its applications in medicine and clean energy generation for satellites and submarines. This highlights that, like most forms of energy, nuclear power has two facets: military and peaceful

[23] As mentioned elsewhere in this thesis, we will not address the debates surrounding the various social and environmental problems associated with renewable energy.

[24] Unfortunately, due to time and space constraints, a discussion of the negative impacts of renewable resources—such as the use of fossil fuels in the construction of solar panels, the extraction of rare metals, and the large areas rendered unproductive due to the installation of wind turbines—is outside the scope of this thesis.

[25] The official ceremony of Japan's surrender was held on September 2, 1945, aboard the USS Missouri (Heiferman, 1975). On the Western Front, the war began to come to an end with the defeat of German troops in northwestern Europe and the signing of a surrender at Montgomery's Command headquarters on Lüneburg Heath on May 4, 1945. With the surrender of the remaining German forces on May 8, 1945, the Eisenhower Operations Center in Reims, France, held the official closure of the Second World War (SWW) in Europe (Cawthorne, 2010).

uses. The term "dual-use" describes the fact that materials and technologies related to nuclear energy can have both military and civilian applications (Joyner, 2011). But let’s not rub it in.

For the scope of this thesis, it is necessary to state that the exclusion of certain energy sources is not a viable solution for addressing the issues related to the fourth energy transition. An ideal energy mix should combine large centralized energy systems with small decentralized grids (Zhaoyuan; Ishwaran, 2020). To achieve an efficient, environmentally friendly energy mix, it is essential to include hydroelectricity, wind, solar, tidal (wave), geothermal energy, and specific forms of biomass and biofuels, collectively referred to as renewable sources.

In short, the four periods of energy transition mentioned above have occurred for various reasons and different demands, involving a diverse array of actors at various levels of political units. They may also begin in cities and be taken up by national projects or have been the work of national groups from the very beginning (Geels, 2011: 22). Nevertheless, the most interesting point to note is that as “a long-term structural change to the energy system, where entirely new components arise or old patterns fundamentally change” (Zhaoyuan & Ishwaran, 2020: 2), energy transitions “entail not only new technologies but also changes in markets, user practices, infrastructures, cultural discourses, policies, and governing institutions” (Geels, 2011: 13).

Reducing the terms of subsequent energy transitions to the focus of interest for the research (observation and use of built space around concepts, products, and services of the energy transition), we should emphasize that an energy system is comprehensive in scope, integrating energy production, conversion, transmission, consumption, and management into a single system (Zhaoyuan; Ishwaran, 2020: 1–3), as we can see in Theoretical Framework 1. Similarly, when it comes to electricity, there are different sources of energy that can be captured and/or generated, transformed, transmitted, and stored. In addition, it is necessary to clarify the term "energy transition" as a long-term period of structural changes in the energy system, during which entirely new components emerge or old patterns are fundamentally altered.

Figure 4: Theoretical framework 1: Key concepts related to energy, electricity, and energy transition

SCOPE AND/OR CHARACTERISTICS

1-Energy system	Integrates energy production, conversion, transmission, consumption, and management into a single system (Zhaoyuan & Ishwaran, 2020) [26].
2-Energy transition	A long-term structural change system, during which entirely new components arise or old patterns fundamentally change (Zhaoyuan & Ishwaran, 2020).
3-The four Global energy transitions since 1800	i) The rise of coal to fuel the Industrial Revolution; ii) The use of oil for mass transport; iii) The rise of gas, hydropower and nuclear power in electrification; iv) The current transition emphasizing the use of renewables to provide clean and sustainable energy (Zhaoyuan & Ishwaran, 2020).
4-Fossil fuels	Include oil, coal and gas, which have negative environmental effects such as air pollution and carbon emissions (Zhaoyuan & Ishwaran, 2020).
5-Non-fossil energy	Comprises renewables and nuclear power (Zhaoyuan & Ishwaran, 2020).
6-Renewables	Include hydropower, wind power, solar power and bioenergy (Zhaoyuan; Ishwaran, 2020).
7-A clean energy system	A system in which the entire energy life cycle – from production and conversion to transmission and consumption – achieves the lowest possible levels of pollution and emissions. Major air pollutants generally include Sulphur dioxide, Nitrogen oxide (NOx), CO_2, and various water pollutants (Zhaoyuan & Ishwaran, 2020)
8-Conventional centralized electricity system	Refers to a long-standing mainstream model in energy supply, characterized by a limited number of large transmission-connected generators, suppliers, and large industrial consumers with flexible demand (Zhaoyuan & Ishwaran, 2020).
9-Decentralized energy system	Comprises a large number of small decentralized resources (Zhaoyuan & Ishwaran, 2020).
10-Energy matrix	The combination of energy sources used to meet a country's consumption needs including oil, gas, coal, nuclear, hydro, wind, and solar (Greenyellow, 2023[27]; MME-EPE, 2023[28]).
11-Electric matrix	A subset of the energy matrix, consisting of the energy sources used solely for electricity generation. It includes a complex network of electricity distribution that delivers energy from plants to end consumers and can be used to assess diversification and dependence on energy sources (Zhaoyuan & Ishwaran, 2020).
12-Installed capacity	Measured in Mega-Watts (MW), it represents the sum of the maximum power of energy sources in a country or region (Eletrobrás/Eletronuclear, 2011).
13-Distributed energy system	Comprises small grids of low-carbon energy networks containing renewable sources operable by consumers. The systems can be connected to the power grid or operate off-grid (Andrews-Speed, 2012; Zhaoyuan & Ishwaran, 2020). .

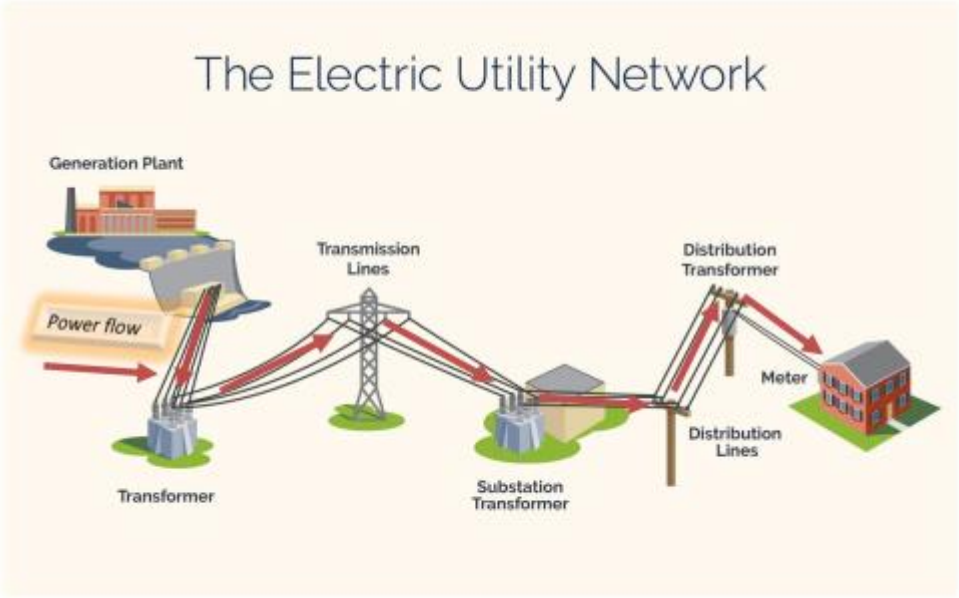
Source: Own elaboration, based on Eletrobrás/Eletronuclear (2011); Andrews-Speed (2012); Zhaoyuan & Ishwaran (2020); Greenyellow (2023); MME-EPE (2023).

[26] See it in more detail in: Shell International B.V. (2020). *China's energy revolution in the context of the global energy transition*. The Hague, the Netherlands: Shell International B.V. 734 p.
[27] See it in more detail in: Shell International B.V. (2020). *China's energy revolution in the context of the global energy transition*. The Hague, the Netherlands: Shell International B.V. 734 p.
[28] Available from: <MATRIZ ENERGÉTICA (epe.gov.br)>. Accessed: January 25, 2024.

According to the descriptions in each numbered row, the logistics of energy supply around the world predominantly rely on the conventional centralized energy system (see the 8th and the 9th rows)[29]. This represents the mainstream model in energy production. In terms of electricity, it refers to flexible demand from large industrial consumers served by a limited number of large transmission-connected generators, as shown in figure 5 (Zhaoyuan & Ishwaran, 2020).

The image bellow illustrates the unidirectional flow from generation to consumption in most of the world's energy systems, characterizing conventional power grids. For illustrative purposes, Figure 6, bellow, depicts a conventional energy transmission tower in China. These types of towers are essential in any energy system. Thus, even our ideal type is attended by this kind of system.

Figure 5: Stylized conventional one-flow energy system



Source: Electric/Kinston, NC (Arrows and power flow legend inserted)[3].

When we critique energy policies that fail to progress beyond a large installed capacity of renewable resources (see the 12th row), we should not consider such systems to be entirely inadequate or that they should be replaced by small renewable energy grids (Greenyellow, 2023). Quite the opposite!

[29] Available from: https://www.ci.kinston.nc.us/557/Electric. Accessed: February 3, 2024.

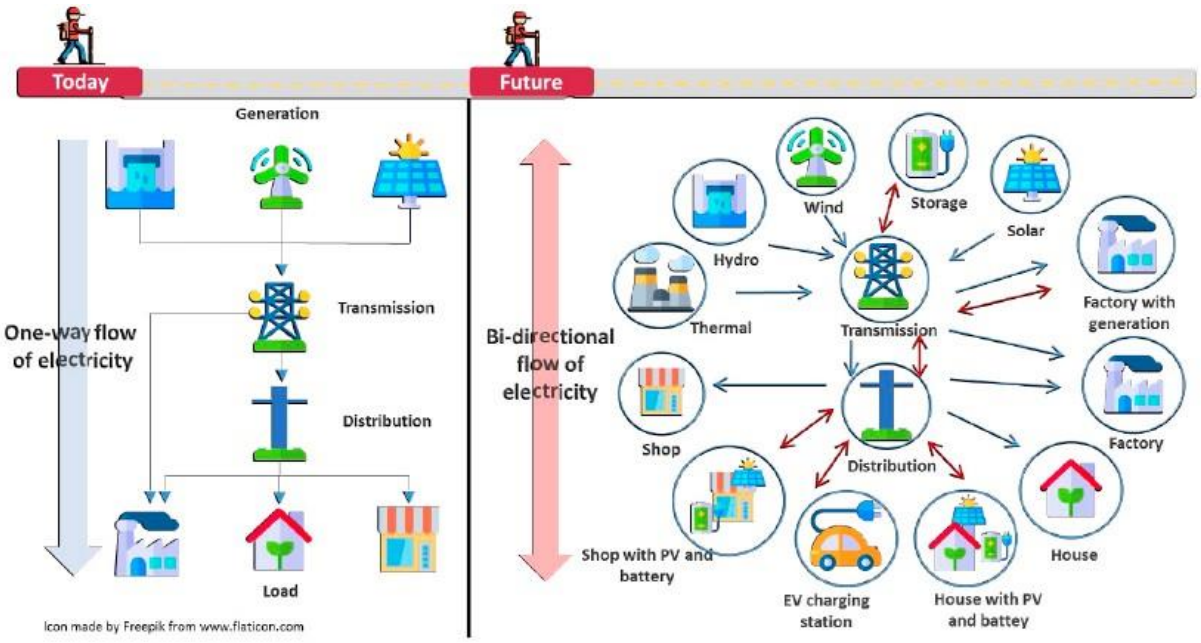
Figure 6: Conventional Transmission Line towers (Shangdi, Haidian district, Beijing, China)

According to the literature mobilized and our exercise in participant observation, conventional systems, like the one shown in figures 5 and 6, should be combined with small-grid energy systems within cities to enable bi-directional energy and electricity flow (Zhaoyuan & Ishwaran, 2020). Unlike conventional systems, small grids are primarily fueled by renewable sources. These low-carbon systems can operate either in connection with larger grids or off-grid, allowing final consumers to manage them as easily as charging a cell phone (Andrews-Speed, 2012).

Figure 7 illustrates the key features of bi-directional electricity flow, contrasting it with the mainstream one-way energy flow[30]. In addition to being charged and recharged locally by final consumers, distributed energy systems experience significantly lower line losses. Moreover, they are environmentally friendly because most of their energy sources are non-fossil fuels, thereby reducing overall CO_2 emissions (Zhaoyuan & Ishwaran, 2020).

[30] Available from: <SciELO - Brasil - Public Policy and Governance Narratives of Distributed Energy Resources in Brazil>. Accessed: February 4, 2024.

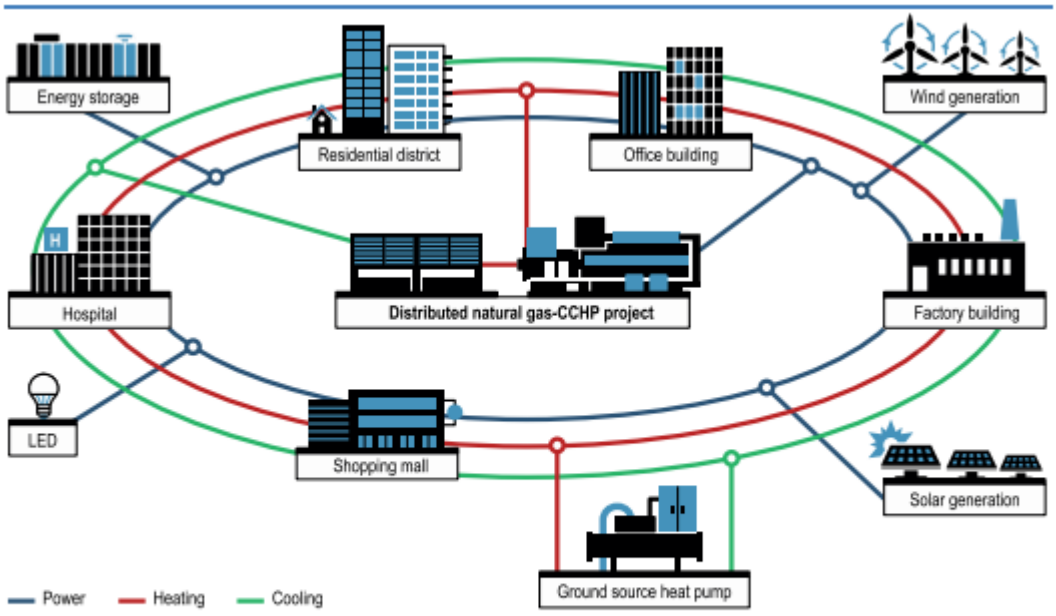
Figure 7: One-flow installed capacity compared to distributed energy small grids



Source: Lampis & Berman (EPE-MME, 2018: 3)

Unlike centralized energy systems, decentralized energy systems (see the 9th row of the theoretical framework 1) rely on microgrids (like the ones on the right side of the figure above) that primarily generate and distribute renewable energy. These systems can operate either connected to the high-voltage grid or off-grid (Figure 8). However, before establishing this balanced energy mix, it is essential to develop adequate installed capacity. This means the state must invest heavily in power flow to ensure a reliable supply of generated energy through transmission and distribution networks, highlighting the importance of conventional systems.

Figure 8: Illustration of a microgrid system



Note: LED = light-emitting diode.
Source: GCL (2017), "Intelligent energy project of golden concord group limited", http://en.gcl-power.com/site/case.

Key point • The microgrid enables the integration of multiple energy sources and loads to maximise efficiency and reduce the cost of energy consumption.

Source: IEA (2017: 76)

The significant challenge arises when public policies fail to extend beyond the mainstream (conventional) one-way flow installed capacity system (Figures 5 and 6). Unfortunately, this represents the global reality, with only a few pioneering cities making progress (Sheng; Cao; Xue, 2018; Sheng, 2020). As we can see in the framework 1 (see row number 7), a clean, environmentally friendly, or sustainable energy system combines production, conversion, transmission, and consumption so that the entire energy life cycle results in the lowest possible levels of pollution and emissions. As we could see from the figures above as well as from the disaggregated concepts on energy from the theoretical framework 1,

> The traditional power grids are generally used to carry power from a few central generators to a large number of users or customers. In contrast, the Small Grids (SG) uses two-way flows of electricity and information to create an automated and distributed advanced energy delivery network utilizing modern information technologies and thus it is capable of delivering power in more efficient ways and responding to widely ranging conditions and events (Tsampasis; Bargiotas; Elias; Sarakis, 2016, emphasis added).

In response to new social, economic, technological, and security demands, "transition also occurs when new end uses require new forms of energy" (Zhaoyuan & Ishwaran, 2020: 2)[31]. In terms of built environments, there are many examples of the coexistence of different energy and electricity sources in cities where small grids are a reality. Two very common examples, often taken for granted, are electric vehicle charging stations and bicycles that can be rented via apps. Our ideal type sites in China provide many examples of these interactions throughout the thesis. However, before reviewing the figures, in the next section, we explore data that helps us understand why China, and not any other energy transition pioneer state, is the ideal type (Weber, 1979) for our participant observation exercise (Yanow & Schwartz-Shea, 2006). This justification will be further reinforced in the methodology chapter.

4. JUSTIFICATION: Why China and No Other Energy Transition Pioneer State

As will be further explained in the methodological chapter, energy transition is a rare phenomenon (Gerring, 2004) that does not occur in the same way anywhere (IEA, 2017). Thus, each country participates in the energy transition according to its own economic potential, availability of natural resources, preference for specific resources, and ability to manage its institutions around a socio-technological transition that, like the other three global energy transitions, historically coincides with major economic transitions (Geels, 2011; Hochstetler, 2021).

Among the various reasons that will be listed for choosing China as the ideal type for this thesis, the theoretical combination (Neo-institutionalism with a focus on state capacity + International Political Economy) highlights China's economic power in the renewable energy market as a distinguishing factor among the countries that invest the most in the energy transition. Hence, there is also an emphasis on how the strategic partnership with China benefits Brazil, challenging the neoliberal order and its micro and macro conditionalities from within. Therefore, while Germany and other pioneer states serve as noteworthy models for energy transition (IEA, 2017; Sheng; Cao; Xue, 2018; Sheng, 2020), China is chosen as the focus for participant observation in this thesis for several compelling reasons:

[31] Energy appears to be a new addition to the foreign policy agenda. Natural resources, however, have enjoyed a long history of influence, stimulating the expansion of European power, provoking state rivalries in the form of "resource warfare," and generating geopolitical structures of power, war, and trade (Hadfield, 2008: 322).

China has been “[Brazil's] main trading partner since 2009” (Carvalho; Veras; Steenhagen, 2023: 10–11). In terms of Foreign Direct Investment in Latin America, Brazil received 48.7% of a total of US$124.8 billion from 2008 to 2019 (Scissors, 2021; Pereira; Ribeiro, 2023: 151). Notably, China is the primary investor in Brazil's energy sector, with a cumulative investment of US$36.5 billion since 2010, accounting for 62% of the total contribution (Santoro; Junqueira, 2023). Several particularities underscore this relationship:

i) Chinese investors prefer projects related to the generation, transmission, and distribution of hydropower; ii) Hydroelectricity generated in Brazil is primarily for local consumption, with no linkage to exports to China or other investors; iii) Loans from Chinese banks, outside the oil sector, are aimed at facilitating the internationalization of Chinese companies, thus avoiding indebtedness for Brazil; iv) State-owned enterprises dominate Chinese investment, with companies like State Grid Corporation of China (SGCC) and Three Gorges accounting for 98% of total investments throughout the 2010s, overshadowing private Chinese firms (Santoro; Junqueira, 2023).

In addition to these specificities, there is a substantial diplomatic effort from both Brazil and China to enhance infrastructure development within Brazil and to explore opportunities for regional integration (Maia, 2023: 65–79). Furthermore, Brazil's comprehensive environmental and labor legislation establishes a standard for social and environmental responsibility, which Chinese companies in the electricity sector adhere to by employing Brazilian consultancies to ensure compliance with local regulations.

China's concern for environmental aspects in Brazil stems from the need to compete in auctions and public bids, such as the Belo Monte Dam (BMD) transmission line, which presents significant social and environmental complexities (Santoro; Junqueira, 2023: 451–452). Despite being the largest emitter of greenhouse gases (GHG), China is also the world's largest investor in renewable energy and serves as the principal trading partner for both allies and rivals (Skocpol, 1985; Gomide, 2016; Hochstetler, 2021).

In this context, the institutional framework of the strategic partnership between Brazil and China has been strengthened, encompassing bilateral and multilateral agendas focused on

technology and innovation, sustainability and the environment, development, poverty alleviation, cultural exchanges, and international cooperation (Carvalho; Veras; Steenhagen, 2023: 10–11). Furthermore, China plays a pivotal role in driving systemic development today. Even without a formal Memorandum of Understanding (MOU), Brazil is included in the Belt and Road Initiative, notably as the country that received the largest investment from this initiative globally in 2021, accounting for 13.6% of the total (Carvalho, 2023: 46). From a more specific perspective with significant domestic, regional, and international implications:

a) Brazil has been China's strategic partner since 1993, initiating an institutional framework to facilitate investments, technical cooperation, workforce training, energy infrastructure development, and bilateral trade (Pereira; Ribeiro, 2023: 159); b) Between 2005 and 2021, Brazil received US$64 billion out of a total of US$140 billion invested by Beijing in Latin America and the Caribbean (American Enterprise; Heritage Foundation, 2021; Carvalho, 2023: 45); c) Although not officially part of the Belt and Road Initiative, Brazil was the country that received the largest investment contribution from the initiative in 2021, accounting for 13.6% of the total (Carvalho, 2023: 46).

From a systemic perspective: a) China is the greatest inducer of global development; b) it is the largest global consumer of strategic resources; c) it is the primary trading partner of both "friends" and "foes"; d) it is the largest global polluter due to the rapid pace of its recent development (Peneluppi Jr., 2023); e) conversely, it is the largest investor in renewable resources, which form the basis for the fourth energy transition (Andrews-Speed; Zhang, 2019).

From a broader theoretical perspective, we assert that the current dynamics in the international energy market, shaped by China and led by its State-Owned Enterprises (SOEs) alongside Chinese private corporations (Andrews-Speed; Zhang, 2019; Hochstetler, 2021), echo many of the motivations that drove expeditions in search of wood, one of the most valuable resources of the nineteenth century. A notable empirical example from that period is the British policy of open waters at any cost, which bears striking similarities to the oil wars of the twentieth century[32].

[32] When it comes to the 19th century, some non-academic but respectable eyewitness accounts highlight the importance of another indispensable natural resource for social and economic life at that time: sperm whale oil. Such accounts can be found in the works of notable writers of the 19th century, including Melville ([1819-1891]),

Considering China's ascendance and its capacity to reshape the international energy market through solutions developed and tested domestically, we base our assertion on Gramsci's maxim that power begins at the domestic level as a relationship of social domination that precedes international relations (Teschke, 2008). In other words, when the international activities of private economic groups align with the foreign policy of their states, it can be inferred that the interests of this transnational elite are being served in international relations (Leysens, 2008; Teschke, 2008). The convergence between Chinese SOEs and private ones when it comes to their preference for the hydroelectric sector in Brazil is as contemporary illustration of Gramsci's maxim about the corporate interests converging with foreign policy (Leysens, 2008).

To analyze this phenomenon, we employ the International Political Economy method of periodization, which allows us to conceptualize globalization as the fourth major change in the history of capitalism (Robinson; Harris, 2000). This framework also helps visualize the historical convergences between the four global socioeconomic transitions (Geels, 2011) and the four energy transitions (Zhaoyuan; Ishwaran, 2020). Furthermore, these lenses reveal that the entrepreneurial actions of the Chinese historic bloc—recently identified as new corporate interests—are not novel; their historical roots predate capitalism itself (Thomas, 2006; Boatcă, 2017; Cruz; Guimarães, 2020).

An example of the systemic implications of China's ascendance in the contemporary international energy market can be seen in the discovery of significant oil and natural gas reserves on the continental shelf of the South China Sea by the United States and some United Nations (UN) agencies in the 1960s. This discovery influenced the signing of the United Nations Convention on the Law of the Sea (The Convention) in 1982, which introduced the 200-nautical-mile exclusive economic zone (EEZ) regime (Ying; Shicun, 2016: 6). Similarly, the Declaration on the Conduct of Parties (DOC, 2002; Ying; Shicun, 2016: 8)[33] in the South China Sea established rules between the Association of Southeast Asian Nations (ASEAN) and

Poe ([1809-1849]), Dostoevsky ([1821-1881]), Tolstoy ([1828-1910]), Eliot ([1819-1880]), Twain ([1835-1910]), and Dickens ([1812-1870]), among others.

[33] Available from: https://nus.edu.sg/2002-Declaration-on-the-Conduct-of-Parties-in-the-South-China-Sea.pdf. Accessed October 18, 2024.

China (Zhang, 2017: 438). Alongside the Taiwan and Diaoyu/Senkaku Islands dispute, this situation represents one of the three major sources of tension between China and the United States today (Fravel, 2011; Congressional Research Service, 2020).

Given the significance of these events for China's energy security, the country has been focused on supplanting the United States as the world's leading oil importer. Consequently, Chinese state entities and energy sector companies have become the most active global investors in Africa, Latin America, the Caribbean, and the Middle East (Zheng; Lye, 2015; Santana, 2016). Not coincidentally, public policies aimed at addressing technological gaps and indigenous historical issues—such as pollution, inadequate irrigation networks for agriculture, and a shortage of technologically skilled labor—have played a crucial role in China's successful repositioning within the global economy (Jaguaribe, 2016)[34].

In this context, the government plans initiated in 1978, along with the reform of the National Innovation System (NIS) that began in 1985 (Lee, 2019), represent early forms of Chinese endogenous solutions aimed at building state capacities to overcome energy insecurity. These efforts can be linked to the current pace of energy transition in the country and its international implications. Recently, these ideological foundations have been strengthened through the industrial policies of the 1990s, which were realigned under the framework of science, technology, and innovation policies. During this period, China leveraged an intermediate technological status—particularly in agribusiness and oil exploration—to invest in secondary innovation.

This logic also permeates the Medium and Long-Term Plans for Technological Development from 2006 to 2016 and the thirteen mega programs outlined in the XII Five-Year Plan (XII FYP) (2011-2015), which focused on developing endogenous technologies (Jaguaribe, 2016). However, due to "a complex set of economic, technical, and regulatory challenges" that persisted in "an immature market for distributed energy systems" (IEA, 2017: 11), the social

[34] Of paramount importance was recognizing that, in areas like biotechnology and information technology, technological boundaries could only be overcome with the centralized coordination of financial dimensions (capital market) and the dominion of intellectual property (Castro, 2016: 141).

impact of distributed energy in China was minimal prior to the advancements made during the 13th FYP, as we can see below.

> Many of the possible benefits of DES have long been recognized in China, such as the ability to achieve high energy efficiency through combined provision of heat and power. However, even during the period of the XII Five-Year Plan (FYP) (2011-15) the anticipated dramatic increase in distributed energy did not take place; particularly distributed natural gas (DNG), struggled in China. By 2015, roughly 120 DNG projects had been built, with an installed capacity of only about 1.4 GW. This number fell short of government targets, which is unusual in China (IEA, 2017: 11).

According to a 2017 report by the OECD/IEA (IEA, 2017), China's pursuit of new growth models, while simultaneously addressing the challenges of global warming, has prompted significant investment in distributed energy systems (DES). The public policy objective is to enhance the efficiency of energy supply to meet the demands of ever-increasing consumption. This consumption is driven not only by industry, commerce, and services but also by a rapidly growing population whose income and aspirations for consumption are escalating exponentially.

To address both the country's energy security needs and its ambitions as a leader in combating global warming—especially in the context of a burgeoning middle class that is newly enriched, educated, and eager for consumer goods—the government developed the XIII Five-Year Plan (XIII FYP) around several technology targets intended to serve as "the building blocks of DES" (IEA, 2017: 12). While natural gas was expected to play a significant role, solar photovoltaic technology was designated as "the backbone of distributed renewable energy deployment during the XIII FYP" (IEA, 2017: 12).

The target set was for 60 GW of distributed solar capacity by 2020, part of a broader solar PV goal of 105 Gigawatts (GW). In this effort, the central government relied on various local government policies to support initiatives for energy efficiency and air pollution reduction. Although the term "distributed energy" was not explicitly used, the report released by OECD/IEA in 2017 (see fragment below) shows that several products related to the concept were launched as part of the industrial policy outlined in the XII FYP.

> In October 2011, the National Development and Reform Commission (NDRC), the National Energy Administration (NEA), the Ministry of Housing and Urban-Rural

Development (MOHURD) and the Ministry of Finance (MOF) jointly issued the Instructions on the Development of Distributed Natural Gas (DNG) (NDRC et al., 2011), which clarified the goals and supporting policies for DNG in China for the first time. In July 2013, the NDRC issued the Interim Measures for the Management of Distributed Power Generation (NDRC, 2013), in which the definition of distributed power generation was first established, and set out requirements on the construction, integration, operation, management, etc. of distributed power generation projects (IEA, 2017: 59).

Figure 9 is an extraction from OECD/IEA report showing the concepts that have come to be associated with the modern understanding of what distributed energy is nowadays.

Figure 9: Distributed energy proto policies in China

Distributed power generation. An energy facility that employs cascading energy use with power output installed at the user's site or nearby. Most of the generated power is consumed by the user, while any excess is sold to the grid and balanced in a nearby distributed grid.

DNG. A modern energy supply source that uses natural gas as fuel and is located near the demand center. Its energy efficiency exceeds 70% due to heat-electricity-cold co-generation or other means.

Distributed solar photovoltaic (PV). Solar PV at the user's site or nearby, where most of the generated power is consumed by the user. Any excess power is sold to the grid and balanced in a nearby distributed grid.

Dispersed wind power. Wind power generated close to demand centers, connected to the local power grid rather than being transmitted over long distances.

New energy microgrid. Any intelligent integrated energy utilization network based on a local distributed grid. It uses multiple energy resources such as wind, solar and natural gas, with high new energy power penetration. It balances local supply and demand through energy storage (ES) and system optimization, and can interact with the public grid or operate independently.

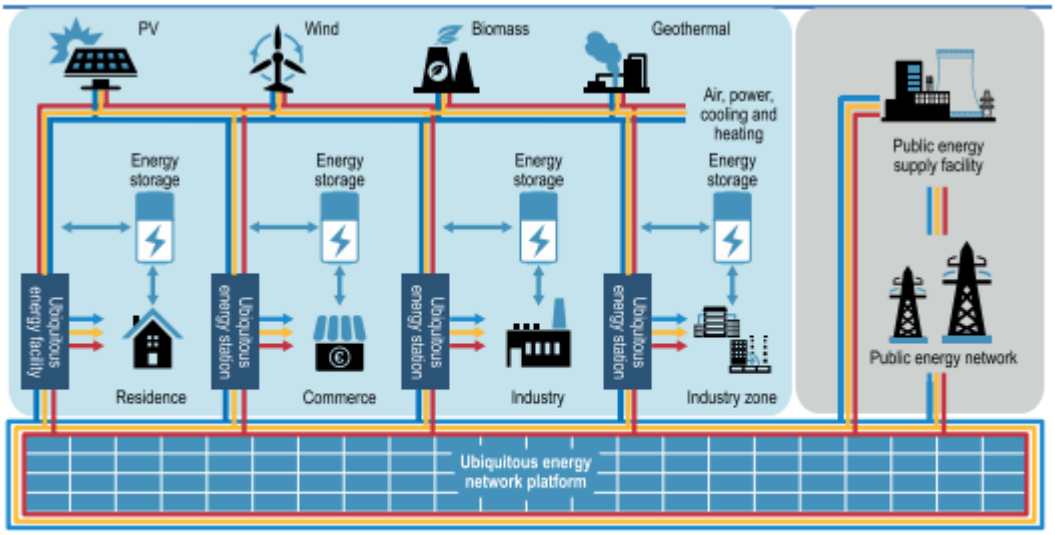
Hybrid energy system. In China, two definitions of hybrid energy system are currently in use. The first relates to an integrated energy supply system based on local conditions, utilizing various available traditional and new energy resources to meet the demand for electricity, heating, cooling, and gas, while operating at a high efficiency level. Typical technologies include gas combined cooling, heat and power (CCHP), distributed renewable energy (DRE) systems and intelligent energy microgrids. The second type is found in areas with abundant energy resources and high demand, integrating different resources such as wind, solar, hydro, coal, and gas.

Source: IEA, 2017: 60

Many of the proto-concepts related to distributed energy developed during the period from 2011 to 2015 in China were integrated into the more assertive energy policies of the XIII FYP. In this context, it is essential to highlight that modern Distributed Energy Systems (DES) represent a means of combining various Distributed Energy Resources (DER) locally within an increasingly digitalized energy framework. This integration leverages advanced Information

and Communication Technology (ICT) resources to enhance efficiency and adaptability in energy management, as we can see in figure 10.

Figure 10: Example of a centrally optimized energy system integration platform (referred to as an Ubiquitous Energy Network by ENN)



Source: ENN (2017), "Ubiquitous Energy Network"

Key point • The Ubiquitous Energy Network integrates an information network with physical energy facilities and loads, using big data and intelligent controls to enhance efficiency and facilitate system optimisation.

Source: IEA (2017: 66)

The "centrally optimized energy system integration platform (referred to as a Ubiquitous Energy Network by [the private energy company] ENN)" (IEA, 2017: 66, emphasis added) is one of the pioneering examples of such integration. It is located in the Sino-German Eco-Park (Qingdao City, Shandong Province) as a national demonstration project for multiple, complementary energy source systems in China. Around 2017, it was advancing "the concept of the energy Internet, or an increasingly networked system of energy supply and demand enabled by digitalization" (IEA, 2017: 80), which was incipient at the time but is now quite common in China.

Shanghai Disneyland, the first Disneyland to use distributed energy in the world, serves as another notable example of a Ubiquitous Energy Network in China (IEA, 2017: 22). The park's energy infrastructure utilizes advanced energy management systems, integrates renewable energy sources, and employs sophisticated grid technology to enhance energy efficiency. It has been recognized as a model for how energy systems can be harmonized within large-scale

commercial settings, leveraging digital technologies to establish an effective and dependable energy supply network.

Other instances of Ubiquitous Energy Networks in China can be found in eco-parks and smart cities, which focus on the integration of diverse energy sources—including solar, wind, and natural gas—into a cohesive, interconnected framework (IEA, 2017). Notable examples include:

1. **Zhangjiakou Renewable Energy Demonstration Zone** – Situated in Hebei Province, this zone plays a significant role in preparations for the Beijing 2022 Winter Olympics, showcasing the integration of renewable energy sources with cutting-edge digital management systems.
2. **Qingdao Sino-German Eco-Park** – This site, previously mentioned, stands out for its commitment to combining various renewable energy sources to exemplify sustainable energy practices.
3. **Tianjin Eco-City** – A collaborative initiative between China and Singapore, this urban area prioritizes sustainable development through integrated energy systems, smart grids, and renewable energy technologies.

The aforementioned projects are part of China's larger commitment to advancing energy management and developing sustainable, interconnected urban landscapes. Furthermore, since Distributed Energy Systems (DES) aim to integrate energy service provision based on Distributed Energy Resources (DER) in a reliable, affordable manner with minimal environmental impact, polluting sources, such as fossil fuels, are excluded from the ideal energy mix (IEA, 2017: 16-80). Figure 11 highlights this focus within the policies developed under the 13th Five-Year Plan (FYP). The numbers added to each row help us to interpret the table.

Figure 11: Distributed energy-related policies in China

Title	Theme	Published by	Time
1- 13th FYP on energy	DP	The State Council	Dec. 2016
2- Energy Production and Consumption Revolution Strategy (2016-30)	DP	NDRC	Dec. 2016
3- 13th FYP on Power, Natural Gas, etc.	DP	NDRC, NEA	2016

4- Some Opinions of Further Deepening Reform on Electricity Sector, and its supporting documents	R	The CPC Central Committee, the State Council	Mar. 2015
5- Some Opinions of Deepening Reform of Oil and Gas Sector	R	The CPC Central Committee, the State Council	May 2017
6- Interim Measures for the Management of Distributed Power Generation	IP	NDRC	Jul. 2013
7- Instructions on the Development of Distributed Natural Gas	IP	NDRC, NEA, MOHURD, MOF	Oct. 2011
8- Notification on Releasing the List of First-Round National Distributed Natural Gas Demonstration Projects	IP	NDRC, NEA, MOHURD, MOF	Jun. 2012
9- Implementing Rules on Distributed Natural Gas Demonstration Projects	IP	NDRC, NEA, MOHURD	Nov. 2014
10- Notification of Regulating the Management of Natural Gas Power Feed-In Tarif	IP	NDRC	Dec. 2014
11- Interim Measures on Distributed Solar Power Management	IP	NEA	Nov. 2013
12- Notification on Issues such as Giving Distributed Solar Power Subsidy Accordance to Power Generation	IP	MOF	Jul. 2013
13- Notification of Further Implementation of Distributed Solar Policies	IP	NEA	Sep. 2014
14- Notification of Promoting the Construction of Distributed Solar Power Demonstration Area	IP	NEA	Nov. 2014
15- Instructions on the Development and Construction of Dispersed-Connection Wind Power Projects	O	NEA	Nov. 2011
16- Guideline of Promoting the Construction of New Energy Microgrid Demonstration Projects	O	NEA	Jul. 2015
17- Trial Measures of Promoting the Construction of Grid-Connected Microgrid	O	NDRC, NEA	Jul. 2017
18- Notification on Releasing the List New Energy Microgrid Demonstrating Projects	O	NDRC, NEA	Mar. 2017
19- Instructions of Promoting the Construction of Hybrid Energy System Demonstration Projects	O	NDRC, NEA	Jul. 2016
20- Guideline of Promoting the Development of Internet-Plus Smart Energy System	O	NDRC, NEA	Feb. 2016
21- Notification of Promoting energy Storage Participating in Electricity Ancillary Services Market in the Three North Areas	O	NEA	Jun. 2016
22- Guideline on the Development of Electrical Vehicle Charging Infrastructure (2015-20)	O	NDRC, NEA, MIIT, MOHURD	Nov. 2015
23- Notification of Releasing the List of First-Round Hybrid Energy Demonstration Projects	O	NEA	Jan. 2017
24- Instructions on Promoting the Utilization of Natural Gas	O	13 Departments including NDRC, NEA, etc.	Jun. 2017

Notes: DP = development plan; R = reform; IP = industrial policy; O = other; CPC = Communist Party of China; MIIT = Ministry of Industry and Information Technology

Source: Own production based on IEA, 2017: 61 – 62

Row 4 of the table above shows that the XIII FYP deepened reforms in the Chinese electricity sector, initially focusing efforts on the production and consumption of oil and gas (row 5). In terms of distributed energy, rows 6 to 11 and 12 to 14 indicate that the focus expanded to demonstrative projects for the management and distribution of natural gas for solar energy (see rows 11 to 14) and wind energy (row 15).

Energy microgrids were more strongly promoted starting in July 2015, the same year when electric vehicle charging stations were also being developed (row 22). The table also shows that microgrids had already been a reality since 2011, although still dispersed (row 15) and not yet integrating systems as today. By 2016, the promotion of hybrid energy systems had already been strengthened (row 19). In the same year, the Internet-Plus initiative was already using smart energy systems to drive such integration (row 20). The first hybrid projects were released starting in 2017, as seen in row 23 of the table (Figure 11).

These endogenous solutions and peculiarities of Chinese reforms illustrate a consistent structure of central and horizontal planning, tailored for autonomous regional application. At first, the public control of the financial system, combined with the significant decision-making autonomy of each region, created a form of "structural uncertainty" (Jaguaribe, 2016: 372). This uncertainty, before extending globally, fostered robust competition that strengthened domestic enterprises in preparation for the international market. This structure emerged as a response to the energy bottlenecks that plagued China from the 1980s until the early 2000s, which posed a significant threat to political stability. In terms of foreign policy, it has been replicated ad hoc across different economic zones, adapting to their unique relationships with the international market.

In summary, the public policies developed by the People's Republic of China aimed to overcome its technological frontiers by leveraging energy crises to surpass prosperous neighbors like Japan, Taiwan, and South Korea in certain knowledge areas (Xinbo, 2016; Castro, 2016), particularly during the decade from 2003 to 2013 (Delgado, 2016). These strategies were transposed to the regional level, marking a new paradigm in industrial policy (Strüver, 2017). This represents a turning point that differentiates a developmentalist policy crafted to navigate a long-standing path dependence trajectory. This new trajectory is now strongly anchored on renewables, a feature that reinforces why, among many other aforementioned reasons, China is the ideal type in a study on the challenges that the fourth energy transition represent for Brazil, as we are going to see in the next sections.

5. METHODOLOGY: Single Unit Case Study

> It has been demonstrated that the difference between a case study and a study (tout court) is rarely clear-cut. Indeed, the study case is best understood as an ideal-type rather than a method with hard-and-fast rules. Yet the fact that the case study is fuzzy around the edges does not mean that it is lacking in distinctive characteristics. When considered as an ideal type the case study research design, like all research designs, exhibit characteristics strengths and weaknesses relative to its cross-unity cousin (Gerring, 2004: 346).
>
> […] This illustrates something important about the structure of descriptive propositions in social science. they are held together by language - by ordinary or technical terms and their definitions. When describing a phenomenon, one is usually comparing it to an ideal-type definition (Gerring, 2004: 347).

This chapter proposes the study of the phenomenon known as the fourth energy transition through two simple units (Brazil and China). The objective is to generalize across a broader group of units (states that present themselves as interested in sharing the social gains of the fourth energy transition). In accordance with the formal units chosen for the interpretation of the phenomenon (Gerring, 2004), Brazil and China, and since this is a regional study (Asia-Pacific Connection), it therefore examines variation across and within the units, synchronically and diachronically, according to the hierarchical model of studies in International Political Economy.

More specifically, we apply analytical elements of IPE from the ideal type of World-System theory (Wallerstein, 1976) to neoliberal updates, passing through the neo-Gramscian critical review (Robinson, 2002; Cox, 2002). The results are interpreted in a unique qualitative research design (Gerring, 2004: 343)[35].

In procedural terms, the case study is the methodological tool used to define the case that will be analyzed by combining interpretative approaches, neo-Gramscian critical theory, and international political economy theory. This application sometimes touches on the same evidence as non-case studies but without the intention of identifying causal effects or analyzing the phenomenon under study (Gerring, 2004). In complementarity to the other methodologies detailed in this chapter, and due to the methodological presence of the ideal-type phenomenon

[35] Whose resulting method could be described as ‘hierarchical time series’ (for a quantitative study) or historical comparative (for a qualitative study) (Gerring, 2004: 342).

(Fourth Energy Transition in China), the case study proposed here approaches the cross-unit research design (Brazil and China, as suggested in item g of figure 12).

As units of limited spatiality, comprising phenomena that are also limited in time, the study units will be broken down by theories and methods focused on the social dimension of the phenomenon of the fourth energy transition: China, before and after the renewal of its National Innovation System (Castro, 2016; Jaguaribe, 2016; Hochstetler, 2021), and Brazil, according to its process of deindustrialization and its accession to the club of Emerging Middle Powers (EMP) (Cano, 2012). In other words, the social implications of the phenomenon are the parameters both for choosing the ideal type and for theorizing about the position of the formal unit, Brazil, in the international energy market.

To be true to the section's opening statements, and for the research proposal and design of this thesis, we apply the case study as "the intensive study of a unit for the purpose of understanding a broader class of units" (Gerring, 2004: 342). Thus, in terms of the case study as an empirical effort and based on the typological framework of research designs (Figure 12), we highlight the impossibility of the restricted pure uses[36], as presented separately below, and at least for the specific research design of this thesis, the first five most common definitions applied to a case study are discussed[37]:

> (a) that its method is qualitative, small-*N* (Yin, 1994); (b) that the research is ethnographic, clinical, participant-observation, or otherwise "in the field" (Yin, 1994); (c) that the research is characterized by process-tracing (George and Bennet, 2004); (d) that the research investigates the properties of a single case (Campbell and Stanley, 1963, 7; Eckstein [1975] 1992); or (e) that the research investigates a single phenomenon, instance, or example (the most common usage). Evidently, researchers have many things in mind when they talk about case study research (Gerring, 2004: 342) [38].

[36] As a general observation, we might say that methods, strictly defined, tend to lose their shape as one looks closer at their innards. A study merges into a case study, a single-unit study merges into a study of a sample, a longitudinal study merges into a latitudinal study, informal cases merge into formal cases, and so forth. Methods that seem quite dissimilar in design bleed into one another when put into practice (Gerring, 2004: 346).

[37] As a substitute for these flawed definitions, we propose to define the case study as an intensive study of a single unit for the purpose of understanding a larger class of similar units. A unit connotes a spatially bounded phenomenon—such as a nation-state, revolution, political party, election, or person—observed at a single point in time or over some delimited period of time. Although the temporal boundaries of a unit are not always explicit, they are at least implicit (Gerring, 2004: 342, author's emphasis). King, Keohane, and Verba (1994: 76–77), among others, also present a similar definition for "unit."

[38] The uses of these definitions in other kinds of research design are not ruled out by us.

Unlike the small-N recommended for type (a) (Yin, 1994, apud Gerring, 2004: 342), and according to the interpretative method of analyzing data observed in the field (Yanow; Schwartz-Shea, 2006), the choice of a qualitative method in this thesis reveals a large number of observations in its two study units, China and Brazil[39]. As for type (b), unlike what was also proposed by Yin (1994, apud Gerring, 2004: 342), this thesis is not limited to the participant observation method; it also employs a review of specialized literature[40], applying diachronic and synchronic analyses of the units according to the neo-Gramscian critical theoretical method (Cox, 1981; 1987; 2002)[41].

Regarding type (c), characterizing the case study as similar to process tracing (George & Bennett, 2005; Bennett; Elman, 2007)[42], we do not rule out the possibility of applying the methodological subtype "process tracing" according to the qualitative precepts of synchronic and diachronic analysis within neo-Gramscian critical theory. We note that this methodological tool would not be restricted solely to the positivist approach commonly found in Political Science (Cunha & Araújo, 2018)[43] and would not be exempt from influence by other relevant methodologies, such as those applied by the aforementioned IPE[44].

In turn, the fourth type (d) is discarded because it suggests that the case study is appropriate for the study of a single case (N = 1), a fact that contradicts the reality of case study application:

[39] Gerring (2004: 343) has argued that what distinguishes the case study method from all other methods is its reliance on covariation demonstrated by a single unit and its attempt, at the same time, to illuminate features of a broader set of units. It follows from this that the number of cases (N) employed by a case study may be either small or large and, consequently, may be evaluated in a qualitative or quantitative fashion by us.

[40] We understand that, despite differences in method, both statistical meta-analysis and literature review aim at the same target: "[to] assimilate a series of studies, treating each of them as case studies in some larger project – whether or not this was the intention of the original authors" (Gerring, 2004: 342).

[41] In terms of research designs and the complementarity of the case study with other methodologies, we establish that the typological table indicates: "covariation may be observed (a) in a single unit diachronically, (b) within a single unit synchronically, (c) within a single unit diachronically, (d) across units synchronically, (e) across units synchronically and diachronically, (f) across and within units synchronically and diachronically," as depicted in Figure 12 (Gerring, 2004: 343).

[42] On the different types of process tracing, whether theory-centered or case-centered, and focusing on causal mechanisms (as in qualitative approaches) or causal outcomes (as in quantitative studies), we refer to the works of Beach and Pedersen (2013), Mainwaring and Peréz-Liñan (2013), Cunha and Araújo (2018), and Figueiredo Filho (2019).

[43] On research designs, case studies, and process tracing, we refer to King, Keohane, and Verba (1994), De Vaus (2001), George and Bennett (2005), Beach and Pedersen (2013), Mahoney and Thelen (2015), Falleti (2015), as well as Cunha and Araújo (2018), among the most prominent scholars.

[44] Consequently, when we refer to the case study method, we are in fact referring to three possible methods, each with a different menu of covariational evidence (Gerring, 2004: 343, author's emphasis). That is to say, we consider different combinations of unit, subunits, with or without some explicit temporal component.

"This is simply wrong [...] case studies always employ more than one case" (Gerring, 2004: 342)[45]. The fifth option (e) is correct in stating that the case study is centered on a phenomenon or instance of reality, though some researchers might argue that it fails to specify that, according to what is being proposed, such a phenomenon can be limited in terms of study units and their implications for understanding a larger class of similar units (revolution, nation-state, economic transition, energy transition, etc.)[46].

Figure 12: Research Designs: A Covariational Typology

		Temporal Variation	
		No	Yes
Spatial Variation	None (1 unit)	[Logically impossible]	(a) Case study I
	Within-unity	(b) Case study II	(c) Case study III
	Across-unity	(d) Cross-sectional	(e) Time-series cross-sectional
	Across-and within-unity	(f) Hierarchical	(g) Hierarchical time-series; Comparative-historical

Source: Gerring (2004: 343)

When it comes to "the case study method considered as an empirical endeavor," we focus on the necessary covariational nature of "all empirical evidence of causal relationships," such as the waxing and waning of X and Y and their rational association with the phenomenon and the units studied (Gerring, 2004: 343). Even when imagined, as in the counterfactual exercise proposed here, the final research design should demonstrate that "[…] the case study occupies

[45] If there is no temporal variation and we examine the phenomena in a single unit at a single point in time, "[…] then the object of investigation will be covariational patterns within that unit, a case study of type II" (Gerring, 2004: 344). On the other hand, we would reinforce the hybrid nature of the case study, combining within-unit observations over time (type I) with synchronic and diachronic observations of the covariations inside the unit (types II and III). However, these are just two of the six kinds of possible ambiguities involving case study, which are outside the scope of this thesis.

[46] Though we should say that nothing prevents researchers accustomed to non-case studies from exploring any topic with a view to generalizing to a broader group of units. We agree with Gerring (2004: 345) when he states that "virtually any intensive study of a relatively bounded topic qualifies as a case study in this minimum sense, so long as it can be linked with some larger topic via a key word (e.g., class formation, war, farming communities, etc.)." For the specificities of this thesis, we understand that, although the energy transitions in China and Brazil are limited phenomena, the fourth energy transition is a broad phenomenon that can be verified in other study units, each with its own peculiarities, whether in pioneering states or in those that are new to the subject. Obviously, a new research design, with a much more intense focus on the subnational units of the study, would be necessary, but the phenomenon of the "fourth energy transition" would have to be maintained so that some degree of comparison would be possible between the proposed research and the new one.

one of the three possible cells" (Type I, Type II, or Type III) of the Research Design Covariational Typology table below (Figure 12):

In short, what the table represented in Figure 12 shows is that…

> Covariation may be observed (a) in a single unit diachronically, (b) within a single unit synchronically, (c) within a single unit diachronically, (d) across units synchronically, (e) across units synchronically and diachronically, (f) across and within units synchronically and (g) across and within units synchronically and diachronically (Gerring, 2004: 343).

Nevertheless, the research design of this thesis presents China and Brazil as units of study for the phenomenon of the "fourth energy transition." Therefore, we discard from the typological framework the empty cell (a) Case Study I - (a single unit observed at a single point in time and without the addition of any subunits) for obvious reasons. Type (b) - Case Study II - does not meet the requirements, not only because it deals only with internal observation but also because it does not present temporal variation. The proposed phenomenon varies over time for China in terms of before and after the implementation of the SNI, and for Brazil in terms of before and after the process of deindustrialization and its rise to the status of an Emerging Middle Power.

Figure 13: Research Design Type III

		Temporal Variation	
		No	Yes
Spatial Variation	None (1 unit)	[Logically impossible]	(a) Case study I
	Within-unity	(b) Case study II	(c) Case study III
	Across-unity	(d) Cross-sectional	(e) Time-series cross-sectional
	Across-and within-unity	(f) Hierarchical	(g) Hierarchical time-series; Comparative-historical

Source: Gerring (2004: 343)

Type (d), despite being an Across-Unit study, does not present an element of temporal variation, as in Case Study II, but only of the cross-sectional type. Type (f) – hierarchical – also does not include the temporal element, despite examining variations across and within units in the same research design. Type (e) – time-series cross-sectional (TSCS) – presents the temporal element

but does not incorporate cross-units, remaining within only one unit (Gerring, 2004: 343). Thus, the research design of the thesis is closer to type (g) (Figure 13).

According to the aforementioned clarifications on research design (Creswell, 2007; 2012), by examining variations across and within units within the same design, this thesis employs the hierarchical model. In qualitative terms, presenting all forms of variation within the same research design aligns the method more closely with the "comparative-historical" type (Gerring, 2004: 343). In this sense, the intention is to use what is structurally ambiguous in terms of case and case study to learn both what is particular and what is generic about the units of study, especially the ideal type China (Gerring, 2004: 345). In specific terms of the combination of methods proposed, this thesis works with the understanding that...

> A case study is best understood as an ideal type rather than as a method with fixed and definitive rules. Its virtues and weaknesses pertain to the type of inference under consideration (descriptive or causal), the scope of the proposition (its depth, breadth, and limits), the degree of homogeneity of unit found across cases and across population samples, the type of causal insight desired (causal effect or causal mechanism), the research strategy (exploratory or confirmatory), and the type of empirical evidence available (Gerring, 2004: 346).

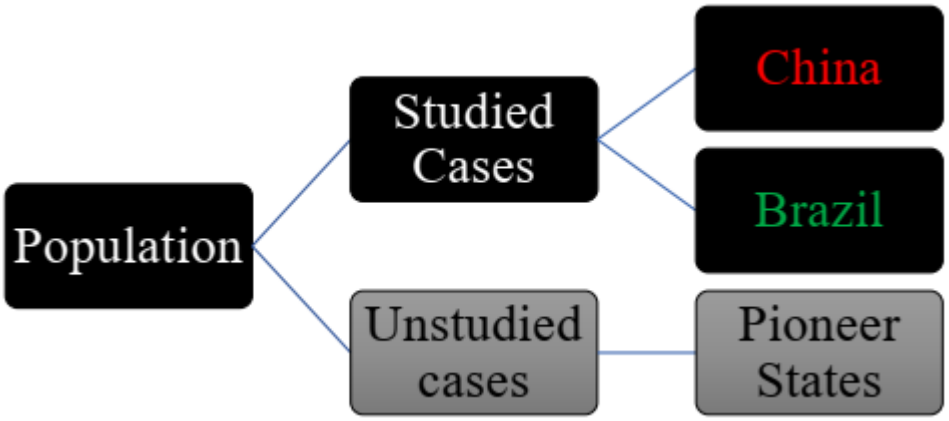
In addition to the discretion inherent to the case study, whether as a method or as an ideal type, and the self-imposed limitation of not using the case study as an analytical tool, we propose an interpretative and naturalistic approach to the fourth energy transition (Gerring, 2004: 346). The meanings attributed to the theme are, therefore, derived from prior knowledge through experience, documentary analysis, and participant observation in the case of the study unit Brazil. In relation to the ideal type, China, the interpretations are based on prior knowledge (through literature and other research sources) confronted with participant observation, unstructured interviews, and cultural immersion.

We understand that "a single case study is still a one-shot, a single piece of evidence resting on the same level of analysis as a proposition" (Gerring, 2004: 349). However, we do not propose to identify causal effects or estimate probabilities. Quite the contrary, in phenomenological terms (Sartori, 1984; Gerring, 2004: 347), the type of descriptive research in this thesis uses concepts disaggregated into theoretical frameworks that, compared to participant observation, allow us to categorize and interpret the phenomenal world in terms of constructed space.

The objective is to identify causal mechanisms that differentiate an ideal-type fourth energy transition from those that are still incomplete, according to the proposed research design (Creswell, 2007; 2012). In addition to the above definition, the technical terms of this thesis according to the diagram below (Figure 14) are "population," represented by the "studied cases," China and Brazil, as well as the "non-studied cases," the pioneering states of the energy transition.

Thus, our "sample" is composed of two "units," each observed at specific points in time: China, in relation to the renewal of its National Innovation System, and Brazil, according to its process of deindustrialization, its accession to the club of Emerging Middle Powers, and the internal debates on energy policy. These two units, "comprising 'cases,'" in addition to the large number of field observations (large N), are also interpreted through the guiding lenses of their energy policies and the role of strategic partnership in their insertion into the neoliberal economic order (Gerring, 2004: 341-342, author's emphasis)[47].

Figure 14: The thesis general topic and single units



Source: Own elaboration based on Gerring (2004); Figueiredo Filho (2019)

Thus, the X:Y mechanism at the heart of the counterfactual hypothesis of this thesis would demonstrate that the universal distribution of microgrids of energy is a sine qua non condition for the social sharing of products and services related to the fourth energy transition. In contrast, the absence or even inadequate territorial coverage of microgrids would make such sharing

[47] On population and observations in qualitative and quantitative research, we refer to King, Keohane, and Verba (1994: 46) and Figueiredo Filho (2019: 38–39).

unfeasible. We work with the idea that "causal arguments" do not depend solely on measures of "causal effects." Therefore, the identification of an X:Y "causal mechanism," in which X and Y are coherently connected, would allow the interpretation of the black box of causality by identifying "intermediate causes that lie between some cause and its supposed effects" (Gerring, 2004: 348, emphasis added). In other words:

> The identification of causal mechanisms happens when one puts together general knowledge of the world with empirical knowledge of how X and Y interrelate […] ideally, they allow one to "see" X and Y interact - Hume's billiard ball crossing the table and hitting a second ball (Gerring, 2004: 348)[48].

The proposed reasoning, starting from the first denaturalizing look at the constructed space observed in the field, therefore begins with a counterfactual assertion of the type "without X or with more or less X, Y would be different" (Gerring, 2004: 350). The objective is that the investigation process, focused on a different type of knowledge, at least initially, from that collected in databases (Creswell, 2007; 2012), provides data that, although not collected but interpreted in loco, help to elucidate the different uses and meanings of the terms and expressions inherent to the fourth energy transition. Such terms, used by energy agencies, experts, and state and non-state actors, often taken for granted (on purpose or not), are addressed in the thesis as constructed according to the corporate interests involved (Leysens, 2008).

We do understand that "[…] building qualitative databases is problematic, because data are seen as being coproduced in and through interactions rather than as objectified, free-standing entities available ("given") for "collection" from the field setting" (Yanow; Schwartz-Shea, 2006: xvii). However, despite all the institutional propaganda, this thesis is interested in what there is of social gain for the most common city dweller, not its shareholders. Thus, despite the hype associating a predominantly sustainable energy matrix (the Domestic Energy Supply – DES) with the benefits of the fourth energy transition, such gains need to be manifested in the real world in the form of built spaces (see rows 10 and 11 of theoretical framework 1) (MME-EPE, 2021)[49]. And these gains must be converted into products and services whose social impacts can be verified in the daily lives of cities.

[48] Ceteris paribus, we find that case studies are more likely to shed light on causal mechanisms and less likely to shed light on true causal effects (Gerring, 2004: 349).
[49] See the table on our installed generation capacity (IGC) in Brazil in 2020 (Figure 46).

Thus, terms and expressions related to the theme of the thesis were disaggregated into theoretical frameworks with the aim of interpreting the social impacts of the fourth energy transition in China and Brazil. Such impacts, according to the understanding of a participant socially immersed in the observed phenomenon, should manifest themselves empirically in terms of small energy and electricity grids, changes in landscapes through built space related to products and services of the said transition, as well as the necessary connectivity inherent to the use, purchase, and sale of such products and services (see the interpretation of the disaggregated concepts on energy along the theoretical framework 1, besides the thesis' figures, photos and tables). The focus of the thesis is, therefore, on the internal variation of each unit, while understanding that the variation between units is a continuum that cannot be discarded (Gerring)[50].

In terms of the interpretative method applied to the fieldwork, although the phenomenon is limited to two study units, the ideal type unity of China provided two subunits of the ideal type (Beijing and Shanghai) and a kind of counterfactual of the counterfactual (Xiantao), resulting in a large number of observations related to energy decentralization (built space, microgrids of energy and electricity, and the use, purchase, and sale of products and services). Furthermore, five months in China were dedicated not only to reading specific literature but also to cultural immersion aimed at the interpretation of the built spaces specific to the fourth energy transition (as described and illustrated elsewhere in this thesis)—spaces that were observed and used daily[51]. Furthermore, users of these spaces, products, and services were interviewed in an unstructured (non-tabulated) manner.

These engaged observations in the study units include conversations conducted with users of services and products related to the fourth energy transition, as well as interviews with teachers, students, and heads of student departments and sectors involved in energy transformation, storage, and distribution (see photos and the boxes represented by figures 15, 16 and 17). Although this research effort involves only two study units, it meets the requirement of data

[50] It is important to make it clear that the qualitative nature of our thesis, although we discard quantitative procedures (in the strict positivist sense), makes use of tables, graphs, and databases as part of our interpretative method whenever we find it necessary to illustrate data from prior knowledge and literature review, as well as data referring to participant observation and cultural immersion (Yanow; Schwartz-Shea, 2006).
[51] We did not count observation hours, nor did we tabulate unstructured interviews.

robustness without the need to increase the number of observations. Unlike positivist research, interpretative approaches...

> […] may entail a small number of research sites—one is not uncommon outside of explicitly comparative work—but field studies of communities or organizations or polities entail large ‘n’ data points in their sustained observation (with whatever degree of participation) over extended periods of time, often in and of various locations within the research site, extended and repeated conversational interviews, and/or multiplicity of agency, policy, or other documents read and analyzed. One might imagine counting, for example, the large number of hours of engaged observation, the number of conversations held, the number of interactions, and the ensuing number of segments of observation and/or conversation and/or interaction analyzed over the course of the research project—any one of which would yield a large ‘n,’ indeed (Yanow & Schwartz-Shea: xvii).

Observations, in the qualitative sense of this thesis, therefore, include the number of interactions during fieldwork (presentations, participation in round tables, seminars, etc.) in which decentralized energy was a direct topic, was simply used, or its use was merely observed (pictures 15, 16 and 17). For example, we are inspired by the experience of sociologist Rosabeth Moss Kanter, who described as "countless" the number of people with whom she conducted 120 "more than momentary conversations" over 120 days of contact during fieldwork and "their situations" (also not tabulated) (Yanow & Schwartz-Shea, 2006: xvii). We understand that, in the specific case of this thesis, the number of observation segments and/or conversations and/or interactions analyzed during the course of the research project raises, each of them, a large "n"—a substantial number of qualified observations[52].

In short, the case study of single units, China and Brazil, proposed in this thesis seeks to apply precepts of the case study as a particular method of defining cases, or "casing" (Gerring, 2004: 341–354; Ragin, 1997, apud Gerring, 2004: 350). The authorial use of the method can be verified in the definition of the study topic, in the hypotheses raised by the primary interest and in the choice and justification of the group of cases that provide relevant information for the investigation of the hypotheses (Gerring, 2004: 350)[53]. In terms of its complementarity with

[52] However, the problem that we will list among the limitations of our research persists: how to create interpretative databases for other researchers to access, since interpretative approaches do not collect but interpret data that remains in the field. We understand that sounds, images, and built space are qualitative data just as much as other types of scientific information that can be ‘collected’ and analyzed constitute quantitative data (Yanow & Schwartz-Shea, 2006: xvii).

[53] The analysis or modeling of causal relationships inherent to the phenomenon we are studying, the fourth energy transition, is outside the scope and the type of case study in our thesis.

"non-case studies," the case study presented here only borrows from cross-case approaches charts, graphs, and tables that are interpreted, as well as other data observed in the field, in a qualitative fashion (Gerring, 2004: 341; Creswell, 2007; 2012).

The proposed exercise is "the intensive study" of simple units whose choices are justified in appropriate chapters and whose central objective is to theorize about the challenges that Brazil faces in sharing the benefits of the fourth energy transition with its society. In other words, beyond market objectives and institutional interests that may involve both national and international actors, hence the justifications for the inclusion of China and the interpretation of the role of this actor in the supposed fourth energy transition when it comes to Brazil (Hochstetler, 2021).

As detailed elsewhere, the object of study, the energy transition, is a historical event that, although coinciding with global economic transitions, is rare and does not occur in the same way in China, Brazil, or even in other possible units of study, such as the pioneering countries in energy transition (Figure 14), here qualified as "unstudied cases" (Gerring, 2004: 342). In other words, it is an event that, even though it presents difficulties of proof or refutation (outside the scope of the thesis), is susceptible to observation and interpretation through a set of assertions about the world as it is (Sartori, 1984; Gerring, 2004: 351).

5.1 The ideal type

For a better understanding of the stage at which Brazil is in an alleged trajectory of energy transition and what has been the path up to now, China's energy transition phenomenon is proposed as a counterfactual hypothesis, an application of the ideal type (Weber, 1949; Wallerstein, 1976). At the heart of the counterfactual hypothesis is the concept of the ideal type originally formulated by Max Weber in the pamphlet *Objectivity in the Theory of the Social Sciences and of Social Policy* (1904) in response to the double prejudice exposed by the economist Carl Menger: i) It is possible to establish cultural laws in the Social Sciences; ii) These same laws are psychologically conditioned.

Considered one of Weber's greatest contributions to Sociology, the construction of ideal types was later expanded in the book *The Methodology of the Social Sciences* ([1913] 1949) and establishes that it is possible to construct certain elements of reality in a completely logical and rational manner, but without the term ideal implying any value judgment. The purpose of such constructions is merely analytical. The counterfactual construction, therefore, is not something that can be proven or refuted but an abstraction that reflects the researcher's interest, whose basis is found in historical facts.

Thus, the cities and places visited in China (Beijing, Shanghai, and Xiantao) will be treated as representing parts of a social system with frontiers, member groups, and rules of legitimation and coherence (Wallerstein, 1976). This self-contained system will be treated in terms of the tensions of its internal social forces, always trying to model the system in its favor, just like the contemporary concept of fragmented authoritarianism details elsewhere in this thesis (Sheng, 2020; Sheng; Liu, Y; Liu, J., 2023). Thus, its developing dynamics will be seen as almost internal to the proposed system[54].

That is: if it were possible for the system to rid itself of all external forces—and we propose that it is not—the system would continue to operate much like an organism. Wallerstein (1976) figures prominently here because we draw on his use of Weber's ideal type, not to describe a world-system as he did, but to treat China's energy transition phenomenon as a self-contained ideal social system for the purposes of our investigation.

5.2 Sources of info

The primary sources of information and evidence in this thesis derive from investigating the role of each country's organic elite, which includes political, economic, and social actors who possess the power to influence public policy in the energy sector. These actors, as the theoretical frameworks (on state capacity; fragmented authoritarianism, e.g.), the neo institutionalist, and International Political Economy theories detail, have the power to interfere in: a) public

[54] In accordance with Wallerstein (1976: 5 – 6), we understand that, although some groups can control certain state interests, the State is not merely a vector of these groups' will. The modern State is the only actor in the international system that can be both de facto and de jure sovereign. Therefore, the influence of transnational elites in controlling the world economy is relative, as the political arena remains under the dominion of the State.

policies; b) foreign policy; c) institutional environment; and d) energy sector. All of these actors, instances and consequent interactions are assessed under interpretive approaches in an attempt "[…] to bring new voices to the policy-making table" (Pachirat, 2006:377)[55].

The sample universe of cases (Gerring, 2004; Figueiredo Filho, 2019: 39)[56] is based on the history of energy policies (Castro, 2016; Jaguaribe, 2016; Hochstetler, 2021), with the following criteria for China: a) it is the greatest inducer of systemic development; b) it is the largest global consumer of strategic resources; c) it is the largest trading partner for both 'friends' and 'foes'; d) it is the largest global polluter due to the rapid pace of its recent development (Peneluppi Jr., 2023); and e) it is, conversely, the largest investor in renewable resources, which are foundational to the fourth energy transition (Andrews-Speed; Zhang, 2019).

The samples in the Brazilian case meet criteria such as: a) Brazil was the largest recipient of Chinese investments in energy and infrastructure among Latin American and Caribbean countries between 2005 and 2021 (American Enterprise Institute; Heritage Foundation, 2021; Ma, 2020, p. 8 apud Liu; Hale; Urpelainen, 2022: 1123; Carvalho, 2023); b) although it is not officially part of the Belt and Road Initiative, Brazil was "[t]he country that received the largest investment contribution from the initiative in 2021 in the world," accounting for 13.6% of the total (Carvalho, 2023: 46); and c) even the most staunchly opposed partisan politics regarding China have not undermined the institutional framework of bilateral cooperation established between Brazil and China since the 1993 strategic partnership (Maia, 2023).

5.3 BUILT SPACES: making the invisible visible

> Finding relations and patterns is central to interpretation, but it is not a straightforward endeavor. Conceptually, this is because the commonplaces of our ways of thinking, seeing, and acting seem, to us, normal and natural; and "normal" things typically do not attract analytic attention. Things we do not "see" and do not think to question because of their normalcy are, in effect, invisible. We're less likely to comment on or even notice a house that looks like the other houses around it. It might even seem so mundane and commonplace in her taken-for-grantedness that we implicitly treat it as non-diagnostic (that is, as irrelevant to the research) (Pader, 2006: 166).

[55] We work with the understanding that "governmental, legal, organizational, communal, and other social actions and their analysis are a human activity, and human perception is not a 'mirror of nature' (Rorty 1979) but an interpretation of it" (Yanow; Schwartz-Shea, 2006: xxii).

[56] We apply King, Keohane, and Verba's (1994: 46) logic that inference is the process of using facts we know to learn about facts we do not know. The facts we do not know are the subjects of our research questions, theories, and hypotheses. The facts we do know form our data (quantitative or qualitative) or observations.

In this section, we present data (images) from our observations of the often taken-for-granted social impacts of built spaces transformed by small energy grids, the X in our X:Y mechanism. This exercise helps us visualize these social impacts in terms of how small grids alter space to provide products and services related to renewable sources. We refer to them as taken for granted (Schwartz-Shea, 2006) because, in the ideal-type site of China—particularly in Beijing and Shanghai—the products and services that arise from the integration of conventional energy systems with small grids are so common, necessary, and reliable that people in these cities hardly recognize their recent emergence (IEA, 2017)[57]. They often overlook the fact that services like, for example, heating and cooling provided for solar panels and other sources are not a national standard (Sheng, C.; Liu, J., 2023; Sheng, C.; Liu, Y., Liu, J., 2023).

However, as researchers, we have seen, experienced, and appreciated these spaces, products, and services, and strive to make them visible as they truly are (Sartori, 1984; Shehata, 2016: 244; Pader, 2016: 174). They are not universally prevalent, even in the ideal-type setting of China, yet they are essential for generating social impacts in everyday life, particularly concerning the fourth energy transition[58]. Therefore, the boxes below show attempts to understand the role of shared collective understandings regarding the level of co-construction and completeness (Granovetter, 1985; Dequech, 2003; Geertz, [1989] 2008) between agent and structure at the level of taken for granted relationships (Yanow; Schwartz-Shea, 2006) such as those of any individual with the invisible products and services derived from energy and electricity (the Y in our X:Y mechanism).

Figure 15: Ideal Type and Participant Observation

My fieldwork in China involved cultural immersion, which included unstructured interviews and participant observation (Wedeen, 1999: vii). This process was complemented by everyday activities, such as socializing with friends, attending university courses, giving lectures, making presentations, conducting interviews, and participating in round tables at various universities across China. During this time, I photographed and catalogued every distributed energy facility relevant to my thesis. I also utilized various applications (Weixin/WeChat, Alipay,

[57] In chapter 8 of *Interpretation and Method: Empirical Research Methods and the Interpretive Turn* (Yanow & Schwartz-Shea, eds., 2016), we develop the idea that it is possible to learn to observe with "an ethnographic sensibility." That is to say, as social scientists, we immerse ourselves in the social reality we are researching (Yanow, 2016: 12), making our participant observation a "lived experience." Methodologically speaking, we were, are, or will be "actually present on-site, eyewitnesses to the events, settings, and interactions described in the research" (Schwartz-Shea, 2016: 101).

[58] It always made intuitive sense to us that if we really wanted to learn about something, there was no better way than to see things for ourselves, speak with those involved, and experience the phenomenon as much as we could—in short, to get to know something well by being there, as Clifford Geertz suggests (1988, 4–5) (Shehata, 2016: 244).

Baidu Map, Amap, etc.) to order food online or in person, rent bicycles, use public transport (buses, subways, urban trains), take taxis or Didi (the Chinese equivalent of Uber), travel by high-speed train, and purchase tickets for events, parks, and tourist attractions—everything a legal foreign citizen is entitled to in the country.

Since the RUC campus serves as a comprehensive real-life example of small grids of distributed energy—a central concept for my thesis—I was particularly interested in its main sources of energy and electricity. A recommendation letter from Professor Liu Jinlong provided me with access to many campus facilities. With this document in hand, I photographed the solar panels on the roof of the International Exchange Building 1 and the Korea Building. I asked the security personnel accompanying me about the water tank, the energy distribution panel, and how the equipment converts energy into electricity for the bathrooms, central heating, and EV charging stations outside the building. Molly, my host, informed me that the energy system for the Korea Building differs from that of the Lide Building and some other student accommodations, which are fueled by gas instead of solar panels. This is why those buildings use serpentine heating, and hot water is available only three times a day.

Interspersed with my fieldwork, Professor Liu Jinlong arranged an interview with Professor Wang Ke at the School of Environment and Natural Resources of RUC. In room 233, we discussed the campus's main energy facilities and how both students and professors often take the significant small grids of distributed energy for granted. Without these small grids, which feature a two-flow energy distribution system, it would be impossible to maintain a reliable security system with cameras throughout the campus, facial recognition, and ID cards for accessing buildings like Ming de, or for purchasing food at the canteens or the PinYuan Market.

Not to mention the services related to Taobao (a virtual megastore similar to Amazon), 24-hour food delivery, electric charging stations, bike rentals via apps, and the banks, markets, stores, and services available within the university campus. Like Dr. Weìye Wang from the Agricultural School, Professor Wang Ke believes in nuclear energy as a reliable energy source. While it is indeed reliable, I explained to them that solar panels are indispensable features of the small grids of distributed energy. Without solar and gas, for example, energy transition has minimal social impact on citizens' lives.

In the same vein as my visit to the Korea Building rooftop, I went to RUC's South District Boiler Room on February 2, 2024. There, I took numerous photos of the boiler system while the furnace worker, Ma Zhanmei, explained that the large facility comprises two systems responsible for heating and providing hot and cold water for showers, kitchens, and serpentines across the campus. The system is fueled by gas, and the machines are from Ebico, the manufacturer that operates the programs remotely while the staff manages the heating and distribution of hot water to the various buildings on campus.

This experience was part of a participant observation exercise inspired by Wedeen (1999: vii, emphasis added), which involves "[...] going beyond the usual, in a practice of cultural immersion that includes not only official interviews (in our case, unstructured interviews) and participant observation, but also a learning process through everyday life practices, such as meeting friends for coffee, studying at the university, and teaching exercises in classes (in our case, giving presentations at RUC and participating in round tables at other universities)" (Box 2).

Figure 16: Round Tables, Meetings, Visits, and Interviews

November 26th, 2023: I participated in a debate regarding Ethiopia's entry into BRICS under the Chinese consensus with researchers from Tsinghua, Beijing, and Renmin universities, along with Ethiopian PhD candidate fellows from various government ministries. I gained valuable informal insights from representatives of the Ministry of Foreign Affairs, Economy, and Agriculture of Ethiopia. From my research perspective, I discussed the Green Belt and Road initiative and China's potential influence on Ethiopia's historical security issues, particularly concerning the Nile River waters and other regional conflicts, as well as domestic security and social challenges.

November 29th, 2023: I presented my ongoing thesis on energy transition to a group of sinologists from Tsinghua, Beijing, Minzu, and Renmin universities. The presentation was titled *Energy Transition: China and Brazil Compared: A Neo-Institutionalist Analysis on State Capacity and Energy Transition*. Available here.

December 29th, 2023: I met with Mozambican students at Shahe Foreign Affairs University to discuss our research projects.

January 2nd, 2024: I had a trial by fire at Renmin University of China (RUC), where I delivered a two-hour presentation (including a lecture and Q&A session) for master's students in Environmental Resources, supervised by Professor Liu Jinlong, my PhD supervisor, with comments from Dr. Weìye Wang. The presentation was titled *Brazil and the Fourth Energy Transition: The China Factor*. Available here.

January 26th, 2024: Professor Jinlong and his RUC staff, including Dr. Chunhong Sheng (participating online from Shanghai) and Dr. Weìye Wang, led a productive meeting with a Peruvian delegation at RUC. I was invited to provide comments on a presentation by Jacques C. Diderot Julien, a PhD student in Agricultural and Natural Resources Economics from Universidad Del Pacífico, Peru, focusing on energy transition in Latin America.

January 29th, 2024: Professor Jinlong led a visit to a preservation forest with the Peruvian delegation, which included a trip to the Great Wall of China. At both locations, I experienced the integration of small grids of energy, essential for the fourth energy transition, alongside internet connectivity with various applications and services. On our return, I photographed the conventional one-flow energy transmission towers in the Shangdi industrial area of Beijing.

February 8th, 2024: I had a long, pleasant, and productive business meeting at the Friendship Hotel in Beijing with Professor Enjiang Cheng, Program Officer for the China division of The Ford Foundation. He expressed interest in the developments of my article on energy transition and sought to understand the concept of distributed energy versus installed capacity. I shared many photographs I had taken as part of my fieldwork.

February 9th, 2024: I was interviewed by Olutimi Osasuna, a Master's student in Development Economics at RUC, who is pursuing a second master's degree and preparing his PhD project. Timi, who is Nigerian, interviews researchers from the Global South. We discussed energy transition and the stagnation of emerging middle powers, among other topics. Link for part 1 and part 2 interviews.

The boxes above and the one below anticipate the photographs taken in Shanghai and Beijing, specifically at Nº 59 Zhongguancun Street, inside the campus of RUC, during the five-month internship and cultural immersion. Throughout this period, we observed, experienced, and utilized the same services, products, and facilities at RUC that we encountered outside the campus in both Beijing and Shanghai. In essence, these are the same offerings—products, services, and facilities—that could be found anywhere distributed energy is a reality as we could see in Shanghai, for instance (Box 3).

Figure 17: Shanghai and Beijing X Xiantao

SHANGHAI
From January 11th to 14th, I conducted fieldwork on solar panels and electric vehicles in Singjian, Shanghai, under the supervision of Professor Doctor Chunhong Sheng from Shenzhen University's China Center for Special Economic Zone Research and the Shanghai International Studies University School of International & Public Affairs. I was particularly impressed by Hua Qiao Xin Cun, an old agricultural village now equipped with modern solar panels. This field trip was arranged by my Chinese supervisor, Professor Doctor Liu Jinlong from the School of Agricultural Economics and Rural Development at Renmin University of China (RUC), as part of my six-month trainee term at RUC.

Additionally, I observed various distributed energy applications at Guangfulin Relic Park in Singjian. Every immersive cultural experience in China is contributing to my thesis and a collaborative paper on energy transition with Professors Liu Jinlong and Chunhong Sheng. The preliminary results of these experiences are presented in this report, and I participated in the first thesis seminar of PPGCP at UFMG since my return to Brazil. This is part of my commitment to my Brazilian sponsors, CAPES-PRINT and CAPES-PROEX, Brazilian government agencies. Available from: Thesis Expanded Summary.

XIANTAO
On February 21st and 22nd, I spent busy days in the Delta of the Han River, where I delivered two presentations at Xiantao Vocational College about the Brazilian educational system—one for students (Feb 21) and another for English professors (Feb 22). During this visit, I took the opportunity to conduct fieldwork on my research regarding energy transition, capturing photographs of the State Grid energy towers, which, unlike in Beijing and Shanghai, are located within the town limits.

In contrast to Beijing and Shanghai, cities such as Xiantao, Wuhan, and Tianmen in Hubei Province do not have central air conditioning in most buildings and facilities. Instead, they rely on standard air conditioners for heating and cooling, which is a significant disadvantage compared to the central air conditioning systems fueled by solar panels or gas in larger cities. On my journey from Beijing to Tianmen, I photographed wind turbines at Anyang East in Henan Province; while they are not included in the presentation, they are part of my ongoing thesis on energy transition. The presentation is available from: Brazilian Educational System.

I also engaged in voluntary work by donating an acoustic guitar to a social project in the Loess Plateau, Gansu Province, where my Chinese friend Karol, who is graduating in German at RUC, volunteers. According to her, life in the Loess Plateau is vastly different from that in major cities like Beijing and Shanghai due to its mountainous terrain. Facilities, products, and services related to distributed energy are not as common in these areas. I hope the children enjoy the guitar and find happiness in it. Available from: Facebook Profile.

As an essential aspect of our experience, we utilized various applications integral to Chinese daily life, such as Weixin/WeChat, Alipay, Baidu Map, and Amap, to rent bicycles, navigate public transport (buses, subways, urban trains), take taxis or Didi (the Chinese equivalent of Uber), travel by high-speed train, purchase tickets for events, parks, and tourist attractions, and access everything else a foreign citizen is entitled to in the country. This experience prompted questions that guided our participant observation exercise and were also posed to the audiences during the thesis development presentations at that time.

The first audience to see these photos was composed of Master's and PhD students supervised by Professor Doctor Liu Jinlong at the School of Agricultural Economics and Rural Development at Renmin University of China on January 2nd, 2024. Professor Doctor Weiye Wang, also from RUC, provided commentary during this session. The exercise with the audience introduced excerpts from the ongoing thesis on state capacity and energy policy in China and Brazil, beginning with seemingly trivial questions such as:

i) Can you imagine life without electricity? ii) Considering the many different gadgets, built spaces, and facilities, are you aware that electricity must be generated, transformed, transmitted, distributed, and stored? iii) What about connectivity? Have you ever contemplated performing the simplest tasks in life—such as watching your favorite series, enjoying artistic performances or online sports, attending classes, conducting research, or communicating with friends—without a reliable network of communication services?

The presentations also included questions such as: i) If almost everything depends on energy, electricity, and connectivity, what's the significance of renewables? ii) What exactly are renewables? iii) What are the various renewable sources? iv) How do they differ from other energy sources? v) What about fossil fuels? vi) What are the major concerns regarding nuclear energy?

To illustrate these questions and the ensuing answers, we presented, as elsewhere in this thesis, pictures and explanations comparing the different uses of the conventional energy system with those of small grids. This comparison demonstrated how these systems, when combined, make the services, products, and facilities that are often taken for granted perfectly available in everyday life.

Now, transitioning to the photographs, let's first examine images that provide context for the existence and functioning of small energy grids. We'll start with a combined heat and power (CHP) facility. One notable example of the "modern distributed energy systems (DES)" (IEA, 2017: 59) prevalent in Beijing is the South District Boiler Room (Figure 18), operational since September 2016. Located within one of the many corners of the 32-acre campus, this facility consists of several large and complex tanks, water pumps, and softening equipment that utilize gas to heat water for household use in campus apartments, stores, markets, schools, banks, sports facilities, offices, administrative buildings, hospitals, and more.

Figure 18: South District Boiler Room (Renmin University of China)

The Southern District Boiler Room is a Solar Thermal Transformation Project for the Heat Supply System at Renmin University of China. This project commenced in April 2016 and was completed in September 2019. It is managed by China Zhongyuan International Engineering Co., Ltd., operating under Beijing Zhonglian Ring Construction Engineering Management Co., Ltd. The construction was undertaken by Hing Run Construction Limited.

Figure 19: Heating boilers and Computer room

Above, there are some of the many heating boilers utilized to provide hot water or steam for heating. All operations are managed by computers and monitored by specialized technicians.

Figure 20: Boiler specifically designed to heat water for bathtubs and sink faucets

This type of boiler is specifically designed to heat water for bathtubs and sink faucets. Buildings that serve as faculty housing or student dormitories, such as the Dongfeng Buildings, receive hot water and central heating from boilers like those shown in the last four photos. Lide Building, one of the largest and most modern structures on campus, is also served by this system[59]. As part of the system, the numerous round blue tanks can store either hot or cold water, depending on the requirements of different parts of the system[60].

Figure 21: Part of the pump and piping system

Some groups of workers, such as those we encountered at RUC, specialize in assembling buildings to house systems like the Boiler System Room. Others, from manufacturing companies, operate computers and machinery integral to the system. In this image, we see a portion of the extensive pump and piping system at the RUC facility.

[59] Buildings with gas heating have the minor inconvenience of providing hot water limited to about three times a day, primarily during the early morning hours. In contrast, buildings equipped with solar panels, such as the Korea Building, offer uninterrupted hot water and heating. However, this inconvenience is nearly imperceptible due to the system's consistent operation.

[60] It is interesting to note that the workers in the Boiler System room do not possess mastery over the entire system. They specialize in the boilers, heating, and water heating systems, while other equipment within the system is operated solely by the manufacturers. Some groups of workers, like those I met at RUC, focus on assembling and operating buildings that house systems such as Boiler System Rooms. In contrast, employees from manufacturing companies operate the computers and other machinery within the system.

Figure 22: Components of the softening system

In this image, we see components of the softening system, where tanks filled with salt are mixed with water to produce softened water for use in the boilers.

Figure 23: Another view of the South District Boiler at RUC

Although the exterior of this building offers no indication of its significance to the operations of Renmin University of China, it exemplifies the many similar structures found in cities like Beijing and Shanghai. Even larger-scale examples can be observed at the Beijing Gas Control Centre (BGCC) and Guangzhou University (IEA, 2017), as well as the Demonstration Projects on Multi-Energy Complement and Integrated Optimization in the Lize Financial Business District of Beijing, the Shanghai Tower in the Lujiazui District, and Shanghai Disneyland—the first Disneyland in the world to utilize distributed energy.

Figure 24: Police officer, staff, and Ebico specifications stamp

Information about the RUC South District Boiler Room was provided by the friendly furnace operator, Ma Zhanmei. Some of the photographs were taken by her cooperative colleagues. We would also like to express our gratitude to the police officer who escorted us during the entire visit. The photo on the right show specifications related to the South District Boiler Room. As mentioned earlier, some of the machines in the facilities are operated by the entitled company and not by the staff.

It is essential to highlight that the entire process before and during the tour of the South District Boiler Room was made possible by the Baidu translation app, developed by Baidu, one of "China's major technology champions" (Jaffe, 2021: 73). Apps play a crucial role in the mix of distributed energy products and services. At the time, we already had a letter of safe conduct from our Chinese supervisor explaining our interest in distributed energy small grids and renewables in general.

However, since we could not find anyone who spoke English to accompany us, we navigated the various departments at RUC on our own using the Baidu translation app until a police officer agreed to escort us to the facility. There, we interviewed Miss Ma Zhanmei, translating the questions and answers into English and printing them to provide accurate descriptions for each photograph presented here.

In addition to the combined heat and power equipment from the South District Boiler Room, several buildings at Renmin University of China are equipped with solar photovoltaic systems. Unlike gas-powered systems, "solar photovoltaic (PV) systems convert energy directly into electricity" (IEA, 2017: 30). In contrast to wind energy, where large-scale projects may not be

suitable for certain regions, PV systems are adaptable for both large and small grids. These systems, which can range from watts (W) to megawatts (MW), consist of modules connected with components such as inverters and mounting systems, collectively known as PV systems. This configuration offers flexibility for installation in residences, buildings, and companies.

> Thanks to the modular nature of solar PV, technology learning for large-scale systems also directly benefits small-scale installations: they both use exactly the same solar panels. This is highly unusual in the power sector and one of the many reasons for the rapid decline in the cost of solar PV (IEA, 2017: 18).

On January 10, 2024, after nearly five months in China, we finally received permission to visit and photograph the solar panels on the roof of the Korea Building, the student housing complex where we spent five out of the six months of our stay in Beijing.

Figure 25: The pipes and the hot water tank on ISO rooftop

On the rooftop of the Korea Building, Molly, an employee of the International Students Office (ISO) at Renmin University of China, accompanied by a building security guard, provided information about the solar panel system for power and electricity supply, as well as the hot water tank serving the entire building.

Figure 26:The simplicity of the RUC solar panel system

Some of the most common applications of this flexibility and immediacy in transforming energy into electricity through solar panels depends on the correct functioning of the panels above.

Figure 27: Solar system panel and pipes on Korea Building rooftop

Two important points to note in these photos are: i) the solar panel system designed to supply, for example, an apartment building with 10 floors, around 15 dormitories per floor, offices, laundries, vending machines, and battery chargers for electric vehicles is remarkably small compared to the gas-based system in the South Boiler System Room we previously saw. A building like Lide (visible in the background of the second photo), one of the largest and most modern on campus, continues to be powered by gas. In other words, any power and electricity supply system could be enhanced by transitioning to solar panels similar to those installed on the Korea Building (IEA, 2017).

As we could understand from the presentation of the then ongoing thesis from the answers we asked about energy, electricity and connectivity, people who use these services in a daily basis just take them for granted. We try to clarify the thesis point on the necessity of the small grids fueled by renewable sources with the photos that follow.

Figure 28: Turnstiles at RUC and tourists visiting the Temple of Heaven

Electronic turnstiles equipped with facial recognition devices, as well as the capability to read or insert identification badges, boarding tickets, or entry passes for public or private events and locations, are ubiquitous in our ideal research site. While such turnstiles have been common worldwide for decades, they have not always functioned effectively. However, powered by small energy grids, as we have explained and exemplified, they never stop working. Imagine thousands of students entering and exiting schools at all levels every day; hundreds of thousands of tourists and art enthusiasts visiting historical and artistic sites, such as the Temple of Heaven in the photo above (along with the Great Wall of China or Shanghai Disneyland, among many other historical sites); the same logic applies to cinemas and theaters; subway stations, high-speed train stations, and other forms of public transportation; or even in ports and airports.

Just imagine that in an ideal application site for sources from the fourth energy transition (as exemplified above), you simply present your electronic document (card, ticket, or badge) or use facial recognition to enter and exit these locations freely. For various events, you can simply purchase tickets online and present them at the appropriate time. You may not see it, but the energy from power-generating plants like the South District Boiler Room or the solar panels we saw a few pages back (both located at Renmin University of China) serves as the invisible source (often taken for granted) that powers all types of electric and communication services where the small energy grids are connected.

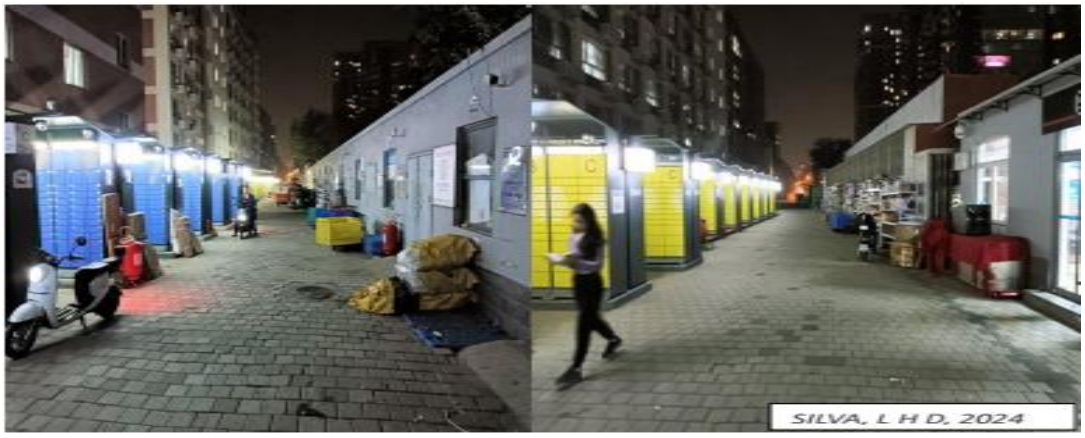
Some locations, like the aforementioned Shanghai Disneyland, utilize smart technology. Others, such as historical sites, despite not using ubiquitous (smart) systems (IEA, 2017), are powered by sustainable energy through small dual-flow energy grids. Ultimately, what we want

to emphasize with the examples of renewable energy small grids, turnstiles, and connectivity through applications is that in certain parts of the world, like China, there is no workaround. If the turnstile or your badge does not work, or if you do not have a ticket for entry and/or boarding, the doors do not open; you do not board, do not enter, do not exit, and do not circulate. Thus, let's see some more taken from granted services, products and facilities related to the small grids of energy illustrated by the following photos.

Figure 29: Shelves designed for food, turnstiles and a girl picking her food out of the shelf

The photo on the left shows a girl walking in front of a wall of white shelves, specifically designed for food, inside the Renmin University of China (RUC) campus. One simply orders food online, and once it's delivered, the person receives a message on their phone. The girl in the photo on the right is retrieving food she purchased online from the white shelves. In the same shot, we can see some people entering and leaving the campus using facial recognition technology. The man on the bike does not need to get off the vehicle to enter or leave places with such technology.

Figure 30:The blue and the yellow shelves according to the delivery company



The products purchased on Taobao or other online platforms are delivered to the yellow and blue shelves shown above. Each shelf has a unique code that is sent to the buyers' cell phones, allowing them to collect their items at their convenience. Some individuals prefer to pick up their products late at night or early in the morning, as illustrated in the photos above. These shots were taken in the middle of the night to showcase the lights. During the day, the floor in front of the mail stores and the shelves fills up with packages being distributed among the appropriate shelves. The building we see in the photos is a student dormitory powered by gas from the South Boiler System, as previously detailed.

Figure 31:Delivery Electric Vehicles (EVs) and the mail companies and customers

In the picture on the left, we see various electric vehicles used to transport thousands of packages related to online purchases. The photo on the right captures two students checking their cell phones to locate the correct shelves for their packages. They are positioned in front of several companies responsible for shipping parcels to and from destinations worldwide. The mail companies close at 9 p.m., but the shelves are always available, even in the still of the night.

Vehicles like the ones depicted in the picture above are just two examples among many other models of EVs used for a wide range of services in areas where battery storage is a reality. As detailed elsewhere in this thesis, people can choose when and where to charge these vehicles at their convenience, and the cost is remarkably low. However, countries like Brazil are lagging nearly 10 years behind China in discussions regarding EVs and battery storage (Caiazzo da Silva & Pizzolato, 2022).

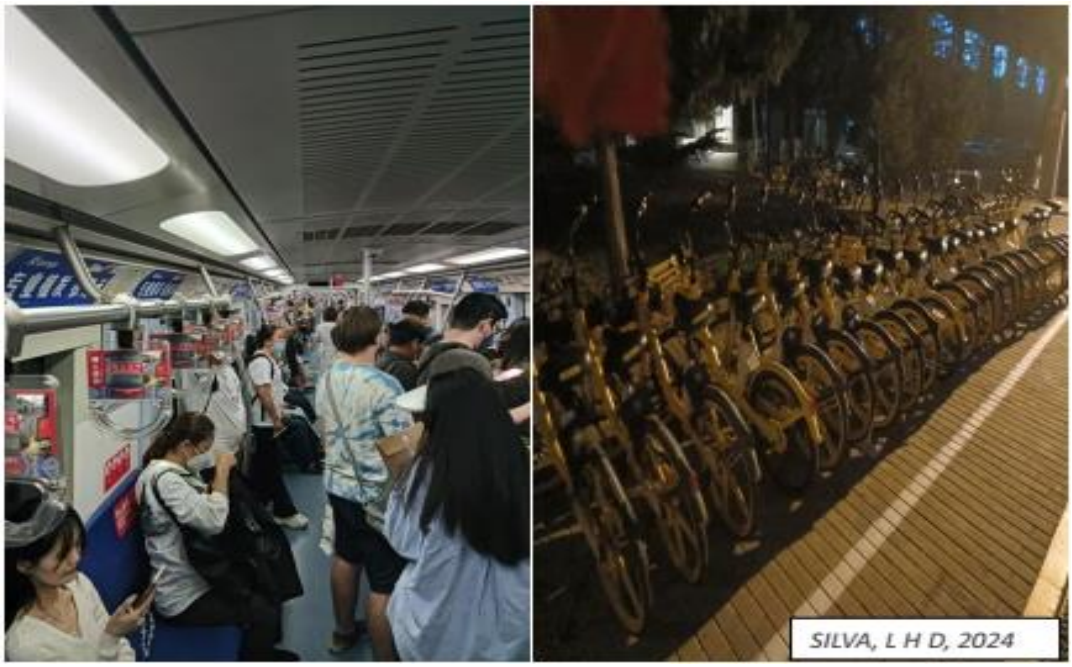
Figure 32: Hot water is a Chinese informal institution

Hot water for tea or plain drinking is one of China's strongest informal institutions[61]. In the photos above, we see a student engaging in her ritual, filling a large thermos bottle in front of a machine that is activated

[61] Informal institutions in China encompass family, consent, harmony, and the various practices surrounding these institutions. They are closely tied to the concept of 'rejuvenation,' which was advanced by former President Hu

by her campus student card. Besides granting access to places like the library and buildings such as Mingde, the student ID card can be loaded with money and is accepted in the many canteens and some markets on campus. These cards are good examples of intermittent connectivity through small grids of energy and internet (Jaffe, 2021).

Figure 33: People inside a subway train and bikes for rent



Speaking of transportation, we can see people inside a subway train. Consider the millions of people using this system every day, the role of apps in purchasing tickets, and the turnstiles to access the metro and other forms of public transportation (buses, trains, trams, high-speed trains, and the like). This underscores the importance of the two-flow small grids of energy, properly connected to the internet+ and operating intermittently (Jaffe, 2021). To access public transport facilities and vehicles, one uses the same apps that work for renting bikes, such as Alipay and WeChat. Users can choose from three different colors of bikes and two apps: Alipay for the dark and light blue bikes and WeChat for the yellow ones, as shown in the picture above.

Jintao and further modernized by the current President, Xi Jinping. As Hu Jintao stated: "We must keep to the orientation of advanced socialist culture, bring about a new upsurge in socialist cultural development, stimulate the cultural creativity of the whole nation, and enhance culture as part of the soft power of our country to better guarantee the people's basic cultural rights and interests, enrich the cultural life in Chinese society, and inspire the enthusiasm of the people for progress. […] We will also strengthen international cultural exchanges to draw on the fine achievements of foreign cultures and enhance the influence of Chinese culture worldwide. […] The great rejuvenation of the Chinese nation will definitely be accompanied by the thriving of Chinese culture" (Hu Jintao, 2007 apud Oliveira; Araújo, 2023: 303). The concept of China's cultural soft power includes both domestic and external perceptions and is therefore associated with the legitimacy underpinning the longevity and resilience of fragmented authoritarianism in the Chinese context. For insights into the complexity, specificities, and endurance of the Chinese regime, see Xu (2011); Gilli, Li, and Qian (2014); Malesky (2021); Tjia (2023). Additionally, authors like Teng Fei and Wang Pu (2021) delve into crucial Weberian concepts such as 'ideological legitimacy' and 'procedural legality' to explain Chinese institutions in energy governance, particularly in the context of China's fragmented political system and regime legitimacy.

Figure 34: One type of EV charger and an EV being charged

The picture on the left shows one type of EV charging station. On the right, we see an EV being charged at night when electricity prices are lower. The EV is located in front of the Korea Building, which is powered by solar photovoltaic (PV) energy, allowing for 24-hour intermittent energy supply since the generated energy is stored for use at the consumer's convenience. In the same image, we can also see the Lide Building, one of the many facilities powered by gas supplied by the South Boiler System mentioned earlier in the thesis.

Figure 35: EV charging station at RUC and another type of EV charger

The EV charging stations are good examples of useful built spaces that, although not invisible, are often taken for granted due to their commonality and reliability in cities like Beijing and Shanghai. In many cases, these charging stations are powered by a small set of PV solar panels installed on the roofs of buildings, such as the one shown in the picture (Korea Building, inside RUC).

Figure 36: Outdoor and indoor EV charging stations

The pictures above illustrate the differences between an EV charging station deployed outside a building in Beijing and one located inside the garage of a residential building in Shanghai. Just as there are many different companies with various models of charging stations (see photos), the key points to note are the convergent technology based on micro grids and the public policies harmonizing the macro structure. This ensures that different enterprises' technologies are compatible, allowing the end consumer to be supported wherever they go, regardless of the kind of EV they use.

Figure 37: Turnstiles at RUC and tourists visiting The Temple of Heaven

Whether entering or exiting public buildings—or even private venues such as cinemas, theaters, museums, parks, tourist sites, sports courts, and gymnasiums—the use of turnstiles equipped with facial recognition, electronic tickets, and magnetic identity cards is extremely common. This is especially true in large historical sites like the Temple of Heaven (see photos above), the Great Wall, or Guanfulin Park in Shanghai. Thanks to the two-flow distributed energy small grids, these turnstiles remain operational regardless of the number of people or the size of the venue[62].

[62] We should note that, while there are efforts to enhance sustainability at historical landmarks through energy-efficient technologies like Light Emitting Diode (LED), solar power, and smart environmental controls, these initiatives are often localized and do not constitute comprehensive Ubiquitous Energy Networks. In contrast, locations like Shanghai Disneyland, smart cities, and eco-parks—such as the Qingdao Sino-German Eco-Park—are more closely aligned with the concept of Ubiquitous Energy Networks, as they focus on integrating multiple energy sources, including renewables like solar, wind, and natural gas, into a cohesive, digitally managed grid (IEA, 2017).

All these services, apps, machines and facilities we saw, and many others not mentioned but essential in everyday life like domestic machines and gadgets, can be (and often are) taken for granted by many Chinese people, especially the younger generation. However, these facilities are relatively new in China (see theoretical framework 1), as "there was no specific industrial policy on distributed energy in China before 2010" (IEA, 2017: 59). Now let's resume this section by taking a look at the prices of some services related to the fourth energy transition small grids.

In addition to turnstiles, which are common and necessary everywhere, as exemplified in this thesis, rental bicycles have become an inseparable part of the landscape transformed by the connectivity provided by the energy transition (Jaffe, 2021). Typically, for Y1.00 (approximately R$0.80, or eighty cents of a Real on average), users can cycle for almost an hour. With a recharge of Y7.00, users can cycle without time limits for an entire month. With different service providers identifiable by the color of the bikes, one cannot walk a block without encountering dozens of bikes waiting to be unlocked and used. Although this information may seem trivial, the barcode is read on the bike itself rather than in designated parking areas. This system effectively removes geographic limits on bike usage[63].

Thus, we assert that many renewable sources can be developed to create small energy and electricity grids. These sources can either be integrated into the larger centralized grid or supplied to local distribution networks, rather than being routed through the high-voltage grid (Andrews-Speed & Zhang, 2019). Small grids enhance the economic efficiency of energy systems by reducing line losses and minimizing the investment costs associated with larger transmission structures. Furthermore, these renewable sources often include energy solutions that are easily operable by end users, such as electric vehicle charging stations.

To conclude this section on participant observation, let's take a look at the photos taken in Shanghai. They illustrate the logic behind the integration of conventional one-flow energy

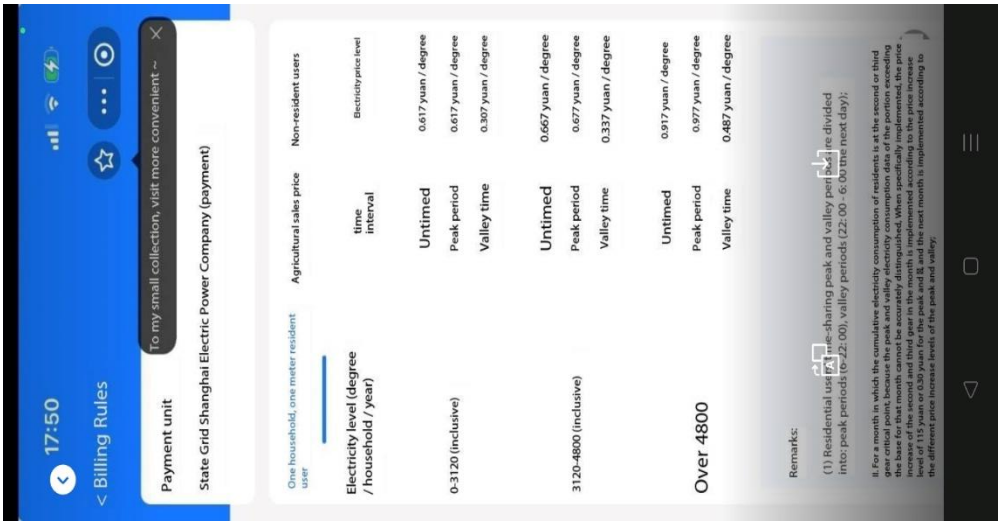
[63] Let's consider Brazil, where renting bikes poses the challenge of requiring users to return them to specific locations. This is because the service relies on designated parking areas for unlocking and locking the bikes using a barcode, rather than allowing each bike to be locked and unlocked independently, as experienced in China.

systems, small grids, and the digitalization of the internet through the use of apps, websites, and other forms of virtual connectivity.

Figure 38: Garage building parking lot equipped with EV charger in Shanghai

Photo 34 shows a residential garage building in Shanghai equipped with electric vehicle (EV) chargers at each parking lot. These chargers are operated by the residents themselves, who decide when to charge their vehicles using apps such as the one provided by the State Grid Shanghai Electric Power Company (Print 1). The chargers are compatible with the two most common types of EVs, identifiable by their green or gradient green-and-white license plates: Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). In contrast, Internal Combustion Engine Vehicles (ICEVs), which have blue plates, do not have access to this convenience.

Figure 39: State Grid Shanghai Electric Power Company App



Source: State Grid Shanghai Company (payment): Feb. 7 2024

The image above, printed on February 7, 2024, shows the variation in electricity prices from "peak time" (the highest prices) to "valley time" (the cheapest prices). The price for kilowatt-hour (kWh) was 0.3 RMB per kWh, approximately ¥6.00 for 21 kWh (6 Yuan for 21 kWh).

With ¥7.00, an owner of an EV could drive for 100 kilometers. The power consumption, measured in Electricity Level Degree or simply Degree (Print 1), is calculated for each 100 kilometers, making it easy to see the average power consumption and how much one pays for each kilometer driven[64]. A quick search using the Baidu search engine (Print 2) reveals that the price of gasoline in Shanghai is updated every 14 days by the government.

Figure 40: Gasoline prices in Shanghai, China (Feb. 2024)

Source: Baidu. Accessed Feb. 8 2024

As of February 8, 2024, the price per liter of gasoline was 7.79 Renminbi (RMB), a rate effective since January 31, 2024. Depending on the type of vehicle, 8 liters of gasoline are consumed for every 100 kilometers driven, which amounts to 62.32 RMB. In comparison, driving the same distance in an electric vehicle (EV) cost only 7 RMB. This doesn't take into account the restrictive policies on Internal Combustion Engine Vehicles (ICEVs). The data on EVs, Plug-in Hybrid Electric Vehicles (PHEVs), and ICEVs are based on Shanghai figures, as the city boasts the largest number of EVs (Shi et al., 2020). Moreover, Shanghai has the most comprehensive policies in China for differentiating license plate pricing for electric vehicles.

Print 3 provides data on energy consumption trends in Shanghai as of February 2024. This information reflects the increasing demand for electricity in the region, driven by the

[64] For the consumer represented in Print 1, the cost was 0.617 Yuan per degree, which is equivalent to ¥0.617 per kilometer.

widespread adoption of electric vehicles (EVs) and the expansion of urban infrastructure. The trends highlight the shift toward sustainable energy sources, such as solar power and microgrids, and emphasize the significant role of smart technology in managing and distributing energy efficiently throughout the city.

Figure 41: Info on energy consumption trends – Shanghai, China (Feb. 2024)

Source: Baidu. Accessed Feb. 8 2024

The app associated with the EV charging system provides comprehensive data on the vehicle, charging status, and electricity consumption through graphical and textual formats. It also alerts users to the best times (usually at night) to charge their EVs when prices are lowest. This allows residents to charge their vehicles either in their own garage or at any nearby charging station at the minimal price of the day.

From our participant observation exercise in two subunits of our ideal type of China, we observed that the invisible rules of the game (the institutions related to energy policy) work in a way that makes the X:Y causal mechanism evident. And as we explored into the impact of the technological advancements on Shanghai's broader energy consumption patterns, it became evident that the integration of EV infrastructure plays a pivotal role in shaping the city's sustainable future. This structured alignment of policies and consumer behavior reflects the broader institutional frameworks governing energy use, a concept central to Neo-Institutionalism, which we will now examine in greater detail.

6. INSTITUTIONS AND STATE CAPACITY: Limits and possibilities of agency

The general objective of this chapter is to present a comparative view of two of the three theoretical strands of New Institutionalism: Historical Institutionalism[65] and Rational Choice Institutionalism, while acknowledging the foundational role of Sociological Institutionalism. Although this debate is deeply rooted in both qualitative arguments and quantitative vocabulary and methodology, our aim is to acquire convergent tools for our qualitative analyses. Guided by the scope of the thesis, this reconstruction emphasizes the divergences but highlights the convergences among the neo-institutionalist theories that analyze public policy management strategies in relation to concepts of federative coordination and decentralization.

However, we will not delve deeply into the theory of federalism[66]. Instead, we draw on assertions from the neo-institutionalist debate, focusing on state capacity and its disaggregated concepts (Theoretical Framework 1). Thus, we operate under the understanding that within a federal system, municipalities, states, and the federation are autonomous and independent of one another, acting as legal equals. Consequently, cooperation depends on mutual gains, as they are all rational actors. Regarding the role of society, it exerts demand and pressure for responses from public authorities, as only the state and governments have the prerogative to create and implement public policies (Lowi, 1964; 1970; 1972).

In this context, we revisit empirical examples demonstrating that institutions serve as the rules of the game. Similarly, the theoretical frameworks incorporating disaggregated concepts related to state capacity and federalism enable us to explore themes such as decentralization and autonomy in the relationships between central and subnational governments in both democratic

[65] A strong reinforcement of the historical neo-institutionalist view comes from the neo-Marxist influences of authors such as Skocpol (1985). By highlighting the fragmented and dispersed nature of power, Skocpol argues that bureaucratic autonomy is not a useful concept for explaining the development of public policies. Both Skocpol and Krasner (1982a; 1982b) continue to influence scholars who seek to understand the differences in bureaucratic autonomy between the USA and Europe.

[66] A deeper understanding of federalist theories would involve, for instance, Agency Theory (AT), as imported from economics (Miller, 2005; Shapiro, 2005), which contributes to understanding the possibilities of coordination between federative entities. It highlights the prerogatives of action versus the types of conditional transfers of resources from the federal to the subnational level (Machado, 2018) and distinguishes between types of federalism: dual, centralized, and administrative. This theory can also be applied to [almost] any type of interaction where one actor can be identified as the principal—the one who hires—and the other as the agent, the one who must perform a function in favor of the principal's interests.

and centralizing regimes (Abrucio, 1998 apud Almeida, 2012: 12; Arretche, 2012; Arretche et al., 2012).

In general, new institutionalism refers to "a theoretical perspective [...] that does not constitute a unified school of thought" (Hall & Taylor, 2003: 193), represented by three main currents: i) Historical Institutionalism[67]; ii) Rational Choice Institutionalism[68]; and iii) Sociological Institutionalism[69]. This non-homogeneous set of authors and methods, most prominent between the 1980s and the mid-1990s, identifies and critiques what it calls old institutionalism as excessively normative, nearly a mere arm of the state[70].

From this perspective, old institutionalism is seen as negligent regarding the role of institutions in solving political problems, treating institutions at most as dependent variables[71]. In *Defense of a Comparative Institutional Approach* (Gerschenkron, 1962)[72], Evans (2004, p. 12) asserts

[67] Although historical neo-institutionalism is critical of the rational approach, this analytical perspective is adopted by Arretche (2012) and Arretche et al. (2012) (Almeida, 2012: 9), particularly when "the expectations of the school of rational choice and historical neo-institutionalism are compatible" (Arretche, 2012: 180).

[68] The assumptions of Rational Choice theory are rooted in Marxist and neo-Marxist arguments, as illustrated by Evans, Rueschemayer, and Skocpol (1985). In their contributions to the book *Bringing the State Back In*, the authors—either collaboratively or independently—apply neo-Marxism in their institutional analyses, offering significant general reflections that counter the pluralist school. This perspective is further supported by authors like Przeworski and Limongi (1993), who employ game theory to assess how democratic or autocratic regimes act as independent variables influencing the economic growth of countries.

[69] "The Neo-Marxist theoretical perspective, centered on society, is utilized by authors such as Poulantzas, Miliband, and Offe."

[70] "The most promising converging conclusions about state capacity are aligned with Weber's legacy (1982; 2014). This alignment prompted neo-institutionalists of the late 1970s and early 1980s to propose an alternative to the society-centered perspectives of the pioneers of political sociology, advocating for state-centered analyses that extend beyond its role in economic development."

[71] The new institutionalist approach posits that the state apparatus is shaped by the social structure it aims to regulate. In this context, state capacities function as independent variables that influence or determine other capacities, contingent upon the state's ability to extract resources and regulate social relations. This perspective is evident in the work of pioneers of new institutionalism, such as Charles Tilly (1990), who analyzes coercive and fiscal capacities. According to Tilly, the state as a dependent variable is neither an actor nor a structure (1990). Similar themes are explored by Migdal, Kohli, and Shue (1994) in their examination of domination and transformation in the Third World, as well as by Migdal (1988) in his analysis of strong States and Weak Societies. The dichotomous typology of strong and weak states, while criticized as trivial, proves useful for analyses. For instance, in *States and Social Revolutions* (Skocpol, 1979), the author examines France, Russia, and China, concluding that revolutions have historically contributed to the emergence of stronger states (Hall & Taylor, 2003: 193).

[72] Gerschenkron (1964) presents an intriguing comparative-historical institutional analysis of three pairs of developmental states from the neoliberal era: South Africa and Brazil, which serve as contrasting models in terms of delivery capacity and the expansion of post-democratic capacity; two hegemonies, one ascending (China) and the other declining (the USA); and two original archetypes of state development models, South Korea and Taiwan. Through Gerschenkron's lens, the state is viewed as an institutional substitute for the bourgeoisie in countries undergoing late industrialization. Gerschenkron, A. (1964). *Economic backwardness in historical perspective: A book of essays*. Harvard University Press.

that the relationship between state and society goes "beyond the utilitarian interests of individuals"[73]:

> Adopting an institutional comparative approach to analyzing the state requires a rejection of reductionism. The state cannot be reduced to an aggregation of interests of individuals in positions of power, to the vector sum of political powers, or to the condensed expression of some logic of economic necessity. States are historical producers of their societies, but this does not mean that they are mere pawns in the social game of other actors. Even if they are shaped by them, States should be treated as institutions and social actors in their own right, with powers to influence the course of economic and social change (Evans, 2004: 12).

March and Olsen (1984, p. 734), founding figures of the new theoretical field who emerged from Sociological Institutionalism and criticized Rational Choice Institutionalism, launched a manifesto that places institutions at the center of political analysis. In neo-institutionalist updates, the state is analyzed both as a structure (a set of organizations) and as an actor (actively involved in the formulation of social policies) (Skocpol, 1985)[74]. The significance of this manifesto lies in the fact that, of its three main points: i) the relative autonomy of political institutions; ii) the importance of symbolic action for understanding politics; and iii) the possibilities of inefficiency in history, only the latter is not consensual among the various authors of the three main approaches.

As previously mentioned, when analyzing the State both as a structure and an actor through a Neo-Institutionalist lens, we find no consensus on the definition of state capacities, as capacity—whether human or state—is not a fixed attribute. Historically, the concept has its roots in political sociology and political economy studies focused on the role of the state in

[73] Evans (2004) inaugurates neo-developmentalism, a neo-institutionalist view of the State, critical of neo-utilitarian and neoliberal views in which the State is a mere watchman of society. By exploring the bureaucratic capacity of the State, the author aims to understand the structures and role of the State, the relations between the State and society, and how States contribute to development. Evans (2004). *Embedded Autonomy: States and Industrial Transformation*. Princeton University Press.

[74] Several events influenced the shift in analytical perspective, including Keynesianism, the decline of empires—which led to the emergence of new types of states, particularly those that are not isolated from their societies at the domestic level and are active participants in transnational relations related to the international division of labor—and the rise of economic globalization from the 1970s onward. Weber (1982; 2014) serves as the foundation for neo-institutionalists who begin to examine the state through the lens of its weaknesses in decision-making, particularly regarding the macro and micro conditionalities imposed by institutions such as the World Bank, the International Monetary Fund, and other international entities. Additionally, the Weberian concept of the rule of law, which is not necessarily democratic and is far from being that of social welfare, is reevaluated in these analyses and studies.

promoting development. Two scholars are particularly noteworthy in this regard: i) Polanyi (2000), who highlighted the artificial creation of the factors of production (land, capital, labor) as a deliberate action by the capitalist state in the 19th century, and ii) Weber (1979), who identified the need for a state built on a specialized, functional body anchored in rational law as one of the requirements for capitalism (Gomide, 2016).

This theoretical Weberian or institutionalist lineage associates the concept of state capacities with the active role of the state in defining and implementing development strategies or transforming socioeconomic reality (Gomide, 2016; Goldstein, 2020: 201). In this sense, paramount parameters include those listed in Theoretical Framework 2: i) political dimension (decision and direction); ii) bureaucratic dimension (formulation and implementation); iii) relational dimension (articulation and consensus building); and iv) financial dimension (financing) (Castro, 2016). Under such parameters, the state is capable of identifying sectors to invest in, focusing on those institutions supposedly able to conduct prospective studies to be considered in the decision-making process. This process also allows for the identification and management of conflicts of interest.

We understand that presenting a collated view of the theoretical strands of New Institutionalism, with a special focus on Historical Institutionalism and Rational Choice Institutionalism, does not fully capture the conceptual richness of their internal differences or the distinctions between the perspectives. However, within the scope of this thesis, such an approach sheds light on important public policy management strategies related to federative coordination and decentralization. Our view is that, while inconclusive, the debate between the new institutionalisms has been valuable for understanding the limits and possibilities of individual or collective actors interacting according to rules that are part of macrostructures, whether in centralized federative structures or unitary states (Almeida, 2012)[75].

Furthermore, while we acknowledge the debate between theoretical perspectives and identify divergences, our focus is directed toward the convergences between Historical Institutionalism

[75] We acknowledge, however, that the same subject may lead to different interpretations. For instance, Elazar asserts that the nature of a federation, rooted in the Latin term *foedus* (pact), entails the existence of "more than one government acting legitimately in the definition and elaboration of public policies" (Elazar, 1987 apud Abrucio 2010; Elazar apud Abrucio, Franzese, & Sano, 2010: 178).

and Rational Choice[76], "since both share the theoretical assumption that there is a trade-off between redistribution—or reduction of territorial inequalities—and the centralization of political authority" (Arretche, 2012: 180)[77].

When considering the state in terms of its capacities, it is essential to recognize that these capacities, while not abstract and not predetermined, are inherent to the state according to different moments in its trajectory. Thus, to better delimit the analysis, it is necessary to ask: capacity for what? In a study on bureaucratic capacity for development, Evans (2004, p. 8) proposes that "the analysis of the various forms of state intervention should be structured based on the historical examination of particular cases [and that] the different forms of state involvement should also be situated in specific arenas."

In a broader sense, the disaggregated elements of state capacity highlighted in Theoretical Framework 2 help us understand some of the general concepts and parameters that should be considered when assessing state capacity under specific historical structures, from the perspective of particular cases as well as the specificities of different arenas (Evans, 1993; 2004).

Figure 42: Disaggregated components of the concept of State Capacity

STATE CAPACITY A set of instruments and institutions available to the State to establish objectives, transform them into policies, and implement them (Castro, 2016: 139).		
COMPONENT		
Political or driving	**Concept**	It refers to the power of agenda or the ability of elected governments to assert their priorities (Gomide, 2016: 23) in the interactions between the Executive and Legislative branches (Anastasia; Las Casas, 2016: 428 - 429).
	Function	To analyze the formal and informal institutions that condition the party system, the Executive-Legislative relations, as well as the channels of intermediation of interests and conflict resolution.
	Concept	It refers to the potential for implementing public policies (Gomide, 2016: 23).

[76] Przeworski and Limongi (1993) utilize the rationalism of game theory to analyze the impact of democratic regimes on development. Similarly, Stark and Bruszt (1998: 13-14) apply rational choice principles in their study of three Central European countries to challenge theories that do not acknowledge limits to executive power. Meanwhile, North (1990; 1993) employs game theory to explore the relationship between institutions and the enforcement of property rights, influenced by the theory of the minimal state. In this context, state capacity is understood as the legal capacity associated with minimal state intervention.

[77] For references from Chapter 5 of *Democracy, Federalism and Centralization in Brazil: Exploring the Problem of Decentralization and Autonomy* (Rio de Janeiro, FGV, 2012): Cite as: **Arretche (2012)**. For references from Chapter 4 of the same book, authored by Marta Arretche, Daniel Vasquez, and Sandra Gomes: Cite as: **(Arretche et al., 2012: 145 - 171)**.

Bureaucratic or administrative		A public policy component that concerns institutions and strategies that influence policy decisions, their formulation and execution (Castro, 2016: 139) in an intragovernmental coordination relationship (Anastasia; Las Casas, 2016: 429).
	Function	To build bureaucratic capacity and invest in the degree of professionalization of the bureaucracy to investigate the conditions under which policies are formulated and executed.
Relational	**Concept**	The State's ability to internalize, analyze, and express patterns of interactions between the public and private sectors (Anastasia; Las Casas: 428 - 429), according to the abilities of the state bureaucracy to connect with the different groups in society (Gomide, 2016: 23).
	Function	To prospect structures based on potential sectors to be encouraged and promoted by the State, dealing with the attempt to equalize conflicts of interest (Souza, 2015; Castro, 2016); To identify and to analyze the main characteristics and trajectories of the systems that govern specific policies, mapping the mechanisms of intragovernmental coordination or executive coordination; To mobilize political resources, rendering accounts and internalizing information necessary for the effectiveness of their actions (Gomide, 2016: 23).
Financial, tax or financing	**Concept**	The State's ability to extract resources from society through the collection of taxes in order to finance its programs and provide public goods and services (Gomide, 2016: 23).
	Function	To investigate the State's ability to collect taxes for the financing of policies, provision of public goods, and redistribution of income among different social groups.

Theoretical framework 2: Own elaboration, based on Evans (1993); Castro (2016: 139); Souza (2012 apud Castro, 2016: 139) (Souza, 2015: 8); and Gomide (2016: 23).

In the political arena related to climate issues, such as the energy transition, the most relevant theoretical concerns revolve around state capacity in the classic sense of the term (Evans; Rueschemeyer; Skocpol, 1985; Hochstetler, 2021: 12). This classic perspective emphasizes the autonomy of the state, focusing not on whether such autonomy exists, but rather on the variations of autonomy (Rueschemeyer; Evans, 1985: 68). As Evans states, “The expansion of the state's economic role will be considered primarily in terms of increasing capacity to exert control over local economic resources. This means that organizational capacity and the relative power of the state vis-à-vis private domestic elites is the focus rather than the state's overall ability to realize its economic goals” (Evans, 1985: 194).

What is at stake, then, is the state's capacity to formulate and implement policies that achieve broad public goods, even if such policies may adversely affect some powerful societal actors (Meckling; Nahm, 2017; Hochstetler, 2021: 31). In this context, the thesis by Arretche,

Vazquez, and Gomes (hereinafter, Arretche et al., 2012)[78] is particularly valuable. They present vertical relations in the federation and explore the problem of decentralization and autonomy "according to institutional mechanisms that allow central governments to obtain the cooperation of subnational governments to carry out policies of common interest" (Arretche et al., 2012: 145).

Arretche et al. thesis complements the analysis by Abrucio (1998; Almeida, 2012). Abrucio observes that national parties exhibit considerable veto power of local interests in federal decision-making arenas. Conversely, Arretche (2012; Almeida, 2012) posits that, based on the distinction between "those who deliberate" and "those who execute," and considering the trajectory of the state's developmentalism in Brazil, "the Brazilian federative state has endowed the Union with normative authority and spending capacity that allows it to decisively affect the agenda of subnational governments, despite the political, fiscal, and competency decentralization adopted from the 1988 Constitution" (Arretche, 2012: 146).

Gabaldón (2009) reinforces this perspective by analyzing environmental management issues. He argues that environmental management becomes more efficient and effective when decentralized, as it is closer to the scenarios where people suffer from ecological imbalances[79]. However, he cautions that "[...] such decentralization must be carried out without losing the national and global vision by instrumentalizing environmental management" (Gabaldón, 2009: 16)[80]. He contends that although global ecological imbalances stem from accumulations of local impacts, environmental management cannot be spatially sectorized because the planet operates as a unique ecosystem.

On this specific theme, Gabaldón converges with Arretche et al.'s analysis of health issues, while diverging from Abrucio's (2010) analysis of education issues and from Abrucio,

[78] References to Chapter 5 of the book *Democracy, Federalism, and Centralization in Brazil: Exploring the Problem of Decentralization and Autonomy* (Democracia, Federalismo e Centralização no Brasil, Rio de Janeiro, FGV, 2012) will be credited to Arretche (2012). For Chapter 4 of the same book, the citation will be (Arretche et al., 2012), referencing the collaboration between Marta Arretche, Daniel Vazquez, and Sandra Gomes (2012: 145-171).

[79] For a more detailed description of the various types of decentralization (administrative, redistributive, and decentralized), see Gabaldón (2009).

[80] "[...] dicha descentralización debe efectuarse sin perder la visión nacional y global al instrumentar la gestión ambiental" (Gabaldón, 2009: 16). "[...] Such decentralization must be carried out without losing sight of the national and global vision in implementing environmental management" (Gabaldón, 2009: 16).

Franzese, and Sano's (2010) exploration of national policy issues. Gabaldón concludes that the environmental sector is interconnected and that its sectorization serves administrative purposes but must also consider broader scopes than subnational levels. However, it should be noted that the actions of subnational actors with agenda power can allow local interests to prevail over national agendas. The trajectory of Brazil's energy sector illustrates this dynamic, as it remains heavily dependent on hydroelectric and oil sources, even in the face of more sustainable and cost-effective options such as solar and wind energy.

Thus, it is crucial to scrutinize the influences of institutions as rules of the game, along with the various state capacities as variables of the bureaucratic capacity of the state, whether in vertical relations or unitary states. This is exemplified by Arretche et al. (2012) when comparing two analytical assumptions: i) the veto power of constituent units in central decision-making arenas (shared rule); and ii) the autonomy of subnational governments to decide on their own policies (self-rule)[81]. The authors suggest that it matters less whether the state is authoritarian or federative than the institutional mechanisms capable of producing convergences between the interests of subnational units and national policies. China's institutional environment serves as a pertinent illustration of this point.

> In reality, the Chinese authoritarian system does have some liberal characteristics. It is a "regional fragmented authoritarian" regime, wherein authorities are distributed between the central and the local governments. As such, the Chinese energy sector is also quite fragmented. It is made up of all levels of governments, SOEs (including the largest SOEs controlled by the central government and numerous smaller SOEs controlled by local governments), and non-state actors; the latter category includes private companies, which play a critical role in China's renewable energy sector. Hence, rather than being dominated by the central government and its SOEs alone, the sector is far more diversified than many assume (Sheng, 2020: 4).

Although autocratic according to its constitution, China operates as a de facto federative arrangement during the thirty-year period from 1978 to 2008, which underpins its energy transition policies (Andrews-Speed, 2012). This institutional reality is best characterized by the term "fragmented authoritarianism," particularly in the realm of renewable energy (Sheng, 2020).

[81] In this sense, it is necessary to recognize that autonomy is not a fixed (innate) attribute. Autonomy can emerge or disappear, and only a historical study can reveal such potentials. Similarly, rationality and public interest should not be assumed but rather empirically verified.

In contrast, Brazil's development and state governance capacity can be analyzed through the lens of competing developmentalist conventions, as identified by Diniz (1996; 2011). These conventions have been present in Brazil since 1930: i) the neoliberal convention, which diverges from developmentalism beginning with the Collor de Mello administration and intensifies during the Fernando Henrique Cardoso (FHC) presidency (1 and 2); and ii) the restricted institutional and neo-developmentalist conventions that competed during Lula da Silva's two terms in office. Prior to Lula's rise, there was a contest between the neo-developmentalist and neoliberal conventions.

Additionally, Gerschenkron's (1964) insights can deepen the analysis under the general hypothesis that the performance of different developmental states in the neoliberal era relates to the nature of state-society relations, characterized by broad transversality among civil society groups and capital. Studies examining the capacity to govern—formulating and implementing policies—under various influences such as i) globalization; ii) pressure from the private sector; iii) politicization; iv) emphasis on goals rather than thorough analyses; and v) increased public participation with reduced room for autonomous decision-making—are further enriched by the contributions of Guy Peters (2003).

Regarding the metaphorical use of the term "State" and the methodological need to treat the State as a monolithic entity at the mercy of individual interests, it is important to highlight Evans' argument (2004, p. 12):

> In this chapter, expressions such as "the state can" or "the state wants" are used, and other chapters share the same language. Such formulations must be taken metaphorically. The purpose of the research is to find out what's behind it. In practice, "the state wants it" because some group of individuals within the state apparatus has a project. This does not mean that the project is merely a reflection of their personal biographies or individual maximization strategies. The project may be challenged by others in the state, so the definition of what "the state wants" is the result of the process of internal political conflict. An investigation of state norms requires investigation of specific sources and supports, to avoid attributing results to some kind of unitary will (Evans, 2004: 12).

This brief summary of the perspectives on state institutions and capacities can be encapsulated as follows: By moving away from the old function of being merely an arm of the State, institutions are now envisioned as autonomous entities that influence political behaviors to the extent of providing them with meaning. The new approaches emphasize politics as an activity

organized around interpretation (March & Olsen, 1984). This interpretive lens allows us to understand the relationships between the State and society as constrained by a variety of institutions, whose outcomes must be recognized in their interactive diversity, rather than being framed within generic and one-dimensional models (Evans, 2004).

Since this thesis is not only about the energy transition in China and Brazil, but also about these countries insert themselves into the neoliberal order, in addition to the Neo Institutionalist lenses, we use the International Political Economy theory to understand through the examination of the micro and macro conditionalities of Bretton Woods institutions what is so special about the strategic partnership between Brazil and China. In short, China imposes no conditionalities to her SOEs or private enterprises investments in Brazil. Under this logic, we should also think about the Belt and Road Initiative to understand Brazilian's decision in not being formally part of the initiative.

7. MICRO AND MACRO CONDITIONALITIES OF ANGLO-AMERICAN HYPERLIBERALISM

In this chapter, the aim is to analyze the conditionalities imposed by the International Monetary Fund (IMF), the World Bank (WB), and the World Trade Organization (WTO), which form the foundation of the Anglo-American hyper liberal model of international political economy (Pereira, 2009). The objective is to present the model of the global economic order in which Brazil and China are positioned. It is within this order that these strategic partners advocate for a multilateral order (Carmona, 2014). By understanding the micro and macro conditionalities of the neoliberal order, we can further comprehend how China and Brazil, two important regional leaders, strengthen their long-standing partnership while investing in the particular foundations of the fourth energy transition, tailored to their own circumstances (Carvalho; Veras; Steenhagen, 2023; Maia, 2023).

7.1 State and economy as moments of the same totality

This section aims to broadly illustrate Anglo-American hyperliberalism as the hegemonic model of international political economy that remains in effect within the system, although it is heavily contested by advocates of a truly multipolar order (Apeldoorn, 2001; Cox, 2002; Gilpin, 2002; Agnew, 2003; Bieler, 2006). This model will be explained as the synthesis of a specific

mode of production practiced after the material updates that have occurred in the international political economy since the 1970s.

Therefore, it begins with an understanding of the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO), moving through other neoliberal institutions, and concluding with an explanation of the conditionalities imposed by these organizations and regimes (Robinson, 2002). This model and the conditionalities imposed by Bretton Woods institutions will provide better insights into China's Market Socialism and the strategic partnership between China and Brazil when the time comes[82].

7.2 Neoliberal institutions and hegemonic stability

In general terms, what the General Agreement on Tariffs and Trade (GATT), the International Monetary Fund (IMF)[83], and the World Trade Organization (WTO) synthesize is Keohane's theory of hegemonic stability (1989), referencing the American functionalist logic of creating institutions to manage the market[84]. According to him, the liberal economic world requires the presence of a power to manage international regimes based on free market norms and rules. This power, in contemporary times, is the United States of America.

However, one limiting factor of this premise is that "the mere existence of a hegemonic power is not enough to ensure the development of a liberal international economy" (Gilpin, 2002, p. 93). There is a need for other powerful states to recognize in the hegemonic leader a commitment to the equitable distribution of social and economic benefits with its partners. Its internal economic structure must reflect traits of a commitment to the free market and not an empire that dominates everything in a centralized, autocratic manner.

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[82] We work with the hypothesis that there is no real dispute between economics and politics in the practical realm of international relations (Gilpin, 2002). However, in line with the ever-relevant and contemporary thinking of Strange (1970), there may be academic discrepancies, gaps, and differences in pace between the respective literatures. For a deeper understanding of Strange's thesis, it is recommended to read *International Economics and International Relations: A Case of Mutual Neglect*.

[83] Concerning the IMF and the financial market as disciplinarians of governments, Stephen Gill's (2001) analysis in *Constitutionalising Capital: EMU and Disciplinary Neo-Liberalism* is quite elusive. The Economic and Monetary Union (EMU) was established by the Maastricht Agreements. In the same work, the author also addresses the Marshall Plan, North Atlantic Treaty Organization NATO, and the establishment of favorable conditions for the advancement of American capital in Europe.

[84] Kindleberger (1973) concurs with the idea but emphasizes the concepts of leadership and responsibility instead.

Because the world economy is tied to the dollar and because the U.S., as a hegemonic power, has the capacity or at least the possibility to unilaterally interrupt technological, financial, and commercial relations, Hirschmann (1945, as cited in Gilpin, 2002, p. 97) identified the interaction between states as one of economic interdependence. In positive terms, such interaction allows the hegemon greater freedom in terms of regime governance and international economic management. The negative side is precisely the possible abuse of power in a unilateral manner. Hence the importance of Germany and Japan acting as checks on American autocratic exceptionalism in critical moments of its economy, especially in the 1980s and 1990s.

In material terms, the tying of the world economy to the currency of the hegemonic power allows it to financialize the entire market, as exemplified by the U.S. via stock exchanges on Wall Street. This material power, conferred by the seigniorage of the international currency, allows for both compensating partners and punishing adversaries or enemies (Gill, 2001). If the U.S. survived the crisis of the 1980s, it was thanks to its preponderant position, which gave it the ability to flex its economy with the obvious advantages of anti-liberal protectionism, while other economies suffered setbacks from the inexorability of the market.

It is also worth noting that the liberal market has, at least according to its proponents, positive points such as increased productive efficiency, economic growth, and market integration, all driven by competition. The negative point for the hegemon is that there is a migration of both activities and the distribution of economic power (Gilpin, 2002). Thus, under the liberal logic, non-developed countries and even emerging powers, finding themselves stagnating along with the leader of the regimes to which they are tied, become discontented. And discontent breeds contestation.

The basic contradiction of the liberal system is the fact that the hegemon supports peripheral economies for long periods. In a crisis scenario, partners may even outshine the hegemonic power, while the hegemon sees increased internal and external costs, such as public and private domestic consumption, in addition to the costs of maintaining military contingents (Gilpin,

2002). The liberal system thus calls for hegemonic rotation, as evidenced by the Venetian and British dominions in different eras, and contemporarily, the U.S.

However, the liberal system endures thanks to several factors: there is an inertial force that keeps the hegemon in place in the absence of another to take its place; powers that share the liberal ideology support each other, thus prolonging the lifespan of the leader of common regimes; there is ideological convergence in terms of maintaining welfare systems among members of the club. Moreover, creating new regimes is more expensive than maintaining the current ones (Keohane, 1989). Additionally, the costs of overthrowing them are high, which explains why the regimes created by Pax Britannica survived long after England lost its hegemonic power.

This is the logic behind regimes such as GATT, the IMF, and the WTO, even though the U.S. does not always show a serious commitment to managing the crises surrounding the international economic system. Moreover, as a stage for two-level games, the WTO reflects both the breakdown of trust and credibility suffered by the hegemon in an anarchic environment and variables like China, which adapts to the global market and trade regime according to its own model rather than following U.S. precepts. Therefore, if there is a limit to the rationalist paradigm (Gilpin, 2002), it is the debate on global governance, where the U.S.'s role is diminished by groups like the G77, the importance of partners like the powerful China, and the emergence of new actors that appear more independent from Western trade regimes: BRICS and ASEAN are good examples.

7.3 Conditionalities of World Bank

The most influential and representative financial institutions in the international system, the World Bank (and its various branches) and the International Monetary Fund, are at the core of the formation of the Bretton Woods System (BWS) itself. Initially, they played the role of disseminating the liberal ideology of the United States, which emerged as the dominant global hegemon in the aftermath of World War II. While there was a need at that time to rebuild the physical, economic, and social structures of the major countries and regions involved in the theaters of war, it also presented an opportunity for the United States to consolidate the markets

it had inherited from the previously powerful England. Pereira (2009) is emphatic regarding the World Bank:

> The attributes of power that gradually gave the World Bank a unique position among other international organizations arose from historical contingencies, institutional decisions, and, fundamentally, American supremacy. The Bank was, to a large extent, a creation of the United States, and its rise to the status of a relevant international organization was supported politically and financially by the U.S., which has always been the largest shareholder and the most influential member (Pereira, 2009, p. 1).

As the majority funder, founder of the institution, and the most interested party in making the world the vast consumer market for credit and products tied to the dollar, the U.S. imposes its conditions on borrowers through the World Bank (Augelli; Murphy, 1993; Gill, 1993; Holman, 1993). After all, what would be the point of emerging from two World Wars as the heir to the global market, economically consolidated, with the power to revive economies worldwide, if those economies did not become clients that would ensure American economic strength and political power in the system? It is worth noting that the technical staff, internal procedures, criteria for action, decision-making bodies, headquarters, and presidency of the most important branches of the World Bank replicate the structure of the Bank itself.

Also noteworthy is the fact that the International Bank for Reconstruction and Development (IBRD), the oldest and most important branch of the World Bank, a direct product of the Bretton Woods conferences, is the institution most closely linked to the IMF, another arm of U.S. economic and political power in the international system (Vreeland, 2005). “The link between the two organizations is that, from the beginning, the precondition for a country to become a member of the IBRD is to be tied to the IMF” (Pereira, 2009: 7). The World Bank, IBRD, and IMF are the primary mechanisms of international economic coercion serving the “freedom of the market” under American standards (emphasis added). These institutions impose the conditionalities necessary for obtaining financial support from their various branches.

The World Bank implicitly exercises its conditionalities through an eligibility mechanism, a criterion that varies over time depending on the international context and the government regime of the borrowing state. However, “formally, it is based on the size of the economy, per capita income, and solvency in relation to international creditors” (Pereira, 2009: 8). At the beginning of the World Bank, only European nations involved in World War II were eligible;

by the 1960s, there was a need to expand credit to poorer countries, extending grace periods, loan terms, and lowering interest rates. The International Development Association (IDA) was created, a branch of the World Bank theoretically intended to assist poor countries but which, in reality, served U.S. purposes to curb the growth and influence of Soviet communism during the Cold War.

The establishment of the IDA shifted the World Bank's focus from mere solvency criteria for borrowing countries and more blatantly aligned the institution with U.S. political interests. It is important to mention that the pressure from resentful Latin American countries, feeling overlooked by the World Bank while Europe received significant aid from the Marshall Plan, was a major factor in this shift. However, unlike its actions in Europe and with countries of higher per capita income and political power, the World Bank's interference in Latin America, Africa, and Asia became a true affront to the principle of state sovereignty (Augelli; Murphy, 1993: 133; Gill, 1993: 204; Holman, 1993: 224).

The following factors were taken into account: a) the payment history of poor countries; b) the incorporation of structural adjustments indicated by the Bank; c) the implementation of a strict government account correction program; and d) whether economic performance met creditor expectations. With this strong intervention, the World Bank made its funders co-participants in the economic policies of borrowing countries, as these creditors expected returns on their investments and wanted guarantees of payment compliance (Augelli; Murphy, 1993; Gill, 1993; Holman, 1993).

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Thus, loans from the World Bank were categorized as Triple A, meaning they were the most reliable in the financial market. The guarantee was the very assets pledged by the borrowing states. Furthermore, the unconditional opening of domestic markets to liberalism led corporations to dominate weakened economies worldwide, all through the International Finance Corporation (IFC), a complement to the IBRD established in 1956, whose main objective was to eliminate the need for government guarantees to obtain funding from the World Bank. In other words, it aimed to directly "favor the expansion of the private sector, both foreign and national, in poor and middle-income countries" (Pereira, 2009: 29).

7.4 Conditionalities of the International Monetary Fund

The conditionalities imposed implicitly by the World Bank are numerous; however, it is now essential to analyze the role of the IMF. This organization, closely linked to the International Bank for Reconstruction and Development (IBRD), conditions its loans on membership in the IMF and exercises its conditionalities explicitly, stating them in the agreements it establishes with various countries. Throughout its history, the IMF has implemented three main types of conditionalities: macro conditionalities, micro conditionalities, and property rights (Vreeland, 2005).

Macro conditionalities were practiced in the early years of the IMF's operation when the imposition of conditions for loans was less stringent, as was the level of detail provided. These conditionalities aimed to correct the trade balance, which suffered from excessive demand for imported products, as well as to address public sector spending. Broadly speaking, they prescribed fiscal adjustments, reductions in public spending, and increased taxes to decrease the public deficit. Because they were quite broad, "macro conditionalities allowed considerable scope for domestic policies to play a role in how governments would achieve the macroeconomic targets of IMF arrangements" (Vreeland, 2005)[85].

Applied during the 1970s, macro conditionalities constituted the first interference by the IMF in the sovereignty of borrower nations. However, this did not prevent the dreadful effects of the insolvency crisis faced by Latin American countries in the following decade. Consequently, what came to be known as micro conditionalities was adopted. This term began to be used in the 1990s and described the level of detail in the IMF's programs (Batista, 1994). It was during this period that the number of imposed conditions multiplied rapidly, and, according to Vreeland (2005), almost literally exploded.

The number of conditionalities increased from six in the 1960s to sixteen by the end of 1997. However, this excessive level of intrusion into the economic policies of borrowing countries did not yield the expected results. A new crisis erupted, this time in Asia, affecting Russia along

[85] Macro-conditionality allowed significant leeway for domestic politics to influence how governments met the macroeconomic targets set by IMF arrangements (Vreeland, 2005: 23).

the way and later reaching Brazil and Argentina in Latin America (Batista, 1994; Boschi, 2010). It became evident that while macro conditionalities were too lenient, micro conditionalities were overly detailed.

In response to criticisms and failures, the IMF adopted a third approach, referred to as ownership. The Fund continued to argue that the error did not lie with them in either of the previous attempts but rather with the borrowers, who failed to implement the terms of the agreements. The new conditionality would be a hybrid of previous experiences, aiming to address the lack of commitment from indebted countries: there would be a sharper focus on macroeconomics and financial sector policies (Vreeland, 2005).

In exchange, in pursuit of greater effectiveness, the Fund would make an effort to be less intrusive in the political choices of the country, paying more attention to the adequacy of the program (Vreeland, 2005). Nevertheless, regardless of the method, the conditionalities threatened state sovereignty. Furthermore, the Fund's interference consistently targeted the trade balance, focusing on reducing demand for imports and controlling public spending through taxation, increased taxes, and other policies that were not always popular at the domestic level[86].

Within the Bretton Woods System, the institutions established by the United States in 1941, even before the end of World War II, served the American project to expand its economic and political influence through the weakening of European powers (Pereira, 2009). Through organizations like the International Bank for Reconstruction and Development and the International Monetary Fund, the U.S. reshaped the global economic landscape, now defined by its market objectives.

By leveraging the financialization of indebted nations, the hegemon was able, through the conditionalities of its economic institutions, to gain access to strategic raw materials and open markets for the manufactured goods and value-added products it produced in abundance. The

[86] The detailed examination of loans through facilities that remain below the ceiling of 25% of the borrower's quota will be reserved for a future study.

combined might of American military, economic, and political power operated by exploiting the economic fragility imposed by war and/or poverty in other nations (Pereira, 2009).

What was advocated to the states that came to orbit within the U.S. sphere of influence was that, through the credit provided by the World Bank and the IMF, full employment—a necessity for development—could be achieved. The new economic policy for state development introduced a concept of controlled freedom, where the market ceased to be operated by the invisible hand of classical economic theory and was instead managed by a mix of autonomy and market freedom. All this took place under the auspices of the institutions created at Bretton Woods, which acted as agents for liquidity and confidence in the market (Carmona, 2014).

Thus, the American establishment identified with the Keynesian proposal to project domestic regulatory power into other regions. It was also this same establishment that, through pressures and negotiations, led to the creation of the World Trade Organization, which, according to Pereira (2009), would complete the Bretton Woods triad alongside the IBRD and the IMF.

> After the second oil price shock in 1979, the World Bank began to further concentrate its loan portfolio on modalities that allowed for high disbursements, directly supported the balance of payments, and facilitated the acquisition of foreign currency needed to roll over debts and maintain the cycle of indebtedness. Consequently, the focus narrowed to loans for "programs", traditional infrastructure projects, and projects deemed strictly productive, particularly agroexport initiatives (Kapur et al., 1997, p. 324 apud Pereira, 2009: 151, author's emphasis).

In summary, within the Bretton Woods system, the IMF and the World Bank operated independently of what one would expect from organizations linked to the United Nations family, adhering instead to American political agendas and economic needs. Thus, it can be concluded that underlying this neoliberal institutional arrangement is the old logic of domination that began with the Great Discoveries and evolved particularly with the Industrial Revolution (Robinson, 2002).

Therefore, based on the empirical examples gathered, it is concluded that the dichotomy of State/Economy serves the interests of central economies; it may apply to academic studies of specific microcosms but does not hold true in practical life within the real world of the international system. In short, it represents a more subtle and sophisticated way of exercising Western imperialism—a perfect marriage of economy and politics (Gilpin, 2002).

It is within this amalgam that China's market socialism navigates and inserts itself in a peculiar way. It is from within the system that Brazil and China advocate for multilateralism (Carmona, 2014). And it is within the neoliberal system that the strategic partnership of these two important regional leaders is built and reinvigorated (Maia, 2023). In the next section we go back to an analysis applying precepts of state capacity to the reform period of China since 1978 to the emergence of a new paradigm of industrial policy.

8. STATE AND ENERGY SECURITY IN CHINA: Historical Perspectives

The general objective of this chapter is to trace the recent history of technological development in the People's Republic of China, emphasizing the construction of state capabilities aimed at reaching and surpassing the technological frontier that has kept the country in a state of energy insecurity within its geographical surroundings. In this context, priority is given to analyzing government plans since 1978 and the reform of the National Innovation System, initiated in 1985. The pursuit of scientific and technological advancement during these two periods forms the basis for the restructuring of academies and research institutes, which was carried out in greater detail and linked to strategic industrial sectors during the Hu Jintao/Wen Jiabao decade (2003–2013).

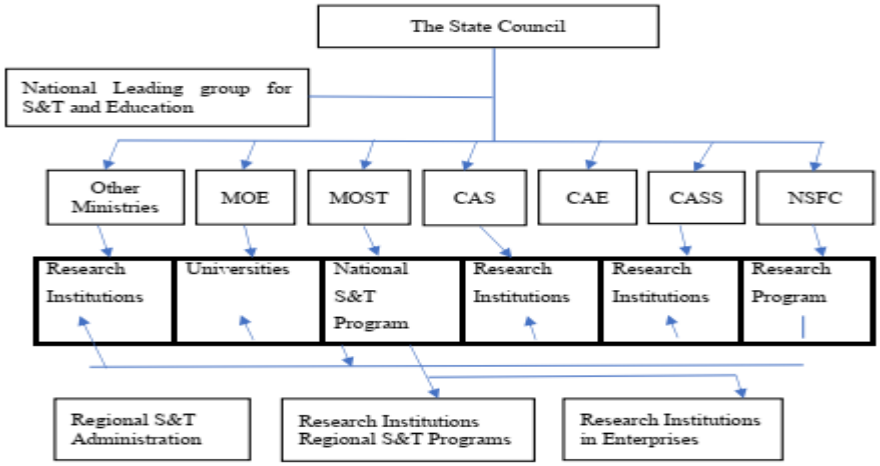
To emphasize these peculiarities, the focus also extends to the second period of reforms in the 1990s (attraction of multinationals, formation of joint ventures, and technological exchanges), and the third round of reforms during the transition to the 2000s, which involved a reduction in the state production sector, preservation of strategic sectors such as energy, the redesign of public administration, and strong regulation of public banks. The same applies to the legalization of private economic activities and China's entry into the World Trade Organization in 2002. In this context, the concept of state capacity is of fundamental importance, as it refers to the public policies that enabled the PRC to overcome its external dependence on coal and oil (Zheng & Lye, 2015; Santana, 2016: 228; Strüver, 2017) in just thirty years. This achievement is linked to the ongoing restructuring of a form of mercantilism that predates and differs spatially from the broader concept of capitalism (Jaguaribe, 2016).

Such assertions are based on the diachronic reconstruction of the history and endogenous dynamics exclusive to the institutional reforms implemented by the PRC (Cox, 2002; George & Bennett, 2005), both in terms of the de-verticalization of its bureaucracy and the necessary distinctions between the roles of government, state, companies, market, think tanks, and scientific academies within an epistemic community of strategic thought, structured around political and market objectives (Castro, 2016; Santana, 2016). Thus, we list and analyze parameters related to state capacity and energy governance[87], taking China's history of technological innovation[88] as the foundation of its energy security[89], which is indispensable to the energy transition in the country (Zheng & Bleach, 2015; Xinbo, 2016).

In this vein, in a systemic comparison, China's National Innovation System (Diagram 2)[90] is distinguished by a character of endogenous innovation (Rongpin, 2004; Castro, 2016: 137–170; Delgado 2016: 171–218; Santana, 2016: 219–258; Jaguaribe, 2016: 361–386), originating at the top of the system: a) toward the bottom, as an instrument of public policy; and b) for Eurasia and beyond, as an instrument of foreign policy (Le Billon, 2004; Hadfield, 2008; Strüver, 2017)[91].

[87] For dilemmas related to coordination and state capabilities in industrial policy within China, India, and Brazil, refer to Delgado (2016: 171–218).
[88] For dilemmas regarding coordination and state capabilities in industrial policy in China, India, and Brazil, see Delgado (2016: 171–218).
[89] For energy infrastructure policies and state capabilities in the BRICS nations, see Santana (2016: 219–258).
[90] In a diachronic analysis (Cox, 2002), China's National Innovation System (NIS) may differ today. However, for the historical construction of this chapter, we adopt Rongpin (2004)'s Governance structure of the Chinese science and technology system as a model for the thesis analysis: Ministry of Education (MOE); Ministry of Science and Technology (MOST); Chinese Academy of Sciences (CAS); Chinese Academy of Engineering (CAE); Chinese Academy of Social Sciences (CASS); and National Natural Science Foundation of China (NSFC) (Castro, 2016: 165).
[91] For a systemic and also a more specific comparison between China's and Brazil's National Innovation Systems (NIS), see Jaguaribe, *Comparative State Capabilities: China and the Reform of the National Innovation System*, in Alexandre de Ávila Gomide & Renato Raul (Eds.), *State Capabilities in Emerging Countries: Brazil in Comparative Perspective*. Rio de Janeiro: IPEA, 2016: 361 – 386.

Figure 43: Diagram 2: China's National Innovation System (NIS)



Source: Rongpin (2004) Development of Science and Technology Policy in China

Anchored in historical features, special skills, and unique choices, Chinese endogenous innovation operates at the top of the current economic system rather than at its base. A key highlight is that, under the coordination of the National Natural Science Foundation of China, there is a complex network of ministries, scientific academies, and think tanks that integrate knowledge governance and strategic coordination as two sides of the same coin, aimed at long-term prospective technological strategies (Castro, 2016).

Complementing the evolutionary path of its innovation system, the centralized institutional arrangement for energy policy formulation in China demonstrates the unbundling of the state's energy industry. These actions create synergy among various ministries and agencies, positioning energy security as a central public policy issue for the PRC and stabilizing its political system. Based on an endogenous innovation policy, the central government controls the institutional arrangements of strategic sectors, managing a multitude of actors and institutions linked to the formulation and implementation of energy policies (Castro, 2016), despite the historical strength of subnational actors in China (Sheng, 2020).

To understand the significance of the aforementioned reformulation, it is important to recognize that the 1980s marked a period of exhaustion for Chinese energy resources, with national demand surpassing production. Later, during the energy scarcity crisis of 2003, China faced a new bottleneck that led to rationing and blackouts in 18 of its 31 provinces. Energy risk was then perceived as the major threat to the political system and the development model of the

time. In pursuit of stability, the energy sectors (coal, electricity, and oil), which had been housed in separate ministries, needed to be integrated into a unified infrastructure perspective—a consensus that China has achieved today, unlike some of its peers (Santana, 2016).

As an initial time frame, it is important to emphasize the role of building state capacities aimed at overcoming energy insecurity, beginning with the government plans of 1978 and continuing with the reform of the National Innovation System initiated in 1985 (Lee, 2019). The pursuit of scientific and technological progress during these two periods formed the foundation for the reorganization of academies, research institutes, and strategic industrial sectors during the Hu Jintao/Wen Jiabao decade (2003–2013).

This set of reforms is the basis for the more recent Medium and Long-Term Plans for Technological Development (2006–2016), the XII Five-Year Plan (2011–2015) for the development of endogenous technologies (Jaguaribe, 2016), and the global nuclear energy market control plan for peaceful use, exemplified by Hualong One, a 1,100 MW pressurized water reactor with a 60-year lifespan (Deng, 2015; World Nuclear Association, 2016; Banks, 2017).

The public policies developed and/or revised by the People's Republic of China during the Wen Jiabao/Hu Jintao decade (2003–2013) (Delgado, 2016), which were implemented with the strategic aim of catching up to and surpassing technological frontiers, leapfrogging prosperous neighbors such as Japan, Taiwan, and South Korea in certain areas of knowledge (Castro, 2016), while also addressing energy crises, can be highlighted as distinctive features of Chinese-style state capitalism compared to that practiced in the international system.

> [t]he literature on the reform process points to some unique features that distinguish China from both the European transitions from socialism to the market and the catching up process of the Asian Tigers (Anderson, 2011; Heilmann and Shi, 2013). The historical singularities of market development in China, as well as the legacy of the command economy and the lack of an appropriate financial system, made it difficult for China to replicate the modernization strategy of Japan, South Korea and other Asian Tigers. The exhaustive work on innovation in China carried out by the OECD in collaboration with the Ministry of Science and Technology of China (MOST) in 2007 highlights a series of factors that distinguish the Chinese model from the rest of Asia: the form in which international opening took place; the modalities of use of FDI; and the negotiation that contrasts technology transfer with market access (OECD, 2007) (Jaguaribe, 2016: 367).

Another important distinguishing factor is that China's decision to pursue Foreign Direct Investment was not driven by a lack of domestic savings, but rather by a strategic focus on technological modernization (Jaguaribe, 2016: 367). During its transition to a market economy, China maintained high savings and investment rates, well above the average of its more prosperous neighbors[92]. The decision to attract FDI, combined with domestic capital and investments, provided the necessary security for the simultaneous advancement of science and technology (S&T) alongside the expansion of the market economy.

As a result, new firms were created in the private sector while the public sector underwent restructuring, fostering a healthy environment of internal competition (Jaguaribe, 2016). The coordinated structure of this complex arrangement allowed the PRC to support diverse ownership regimes, including large state-owned enterprises, cooperatives, private companies, joint ventures, and foreign firms, all organized horizontally. Summarizing the significance of the reforms initiated in 1978, starting from that year...

> The dismantling of the planned economy and the expansion of the market economy led to significant changes in the organization of the state and governance of the relationship between the state and the market. New administrative and financial bodies are created with their own autonomy and jurisdiction. There is a progressive separation between the state and the government, sectoral ministries, and state industries. Sectoral and functional bureaucracies are gradually replaced by ministries and horizontal coordination bodies, allowing for greater inter-ministerial coordination (Jaguaribe, 2016: 365).

This dynamic is illustrated in the table below (Figure 44) (Jaguaribe, 2016: 366)[93], which shows the gradual reformulation of the political system in China from 1978 to 2012.

Figure 44: Institutional Changes (1978 – 2012)

	1978- 1992	1992 – 2000	2000 - 2012
State	Abolition of centrally planned structures. Transformation of village and municipal enterprises.	Reform of the financial system and tax reform. Reform of state-owned enterprises.	Reorganization of the ministries. Creation of the National Development and Reform

[92] Direct investment encompasses both fixed capital investments and those that may lead to the control of firms and enterprises. While the specific percentage may vary based on statistics and institutional arrangements, an investment is generally classified as direct if it exceeds 25 percent of a company's share capital (Poulantzas, 1975: 51).

[93] For further insights into China's political reforms during this period, you might explore scholarly works by authors like Xu (2011) and Wedeen (1999), which provide detailed analyses of the shifts in governance and policy-making in China.

	Creation of export processing zones.	Opening to foreign direct investment (FDI).	Commission (NDRC), responsible for the horizontal coordination of reforms. Establishment of the State-owned Assets Supervision and Administration Commission (SASAC), responsible for state-owned enterprises.
Chinese Communist Party (CCP)	Evolution of the party landscape. Separation between political and military leadership.	Increase in technical personnel – party technocracy. Consolidation of collective leadership.	Opening of the CCP to various political representations. Flexibility in political nomenclature appointments.
Government	Strategic planning with broad consultations.	Company Law. Reform of the financial and tax systems. Opening to foreign direct investment (FDI) and establishment of a regulatory framework for investments. Law and regulation for the capital market, aiming for entry into the World Trade Organization (WTO).	Regulation of the renminbi and gradual regionalization. Increase in regional and inter-regional agreements. Expansion of global investments. Creation of the Shanghai Free Trade Zone.

Source: Jaguaribe (2016: 366)

The decade from 1993 to 2003 marks a turning point that distinguishes Chinese developmental policy from overcoming a long-standing path of dependence. This period incorporates elements of neoliberal restructuring that can be interpreted through the Gramscian lens of positional warfare and passive revolution. In this context, the aforementioned Chinese epistemic community functions organically, as internal restructuring aimed at international integration harmoniously incorporates external elements, such as FDI, alongside domestic policies that interact with local political and cultural values and institutional arrangements, as advocated by Gramsci's (1999) concept of passive revolution.

The PRC benefits from the prolonged hegemonic crisis of the United States of America (Gilpin, 2002), recognizing that this is not merely the death of the old and the birth of the new, but rather another phase in which neoliberalism, beyond mere economic fatalism, demonstrates its capacity to "build new social relations and new state institutions based on a mercantile order of

capitalism and a conservative morality" (Cruz & Guimarães, 2021: 2). In this sense, the CCP conducts the passive revolution from the top, mobilizing a newly formed epistemic community to foster an organic interaction within society, as advocated by the concept of positional warfare: a strategy for the long-term construction of self-conscious social groups into a concerted emancipatory bloc within society (Cox, 2002: 105–106).

This understanding informs our perspective on how the leadership of the Chinese Communist Party operates as a historical bloc, managing the revolution-restoration dialectic. When analyzing China through the lens of neoliberalism or from the perspective of Chinese market socialism, it is understood that...

> The concept of neoliberalism needs to find a political foundation capable of bringing together its various intertwined dimensions. It will be necessary to understand its organic roots, with the process of financialization and globalization, the proto-formation of global corporate business powers and their networks of institutions. Above all, it is necessary to historicize it, to understand its rise from its origins to its power to saturate contemporary times [...] to better understand its differences in ideas and what they have in common and what they differ from classical liberalism. To explain its new neocolonial dynamics in the context of the great systemic crisis of North American hegemony in the face of the rise of China (Cruz; Juarez, 2021: 2 – 3).

Assuming that various forms of the market existed before capitalism, the trajectory of the People's Republic of China illustrates not only the intricacies of liberal and neoliberal capitalism but also the historical roots of socialist market trajectories that predate capitalism itself (Thomas, 2006; Boatcă, 2017; Cruz & Guimarães, 2020). By historicizing the Chinese trajectory, we can understand how contemporary China successfully integrates into a world where the pattern of capitalism is dictated by neoliberal institutions and organizations. It is evident that since the 1970s, the PRC has been reworking forms of market socialism present in its type of mercantilism, which existed before the consolidation of capitalism. Hence, its integration into the neoliberal capitalist world as a form of market socialism or state capitalism (Zheng & Lye, 2015; Xinbo, 2016; Castro, 2016; Delgado, 2016; Gomide, 2016; Jaguaribe, 2016; Santana, 2016).

When discussing innovation and energy governance in China, we start from the premise that Chinese technological innovation, beyond mere pairing with the United States of America (USA) and its Asian allies (Zheng & Lye, 2015; Xinbo, 2016), is characterized by endogenous

innovation that originates at the top of the system: a) directed towards the base as an instrument of public policy; and b) aimed at the Eurasian space and beyond as a tool of foreign energy policy (Le Billon, 2004; Hadfield, 2008; Strüver, 2017). This distinction sets the state capitalism or market socialism of the People's Republic of China apart from both other modern and contemporary socialist models and from contemporary capitalism in the Western mode (Castro, 2016; Delgado, 2016; Jaguaribe, 2016).

Working with the notion that China is an authoritarian state, one might assume that the central government can easily create and implement public policies. Indeed, China is governed by a central authority; however, its political regime exhibits many similarities to a de facto federalism, making negotiations with local actors (both public and private) a daily reality for cities, regions, provinces, and the central government. This holds true for public policies in general as well as for specific energy policies in China, as illustrated in the images below.

While it is clear that China operates as a unitary political system, its political authority is fragmented in two distinct ways. As shown in Diagram 1, horizontal fragmentation refers to different administrative departments organized by function. For instance, China's National Natural Science Foundation is a complex network of ministries, scientific academies, and think tanks, integrating knowledge governance and strategic coordination as two sides of the same coin, aimed at long-term prospective technological strategies (Castro, 2016).

Conversely, vertical fragmentation occurs across five levels of government: i) central; ii) provincial; iii) municipal; iv) county; and v) township (C. Sheng, Liu Y., and Liu J., 2023: 2). As demonstrated in Theoretical Framework 3, "Chinese non-governmental actors, including businesspeople and their companies, and social organizations such as industrial associations and non-governmental organizations are also gaining influence over public affairs in China" (Kennedy, 2005; Hensengerth, 2019: 121–143).

Figure 45: Regional Fragmented Authoritarianism Model and Private Entrepreneurship Theory: The Chinese model of addressing climate change

China's Regional Fragmented Authoritarianism	
Components	**Characteristics**
Authorities	Distributed between central and local governments

Levels of Government	The largest State-Owned Enterprises (SOEs) are controlled by the central government, while numerous smaller SOEs are managed controlled by local governments and non-state actors (private companies).
Private Entrepreneurs	Exhibit competitiveness, alertness to business opportunities, learning capability, a lack of risk aversion and the ability to utilize resources to pursue innovative strategies.
Fragmented energy sector	Private entrepreneurs first emerged in the solar thermal industry in the 1980s, followed by the solar Photovoltaic (PV) industry in the 1990s, and the wind and electric vehicle industries in the 2000s.
Solar thermal industry	Characterized by low entry barriers due to relatively low technology content and fewer government regulations, primarily involving local activities.
Solar Photovoltaic (PV) industry	Solar companies initially focused on overseas demand, with support from local governments within the context of China's export-oriented strategy. The central government did not recognize the solar industry as key or strategic until after 2010; it was initially categorized as part of the broader energy-saving and environmentally friendly industries, which local governments welcomed.
Wind and Electric Vehicles industries	The central government identified the wind and electric vehicle industries as high-tech and strategic sectors as early as the 1980s, imposing significant entry barriers for private entrepreneurs in these areas. Before 2000, many private entrepreneurs in the electric vehicle sector faced challenges in obtaining operating permits from the central government. The situation changed after China joined the World Trade Organization (WTO) in 2001. From then on, more private entrepreneurs entered these industries and quickly became leaders in their respective fields.

Source: Own elaboration based on Sheng (2020: 1 - 13)

Although the central government continues to favor SOEs, the main barriers to private entrepreneurship in renewable energy in China are now regulatory in nature. Nevertheless, the fragmented authoritarian system in China has created more opportunities for non-state actors to develop and grow. Besides, there are several fundamental differences between state-owned enterprises and private companies:

i) SOEs are generally risk-averse and prefer to invest in fossil fuels; they are compelled by the central government to invest in renewables; ii) In contrast, private companies have strong incentives from local governments and market motivations to invest in low-carbon industries. They choose to do so because the return on research and development (R&D) investment is higher for private companies than for SOEs; iii) Private companies offer better incentives than SOEs; for example, managers in SOEs earn significantly less than those in private companies within the automobile industry (Sheng, 2020: 13, highlights added).

In summary, China represents much more than its endogenous approaches to public policy and its unique governing system. Furthermore, it serves as an ideal case study for the participant observation methodology section of this thesis for the following reasons:

i) China has already reached the stage that Brazil is currently at in its energy policy path (Wei; Beurden, 2020); ii) China is Brazil's main trading partner; iii) It is recognized in reports by specialized organizations and by energy experts as a model to follow in the transition to renewable energy (Andrews-Speed; Zhang, 2019)[94].

> The country has been variously described as a 'renewable energy champion' (Lin, 2018), as 'the next champion on climate change' (Wu 2017), as replacing 'the US as a champion of clean energy' (El Chaar, 2017), as a 'global climate change mitigation champion' (Engels, 2018) and as 'the largest force in global clean energy development' (Timperley, 2018) (Andrews-Speed; Zhang, 2019: 2, author's emphasis).

Contemporaneously, China's developmental trajectory is reinforced by the features of the even more assertive Xi Jinping era (especially when compared with predecessors like Hu Jintao and Wen Jiabao). When it comes to describe the built spaces and the specific logistics for the renewable energy-related social products and services, we can see that the adoption of endogenous solutions for the reform of China's NIS through the specificities of her fragmented authoritarianism political system have created a new path dependency trajectory on energy policies, this time anchored in the requirements of the fourth energy transition.

On a longer and necessary historical arc, the country's oldest embedded institutions—such as the centralization of power, the role of ideas and slogans, and the preference for conformity and consensus—serve as sources of resilience, tracing the trajectory of dependence on modern and contemporary energy governance institutions in China (Andrews-Speed, 2012: 134). Embedded for hundreds of years in the Chinese institutional environment, these institutions link the apparently fragmented political arrangement at the subnational levels, preventing this alleged fragmentation from compromising the unity of state policies especially when it comes to

[94] If we were to further justify China's presence in a study of Brazilian energy policy, we should explore concepts like "expanded Weberianism" to better understand the bureaucracies of both Brazil and China. For more on this, see Gomide, A. A. et al. in *Public State Capabilities in Emerging Countries: Brazil's Comparative (Dis)Advantages*, in Alexandre de Ávila Gomide and Renato Raul (Eds.), *State Capabilities in Emerging Countries: Brazil in Comparative Perspective*. Rio de Janeiro: IPEA, 2016: 536. This approach also applies to the reasons China and Brazil are classified as whale states (or monster states), which reflects their similarities within the expanded BRICS. Additionally, refer to Spínola, V. in *Let's Trade in English*. São Paulo: Lex Editora, 2012, 3rd edition.

strenghten China’s commitment with the fourth energy transition, as we can see in the next section.

8.1 The Xi Jinping Era: Continuity in Innovation with a Strengthened Assertiveness

By resorting to the political strategies of imperial China, assimilated, adapted, and renewed through the Leninist revolution since 1949, the Communist Party of China maintains its power over the former State Planning Commission. This influence is sustained and reinforced by a society characterized by a culture of respect for hierarchy, family, and social capital. In political terms, the CCP absorbs, manages, and reinforces these characteristics through continued authority over the significant National Reform and Development Commission, projecting its power empirically onto a large number of state-owned enterprises. Andrews-Speed (2012: 134–135) helps us visualize how the CCP is able to bring cohesion to both old and new formal and informal Chinese institutions, illustrating the Party's strategy for maintaining control and stability within the evolving political landscape:

> Some features of the current institutional environment have their roots in these long-standing embedded institutions, whilst others have arisen from innovations or adaptations introduced by the Party since 1949. The highly centralized Leninist state structures built around the old State Planning Commission persist to the present day, albeit in modified forms. The continuing authority of the National Development and Reform Commission and of the large state-owned enterprises exemplifies this. The fragmentation that we see in modern China has been exacerbated by economic and political reforms over the last 35 years, but can be traced back to Imperial times when the emperor needed networks of spies to monitor his local officials. Today, the Party fulfils this role. It is the Party which remains the key formal institutional source of resilience, with its control over key appointments in government and in state-owned enterprises and over the careers of these officials. The Party retains effective monopoly over key policy decision-making and control of the legal system. Its success in co-opting different segments of society has helped maintain its authority (Andrews-Speed, 2012: 135).

In terms of Xi Jinping's inaugural speech in the final days of 2012, this institutional update embraces what he calls the "Chinese dream," initiated by the May Fourth Movement of 1919, against the discriminatory Western influence and treatment imposed on China. In 2019, on the centenary of that founding movement of the People's Republic of China, President Xi urged young people to carry forward the dream of rejuvenating the nation. It is no coincidence that the terms "rejuvenation" and "revitalization" used in Xi's speeches in the twenty-first century refer, in Chinese characters, to the term "Renaissance", of European origin and characteristics

(Carvalho, 2023: 17 – 19, authors emphasis)[95]. It is now not only a question of resistance, but also of assimilation of what is foreign through the CCP's encouragement of the strengthening of traditional Chinese culture by young people and society at large (Jabbour; Rodrigues, 2023: 280). Hence the strong focus on youth vocational training and the digital technology sectors (Jaffe, 2021, author's emphasis).

While reinforcing its authority, China's central government has been applying this management and updating of its historical institutions in the regulatory frameworks of its energy transition with a view to increasing integration between renewable energy and digital technologies (Carvalho, 2023). It is a historical learning in the sense that "[...] national institutions and regulatory frameworks play a critical role in fostering the kinds of innovation that propel the nation to prominence" (Jaffe, 2021: 15).

At least domestically, the country is creating a new trajectory based on digital technology, renewable energy for electric vehicles, as well as the integration of these vehicles into the extensive range of digital applications and platforms, such as Alibaba, Tencent, iFLytek, SenseTime, ZTE Corporation (ZTE), Huawei, Baidu, and WeRide (Jaffe, 2021: 88-90). But what does digital integration have to do with embedded institutions and the CCP's ability to hold together its power even in a seemingly fragmented institutional environment? Everything!

Article 7 of China's National Intelligence Law equated the status of private companies, such as Alibaba, Tencent, iFLytek, SenseTime and Baidu, with that of state-owned companies. Now, as "national champions," they are obliged to cooperate with state objectives beyond their market interest. Such cooperation becomes even more strongly institutionalized under the terms of China's XIII Five-Year Plan (Jaffe, 2021: 90). Taken together, the new industry regulations not only increase the flow of cutting-edge digital technology between private companies and the central government, but also reinforce the penetration of Communist Party elements into the highest decision-making layers of such companies. A historical infiltration tactic adapted from the times of imperial espionage in China.

[95] The Chinese characters referring to the revitalization movement (fùxing, 复兴) also appear in the term for the European Renaissance (wényì fùxing, 文艺复兴), which was an ideological and cultural movement originating in Italy in the late fourteenth century and lasting until the sixteenth century. This period reflected the ambitions and demands of the emerging bourgeoisie (Carvalho, 2023: 19).

And here is an addendum. It is not the intention of this thesis to discuss ideologies or regimes of government, whether authoritarian or democratic. Our intention is only to apply a combination of neo institutionalist and IPE analysis focused on the capacities of the State to manage social, political and economic institutions necessary for the energy transition. However, for the scope of the thesis, it is necessary to note that since the coming to power of the current president, Xi Jinping, in 2013, private companies have been undermined in their ability to invest in economic activities. If until 2013 they were responsible for 50% of all investment in about 75% of economic activities, such numbers no longer reflect the current reality (Jaffe, 2021).

With new laws, especially since 2017, obliging companies and individuals to collaborate with the national intelligence service, those who resist have been replaced in private firms or on their boards by members loyal to the CCP (Jaffe, 2021: 95). This trend reflects the Chinese government's approach to maintaining final decision-making authority over energy transition and technological innovation, demonstrating the CCP's resilience in power. The cases of compulsory retirement of high-profile Chinese executives serve as exemplary illustrations, as we can see from some notable examples below:

> The conflict between freedom and innovation and China's repressive government system started to come to a head in 2019, when a highly visible number of famous Chinese entrepreneurs began to be forced into retirement by Chinese authorities, amid an economic downturn propelled by the U.S.-China trade war and later reinforced by the outbreak of the new coronavirus. Among the high-profile executives to step down in 2019 were Jack Ma, founder of Alibaba, and Pony Ma, founder of internet giant Tencent, as well as Liu Chuanzhi, founder of computer manufacturer Lenovo, and Robin Li Yanhong, cofounder of Baidu. Tencent's performance took a beating in 2018 after regulators stopped approvals for new online games. The retirements are further evidence that the Chinese Communist Party wants to ensure that the private sector and individual entrepreneurs do not become an alternative center of power to its authoritarian structure (Jaffe, 2021: 95).

Since coming to power in 2013, President Xi Jinping has also led a campaign to purge corrupt elements from the oil industry while developing a new strategy for energy capture, transformation, and distribution, focusing on sustainable matrices such as hydropower, solar, and wind farms. This shift does not represent a break from previous strategies, which had already invested significantly in solar energy; rather, it signifies greater assertiveness in

directing public policies that align with scientific and technological advancements in favor of sustainable matrices (Jaffe, 2021: 61).

In terms of foreign policy, China has tightened the requirements for foreign companies entering its market, reinforcing a nationalist tone that demands technology transfer, equity stakes in companies, and even censorship power (Jaffe, 2021: 76). In the solar energy sector, such measures mean that among the five largest global manufacturers, four are Chinese, sidelining prestigious American firms like First Solar and SunPower[96].

> As the Internet + smart energy sector develops, its most striking feature is the rapid growth of electric vehicles (EVs). On the one hand, EVs are electrifying the transport system, which reduces oil dependency in socioeconomic development. On the other hand, EVs are the only way to fully connect the transport sector with Internet + and build a new and modern intelligent transport system enabled by artificial intelligence technologies, including remote control and unmanned driving. By 2016, China's EV ownership exceeded 1 million cars; there were more than 150,000 public charging stations and more than 200,000 private recharging points. (Wang, Nie; Wang, 2020:161).

Since 2019, the country has been implementing the Green Travel Action Plan (2019–2022), jointly published by the Ministry of Transport and 12 other ministries. This plan aims to accelerate the construction of charging infrastructure, promote the large-scale use of green vehicles, improve public transport, and expand the connectivity of information systems linked to green mobility. Based on the May 2019 Plan, progress has already been made in three sectors: the development and construction of high-speed trains, subway systems, and electric bus networks (Peneluppi Jr., 2023: 360). Compared to countries with higher Gross Domestic Product (GDP) per capita, and even to more developed economies, the density of public transport services linked to sustainable energy sources in China is significantly higher, both in urban areas and conurbations.

Regarding other forms of sustainable energy, the May 2019 Plan provided substantial impetus for China's production landscape to take a great leap in both quantity and quality. By that year, China was responsible for 40 percent of all global wind turbine production and produced three-quarters of the world's solar panels. In domestic terms, but with impacts on global market

[96] The blow to the American solar industry was so severe that several companies, including SunPower, GlobalWatt, Evergreen Solar, and Spectra Watt, declared bankruptcy (Jaffe, 2021: 76).

numbers, by 2020, China accounted for half of the planet's electric vehicles, with "[...] half the hydrogen-fueled vehicles owned by Chinese people" (Zhaoyuan & Ishwaran, 2020: 8).

In short, as part of its effort to develop an "ecological civilization," China is projected to account for about 36% to 40% of the growth in solar and wind energy over the next five years, according to the International Energy Agency (Peneluppi Jr., 2023: 351). This new type of industrial action is diametrically opposed to the reality that China is still one of the four largest polluters in the world, alongside India, Iran, and Saudi Arabia, which together are responsible for 39.4% of global CO_2 emissions (Peneluppi Jr., 2023: 351–352).

However, in light of this thesis's interest in society's spatial access to the fourth energy transition correlated products and services, it does not appear that Brazil is assimilating China's example. Drawing from the participant observation experience in the ideal type of China and the prior knowledge of Brazil, it seems that new initiatives, like connecting small grids of two-flow energy to the conventional one-flow ones are being undermined by powerful actors with agenda-setting power entrenched in the country's incumbent energy sectors. Consequently, the resistance from these sectors to transforming the built environment for the installation of new infrastructure significantly hampers the equitable distribution of goods and services related to the energy transition in Brazil.

9. BRAZIL

As we shift our focus from China's energy policies to those in Brazil, it becomes essential to examine the unique challenges that Brazil faces in its energy transition. In environmental terms, energy transition policies propose solutions linked to the United Nations Sustainable Development Goals (SDGs), as well as the Paris Agreement on Climate Change. These frameworks state that three-quarters of global greenhouse gas emissions stem from the extraction, refining, and industrial use of fossil fuels. In 2014, 31% of these emissions originated from industrial activities.

Brazil, on the other hand, emits GHG primarily due to the accelerated deforestation process driven by the strength of agribusiness (Hochstetler, 2021). Thus, although different governments emphasize an environmental agenda and count on China—a global leader in

renewable energy investment—as their largest investor, there is no coherent Brazilian environmental discourse to explain the cancellation and restriction of photovoltaic sources in federal auctions in favor of contracting thermal plants powered by fossil fuels (Maluf, 2023:378). Given these contradictions, a significant puzzle arises: to understand why Brazil is not effectively pursuing its energy transition, we must examine some critical data.

In economic and financial terms, Brazil has been a strategic partner of China since 1993[97],with the two countries establishing an institutional framework that facilitates Chinese investments in Brazil for technical cooperation, productive training, construction of energy infrastructures, and bilateral trade (Pereira; Ribeiro, 2023, 159)[98]. Despite the fact that, and perhaps even because it has not formalized its participation in the Belt and Road Initiative, Brazil has been the largest recipient of energy and infrastructure investments from China[99]. By joining the Asian Infrastructure Investment Bank (AIIB)[100] but only purchasing US$5 million in shares—where the expectation was for a contribution of at least US$3.18 billion—the country maintained the prerogatives of the strategic partnership, which are much more advantageous, even while limiting its participation and access to financing from the institution (Carvalho, 2023: 29).

This seemingly paradoxical yet wise strategic decision highlights that, between 2005 and 2021, Brazil received US$64 billion out of a total of US$140 billion invested by Beijing in Latin America and the Caribbean (American Enterprise; Heritage Foundation, 2021; Carvalho, 2023:

[97] In 1995, Li Ruihuan, a member of the Politburo Standing Committee of the Communist Party of China, emphasized Latin America's dynamic economic development, highlighting Brazil's strategic importance. He identified both Brazil and China as committed to improving living conditions through economic growth and bilateral cooperation. Their partnership was deemed promising due to the absence of fundamental conflicts of interest (Oliveira, 2004; CPPCC National Committee, 2020). For more information, you can access the source here.

[98] Until the mid-1970s, Brazil's engagement with Asia was primarily economic with Japan and a limited political relationship with China. After a decline in the 1980s, relations resumed in the 1990s, particularly under the Itamar Franco government, which promoted trade potential with East Asia, especially China. The term "strategic partnership" emerged to describe the political-economic alignment between China and Brazil, further solidified by the subsequent governments of Fernando Henrique Cardoso and Luiz Inácio Lula da Silva, alongside Chinese President Hu Jintao (Oliveira, 2010; Niu, 2010; Oliveira, 2004).

[99] Brazil does not offer a clear definition of "strategic partnership," reflecting the multilateral tradition of its foreign policy. Despite variations over time and in different international contexts, the partnership's main axes encompass political, economic-commercial, and scientific-technological aspects (Gonçalves; Brito, 2010).

[100] Established in an official ceremony on June 29, 2015, the Asian Infrastructure Investment Bank (AIIB) was created to address a demand for infrastructure investments in New Silk Road countries, estimated at US$730 billion annually between 2010 and 2020. In December 2014, China initiated funding with the Silk Road Fund, contributing US$40 billion. Pakistan and Russia were early beneficiaries, receiving support for projects like a hydroelectric power plant and liquefied natural gas ventures, respectively, and are integral to the AIIB's institutional framework (Carvalho, 2023: 29–30).

45). Continuing along this vein, authors like Carvalho (2019) assert that "[...] Brazil is included in the Belt and Road," especially because it was the country that received the largest investment from the initiative in 2021 in the world, "[...] with a share of 13.6% of the total" (Carvalho, 2023: 46)[101].

In other words, even if it the arrangement refers to the "[...] synergy between national and regional development strategies and the Belt and Road Initiative," and it is not something specific to the Brazil-China strategic partnership (Maia, 2023: 78-79), it is interesting to highlight that:

> In 2015, the National Congress established the Mixed Parliamentary Front for the Bioceanic Railroad, composed of 206 deputies from the most diverse party labels (Workers' Party - PT, Republican Party - PR, Brazilian Democratic Movement - MDB, Brazilian Republican Party - PRB, Democrats - DEM, Brazilian Labor Party - PTB, Communist Party of Brazil - PCdoB, Brazilian Socialist Party - PSB, Social Christian Party - PSC, Green Party - PV, Progressive Party - PP, Solidarity, Podemos, Patriotas, Avante, Brazilian Social Democracy Party - PSDB, Humanist Party of Solidarity - PHS, Social Democratic Party - PSD, Progressive Republican Party - Pros, Democratic Labor Party - PDT, Social Liberal Party - PSL, Popular Socialist Party - PPS, Sustainability Network - Rede) and eight senators from various parties (Democratic Labor Party - PDT, Workers' Party - PT, Social Democratic Party - PSD, Brazilian Socialist Party - PSB, Brazilian Democratic Movement - MDB, Liberal Party - PL). The Front was not reinstated in the 56th Legislature because the overwhelming majority of parliamentarians were not reappointed to office. Additionally, the 56th Legislature was surprised, in its second year, by the COVID-19 pandemic. As a result, many of the meetings of the groups and committees of the parliamentary houses were suspended, a situation maintained until the closing date of this article in September 2021 (Maia, 2023: 78-79, emphasis added).

Initially, from Itamar Franco (1992-1994) to Jair Bolsonaro (2019-2022), continuity characterized the Brazil-China strategic partnership, even though an anti-China rhetoric prevailed during Bolsonaro's government. In economic and financial terms, there was no break with the AIIB, as evidenced by a decree signed by President Jair Bolsonaro on September 17, 2021, which "[...] promulgated the AIIB constitutive agreement, signed by the Brazilian government under the presidency of Dilma Rousseff in 2015, in Beijing" (Carvalho, 2023: 29).

[101] While Brazil has not signed a Memorandum of Understanding with China or officially joined the initiative, it has been China's main trading partner since 2009 and a significant recipient of Chinese investment. The year 2023 marks the thirtieth anniversary of the Sino-Brazilian strategic partnership, which was elevated to a global level in 2012. Both nations continue to enhance their cooperation across various areas, including technology, sustainability, cultural exchanges, and international development efforts (Carvalho; Veras: Steenhagen, 2023: 10–11).

As previously mentioned, several factors have influenced Brazil's energy policies such as bilateral cooperation, investments, and the national response to the energy transition. Among them, the role of the Chinese presence stands out, as it establishes an essential condition for understanding the dynamics of Brazil’s energy transition and the implications of energy transition policies in relation to industrial policies. Thus, it is essential to assess how these energy transition policies are intertwined with Brazil's deindustrialization strategies, particularly regarding the continuity of partisan politics (Cano, 2012). This deindustrialization process highlights the challenges Brazil faces in leveraging energy transitions effectively, especially when contrasted with China's more deliberate reforms of its National Innovation System.

Thus, understanding Brazil's deindustrialization process through the lens of partisan politics not only highlights historical continuity but also sets the stage for exploring its implications on the nation's energy transition and industrial policy frameworks.

9.1 Continuities in Partisan Politics through the Era of Brazilian Deindustrialization

The continuity highlighted in the title of this section can be traced through the deindustrialization process in Brazil, which began under Collor de Mello (1990 – 1992) and continued through Itamar Franco (1992 -1994) to Fernando Henrique Cardoso during both terms (1995 – 2002). This continuity stems from Brazil's adherence to the Washington Consensus. Applied since the 1990s, the Washington Consensus, an expression coined by John Williamson in 1989, was an imposing agenda, with 10 specific reforms, created by international institutions (Kuczynski; Williamson, 2003) for the alleged growth of Latin America, in the 1990s, breaking with the protectionist model and industrialization by import substitution inspired by the critic of the classical liberal model, the German Friedrich List (1789 – 1846).

This influence of the new liberalism preached by the Consensus playbook is directly associated with the opening of Brazil to imported products, economic liberalization, the process of downsizing the State machine (privatization), with the consequent wave of privatizations promoted by the Collor de Mello, Itamar Franco and FHC governments. While this neoliberal

influence resulted in negative deindustrialization, it also elevated Brazil to the status of Emerging Average Power (EAP) in the 2000s (Spínola, 2013).

The unfolding of this process led to the most complete revision of the strategies for the country's industrial development, with the Lula 1 and 2 governments (2002 – 2010) seeking better access to international markets, credits and technologies[102]. This continuity of the new developmentalist policy in Brazil, regardless of party politics, was marked by the achievement of Emerging Middle Power (EMP) status in the first decade of the 2000s.

Cano (2012) provides an insightful analysis of the role of industrial policy, especially through the National Bank for Economic and Social Development (BNDES), contrasting with the absence of a sustainable macroeconomic and industrial strategy against Brazilian-type deindustrialization, privatization. The author emphasizes the need for a sustainable macroeconomic strategy. Rodriguez (2012: 74) goes beyond arguing that Brazil's EMP status reflects a broader redistribution of capacities in the international system, not the country's real status.

According to this view, Brazil was elevated to the status of EMP by international contingency and the need for commodities by dominant global powers, particularly the already-emerging China (Rodriguez, 2012). At the time, Brazil was a regional leader without followers, as it had no military projection, no adherents to its economic policies, and no ability to reach consensus with countries such as Argentina, Venezuela, and Chile. This functionalist view accurately describes the type of EMP Brazil represented. If a realistic assessment of Brazil's material and economic resources were made, such a term would not apply.

The general concept of Middle Powers is very broad, as it encompasses diverse countries. Jordaan (2003) explains that Middle Powers are states that are neither large nor small in terms of international power, capacity, and influence, and they demonstrate a greater propensity to promote cohesion and stability in the international system through peaceful means. Countries

[102] The discourse surrounding the Brazil-China "strategic partnership" claimed to enhance citizens' welfare through state development. However, the reality was different; Brazil faced high taxes and public spending without corresponding benefits to its citizens. To balance public accounts, Brazil attracted speculative capital by raising the exchange rate, which did not contribute productively. This manipulation allowed Brazil to appear as an emerging power, but privatization did not lead to necessary investments in infrastructure (Mendes, 2010: 4).

such as Australia, Canada, Norway, and Sweden were the first to be included in this group, also characterized by the migration of industrial surplus capital to social welfare sectors (Jordaan, 2003).

In the new international configuration, which shaped the potential of emerging medium powers, a new analytical concept was needed. Especially with the inclusion of countries such as Argentina, Brazil, Nigeria, Malaysia, South Africa, and Turkey, they were categorized in the literature as Emerging Middle Powers. Thus, within the group of Middle Powers, traditional Middle Powers were differentiated from emerging ones (Jordaan, 2003).

In the case of Brazil as an Emerging Middle Power, the concept of deindustrialization becomes even more diffuse. Power is a positive term, implying projection, domination, and the realization of potential. An emerging medium power, however, refers to older terms such as Third World and Developing Country. It is important to emphasize that despite the positive appeal of the term "power" (Jordan, 2003, emphasis added), Brazil at the time, a country with enormous disparities between high public spending and the real needs of its population, was far from being considered a true power, even if it was an emerging medium power.

Public overspending ranged from 14 percent to 26 percent of government revenues, leaving the country in 13th place on a list of 103 nations with poor spending practices. Specifically, between 1995 and 2009, public spending was between 19% and 30% of GDP (Mendes, 2010). But after addressing the political continuities of Brazil's deindustrialization process and clarifying the main points, we can now proceed to assess the specificities of energy public policies.

In short, the Brazil-China strategic partnership was not only maintained but enhanced (Carvalho, Veras & Steenhagen, 2023; Maia, 2023). Brazil is considered by China as part of the BRI (Carvalho, 2023: 46), and the deindustrialization process was also a period of partisan political cooperation that led the country to the status of an EMP (Spínola, 2013). It is, therefore, necessary to understand what made this investment inefficient, leading to the non-implementation of major energy projects, including, for example, those announced between 2014 and 2017 for the photovoltaic sector.

At first, it was not due to a lack of regulation because, "[...] on the initiative of the Ministry of Science, Technology, Innovation, and Communications (MCTIC) and the now-defunct Ministry of Development, Industry, and Foreign Trade (MDIC), photovoltaic modules were included in the already existing semiconductor development program (Padis – Decree No. 6,233/2007)"[103].

> During Chinese President Xi Jinping's visit to Brazil in 2014, 54 cooperation and investment agreements were signed, 32 of which were signed in the presence of Presidents Xi Jinping and Dilma Rousseff, according to news published by the UOL portal in 2014. Most of the agreements were made between Chinese state-owned enterprises (SOE) in partnership with Brazilian state-owned companies. The only two projects by private companies to enter the official agenda for signing cooperation projects included the investment of Chinese automaker Build Your Dreams (BYD) for the opening of its electric bus chassis factory in Brazil, as well as a project to expand connectivity and monitoring of the Amazon region. According to the Brazilian Trade and Investment Promotion Agency (Apex-Brasil), BYD's investment was considered a milestone by the government, since it would place the country in a select list of few countries to master lithium battery technology (APEX-BRASIL, 2014) (Maluf, 2023: 373).

The figures from the strategic partnership, since the expression was first used during the Itamar Franco government, are impressive. Between 1991 and 1995, Brazil's exports to China increased from US$226 million to US$1.2 billion (CEBC, 2015; Maluf, 2023: 374). Under Lula da Silva's administration, Chinese investments soared from $450 million between 2007 and 2009 to $13 billion in 2010, before falling to $8 billion in 2011. The contraction in Chinese investment in Brazil continued between 2012 and 2014, ranging from US$2.9 billion in 2012 to US$3.4 billion in 2013, then declining further to $1.7 billion in 2014. However, after the aforementioned visit of President Xi Jinping in 2014, the figures for confirmed investments increased from US$7 billion to US$8 billion in 2015, US$8.4 billion in 2016, and US$8.8 billion in 2017 (CEBC, 2015; Cariello, 2021: 19; Maluf, 2023: 375).

Two years after President Xi Jinping's visit, "China's Canadian Solar Inc (CSI), one of the world's largest manufacturers, opened its factory in Sorocaba, in São Paulo's countryside" (APEX, 2016; Maluf, 2023: 375). The following year, BYD also established a physical

[103] Interministerial Ordinance No. 1,045, issued on October 2, 2014, outlined production processes to be implemented in Brazil, with initial factory installations occurring between 2016 and 2018. While some necessary decrees and ordinances progressed, parallel policies and actions were often neglected. Consequently, many benefits promised by the ordinance were not fully realized for the beneficiaries of Padis (Maluf, 2023: 381).

presence in Brazil. Both companies were attracted by the announcement of a tripod strategy to draw international investments in industrial policies focused on the Brazilian photovoltaic sector (Maluf, 2023: 375).

> The first pillar was the creation of an industrial policy with the entry of the solar energy segment in the Development Support Program Semiconductor Industry Technology Center (Padis). The second pillar was the insertion of solar modules produced in Brazil under the policies of the National Bank for Economic and Social Development (BNDES/Finame). The third pillar would be the introduction of solar photovoltaics in the auctions, being able to compete with other sources, which would create demand for solar PV modules to be produced in Brazil (Maluf, 2023: 375).

The establishment of these two giants in the photovoltaic solar panel segment in São Paulo's countryside marked a milestone in the first wave of Chinese productive investments, "expanding the initial phase of acquisitions and purchases of energy companies in Brazil by large Chinese state-owned groups" (Maluf, 2023: 376). Other major investments announced during this period accounted for nearly 50% of Brazil's total import market in 2017 (GREENER, 2018; Maluf, 2023: 376). Following the initial investments and the commencement of operations by BYD and CSI, the MDIC and BNDES began implementing the first ordinances on the Basic Production Process (BPP) and the Progressive Nationalization Plan (PNP), along with other measures to guide *Agência Especial de Financiamento Industrial Finame* – Special Agency for Industrial Financing (Finame/BNDES) policies. These efforts also included the first *Leilão de Energia de Reserva* (LER) - Reserve Energy Auctions (LER 2016 and 2017) (Maluf, 2023: 376).

> However, as of 2018, most of the government measures announced by the Brazilian government between 2014 and 2017 for the expansion of local production in the solar photovoltaic sector has not left the paper. This caused the planned expansions to be canceled. Something similar happened to other Chinese investments in Brazil. The amount fell down from 7 billion made in 2015 to $1.9 billion in 2020 (Cariello, 2021, p. 19) in the first year of the government Jair Bolsonaro (Maluf, 2023: 376).

The negative shift, which had already been hinted at during the turbulent Dilma Rousseff government, intensified in 2018. Following Rousseff's impeachment, Vice President Michel Temer completed her term, and then, with the start of Bolsonaro's presidency in 2019, an unusual anti-China rhetoric took hold in the Planalto Palace. As a result, Brazil's once-strategic partner, along with Chinese companies, drastically reduced their investments. Despite solar

energy being the fastest-growing energy source worldwide, and surpassing 5% of Brazil's overall energy consumption in 2021 (ABSOLAR, 2021; Maluf, 2023: 378), the outlook after 2018 remained discouraging.

Another aspect of Bolsonaro's government was the unequal treatment of domestic and foreign investors. Foreign investors benefited from tax exemptions on imports and sales in the local market, while Brazilian entrepreneurs continued to pay for inputs for photovoltaic solar modules. As a result, the domestic production chain was strained. In 2017, local manufacturers contributed to 50% of import rates for inputs; by 2019, this share had dropped to less than 3% (Sebrae, 2018: 153; GREENER, 2018, 2019).

> One by one, the pillars of the tripod that attracted these productive investments were discontinued or misconfigured, slowing down the transfer of technology and the massive investments in local research foreseen in the Padis program (which requires 5% of revenues invested in Research and Development (R&D), while an imported product does not invest in local R&D) [...] The BNDES PNP used to guide the sector towards progressive densification, with the objective of manufacturing solar cells in the country in a few years. However, some of the federal fiscal distortions, such as the suspension of taxes on inputs for local purchase or imports, were never materialized, making it difficult for the BNDES PNP to be fully realized. Imported solar modules are exempt from almost all federal taxes (PIS/Cofins – Reidi and IPI), while those manufactured locally pay many of these taxes (Maluf, 2023: 381-382).

Despite attempts at dissuading the Bolsonaro government from enforcing these institutional distortions, there was no official communication, meeting, or technical justification that could reverse the policy. On the contrary, ordinances from the Ministry of Economy (ME 309/2019 and SDCI 324/2019) exacerbated the situation. These documents "expanded the granting of total exemption from the Import Tax- *Imposto de Importação* (II) through the Ex-tariff instrument – eliminating the II on imported final goods, even for products with domestic manufacturing" (Maluf, 2023: 382). These ordinances were in direct violation of Brazilian law (article 2 of Law No. 9,784/1999 and article 3, II, 170, VIII and IX, and 219 of the Federal Constitution of Brazil - CF/88), as well as Mercosur Decision No. 25/15 of 2021, which governs the Import Tax.

The final blow to the Brazilian solar photovoltaic sector came with the hollowing out of technical authority over the granting of Ex-tariffs. Ordinance ME 309/2019 transferred this responsibility from the technical divisions of the Secretariat for Industrial Development and Competitiveness (SDCI) of the Ministry of Economy (formerly MDIC) to the Special

Secretariat for Foreign Trade and International Affairs (Maluf, 2023: 383). From that point forward, ideological and economic concerns overshadowed purely technical decisions. Article 13 of the ordinances introduced absurd requirements for national manufacturers:

> Art. 13. For the purpose of ascertaining and comparing the existence of equivalent national production, it will only be considered that there is equivalent to that of the imported good considered when the I – performance or productivity equal to or higher than that of the imported good, provided that the parameter is included in the suggested description of the Article 3(II); II – delivery time equal to or shorter than that of the same type of imported good; III – previous deliveries made by the manufacturer within the last five years; and IV – price of the national good, calculated at the EXW (Ex Works) factory, without the incidence of taxes, not higher than that of the imported good, calculated in national currency, based on the CIF (Cost, Insurance and Freight) price (SDCI, 2019).

In summary, the combination of tax burdens on local manufacturers, exemptions for foreign products (which ensured that, even when a domestic product was superior, it still wasn't cheaper than its foreign counterpart), the failure to update the Padis program regarding import taxes like IPI and PIS/Cofins on inputs, and the approval of Ex-tariffs based on ideological rather than technical criteria increased the cost of Brazilian-produced photovoltaics by 40% (Maluf, 2023: 385).

> Between the beginning of 2020 and September 2021, more than 530 ex-tariffs for solar PV modules alone were approved. For a single product, there are 530 supposed exceptions to the tariff rule, that is, imported products that won the similar national good in only one of the four requirements, be it performance, deadline, proof of supply, or price (Maluf, 2023: 385).

In conclusion, by subsidizing imported products and penalizing Brazilian producers, the government created significant legal uncertainty in the domestic solar photovoltaic sector. The increasing tax distortions led to a lack of investment and job creation in the sector, eventually resulting in the cancellation of energy auctions.

So, would partisan politics be an inhibitor of the energy transition in Brazil? The strong anti-China rhetoric, which caused a drastic drop in energy investments—from $7 billion in 2015 to $1.9 billion in 2020 (Cariello, 2021: 19)—also coincided with significant changes to the institutional framework that had previously ensured the strategic partnership. There was increasing leniency toward foreign investors, while national investors faced rising barriers. This

favoring of foreign investors created additional challenges for adapting projects to each new institutional change.

Public auctions, which once allowed for transparent monitoring by civil society, were almost entirely disfigured during Bolsonaro's term. However, it is important to point out a critical detail: while the Bolsonaro government drastically altered the institutional framework related to energy, the sabotage of auctions and the non-implementation of programs planned since 2014 predated the anti-China rhetoric of the 2019–2022 period.

In short, from 1993 to 2013, Brazilian party politics—although a potential threat to the institutional arrangement of the energy sector—did not appear to have a detrimental impact on the institutional framework as a whole. On the contrary, there was a strong ideological commitment among parties to strengthen the strategic partnership and increase energy investments. However, something changed around 2014, even before Bolsonaro's anti-China rhetoric emerged. Since this period coincides with the fourth global energy transition, the shift to renewable resources, Brazilian partisan politics should be added to the puzzle of Brazil's stalled energy transition.

But for now, let's investigate another hypothesis: could the strategic partner, China, paradoxically be the great inhibitor of the energy transition in Brazil? This is a hypothesis that cannot be ruled out.

In line with strengthening the resilience of the incumbent energy sectors in Brazil, it should be considered that the Chinese preference is for hydroelectric energy, which represents 81% of the capital invested. Furthermore, there is a strong tendency among Chinese investors to favor the generation sector (81%) over hydroelectric transmission (17%). This mix of investments, favoring a historically rooted and resilient structure in Brazil, leaves little capital for the second most financed source, wind (12%), and even less for solar, which accounts for only 3% of the total invested by China (Barbosa, 2020: 13; Costa; Vasconcelos, 2023: 418).

It is well known that China learned about energy capture and generation from Itaipu, taking this expertise to its Three Gorges project (Santoro; Junqueira, 2023: 448). This supports Beijing's

energy policy of investing more in the foreign hydropower sector. However, domestically, Beijing has not remained tied to its historical reliance on hydropower, becoming instead the largest investor in renewable energies that are less aggressive to the environment, such as wind and solar (Andrews-Speed; Zhang, 2019).

In other words, China has overcome an entrenched trajectory of dependence, not only on the hydraulic sector but also on sources like coal and oil. To this end, it has invested, albeit with resistance at the subnational level, in public policies aimed at creating infrastructures for the capture, transformation, and distribution of renewable energy, especially wind and solar. These investments, in turn, foster new consumer behaviors. Once the patterns of energy capture, transmission, distribution, and consumption are modified, a new trajectory of dependence is established.

In Brazil, consolidated data from 2020, published by the Energy Research Company (EPE) of the Ministry of Mines and Energy (MME) (MME-EPE, 2021) (Figure 46), reveals some striking insights:

i) Brazil possesses the largest installed capacity in Latin America; ii) It exhibits a significant advantage in the proportion of renewable resources within its energy matrix, with the Domestic Energy Supply (OIE) at 48.45%, compared to 12.1% in OECD countries and 14.9% globally; iii) Brazil also emits less CO_2 in electricity generation—37% less than the OECD bloc and 41% below the global average—both by source and production sector (MME-EPE, 2021: 6)[104].

Figure 46: Installed Generation Capacity (IGC) in Brazil - 2020

Source	2019	2020	Structure % de 2020	Expansion n-(n1) MW
Hydroelectric (*)[105]	109.058	109.271	60,9	213
UHE	102.999	103.027	57,4	28
PCH e CGH	6.059	6.244	3,5	185
Biomass	14.978	15.306	8,5	328

[104] Available from: <1 (www.gov.br)>. Accessed: January 24, 2024.

[105] According to the National Water Agency (ANA) Metadata Catalog, the National Electric Energy Agency (ANEEL) adopts three classifications for hydroelectric plants: Hydroelectric Generating Plants (CGH) (with up to 1 MW of installed power), Small Hydroelectric Plants (PCH) (between 1.1 MW and 30 MW of installed power), and Hydroelectric Energy Plants (UHE) (with more than 30 MW). Available from: https://metadados.snirh.gov.br/geonetwork/srv/api/records/d0886b5c-f94c-4573-941b-febad5a990f3. Accessed April 12, 2024.

Sugarcane	11.438	11.712	6,5	274
bagasse	186	206	0,1	20
Biogas	3.354	3.388	1,9	35
Bleach and others				
Wind	15.378	17.131	9,5	1.753
Solar	1.753	3.287	1,8	814
Uranium	1.990	1.990	1,1	0
Gas	15.303	16.825	9,4	1.522
Natural gas	13.385	14.927	8,3	1.541
Industrial gas	1.918	1.899	1,1	-20
Oil	7.670	7.696	4,3	26
+ Combustible oil	3.316	3.256	1,8	-60
Mineral Coal	3.228	3.203	1,8	-25
Unknown	40	27	0	-13
Subtotal	**170.118**	**174.737**	**97,3**	**4.618**
Distributed generation	**2.162**	**4.768**	**2,7**	**2.606**
Solar	1.992	4.635	2,6	2.643
Wind	10	15	0,0	5
Hydro	97	23	0,0	-74
Thermal	63	95	0,0	32
National total	**172.280**	**179.505**	**100**	**7.225**
Of which renewable	144.049	149.764	83,4	5.714
Availability with import	**178.130**	**185.355**		

Source: Own elaboration based on Resenha Energética Brasileira – Resultados de 2020 (MME-EPE, 2021: 10)[106] and the National Water Agency (ANA) Metadata Catalog[107].

Calculations of Lampis and Bermann (2022: 3 – 4) shows that…

> The Brazilian electricity system is by far the largest in Latin America and in 2019, the total installed capacity of electric power generation in Brazil (public service plants and self-producers) reached 170,118MW (MME-EPE, 2020). According to the 2020 National Energy Balance [(base year 2019) (MME-EPE, 2020)], more than 80% of the country's electricity is derived from renewable sources (83%), and particularly from large hydroelectric plants (64, 9%), a component in which the country is the second largest producer in the world, with 389TWh, representing 9% of world production (Lampis; Bermann, 2022: 3 – 4).

[106] Available from: https://www.gov.br. Accessed January 24, 2024.
[107] Available from: https://metadados.snirh.gov.br/geonetwork/srv/api/records/d0886b5c-f94c-4573-941b-febad5a990f3. Accessed April 12, 2024.

Nevertheless, as previously highlighted, installed capacity alone is insufficient to meet all societal demands. To achieve satisfactory connectivity for all energy and electricity consumers, it is essential to invest in distributed energy systems. As we can see in the framework above, and could also analyze through the thesis, Brazil remains committed to the resilience of its hydroelectric, biomass, and oil sectors in relation to other sources, even in light of economic losses in energy auctions and contrary to technical recommendations (Maluf, 2023: 381–385). In this self-sabotage, the aforementioned ordinances of the Ministry of Economy offer tax exemptions to importers while burdening national energy producers with PIS/COFINS, Reidi, and IPI, among other national taxes.

10. ANALYSIS: a reassessment

As can be seen from the theoretical frameworks and charts presented in this thesis, and under the ideal terms observed, utilized and shot in China, it is not enough to have a great installed capacity system of energy and a sustainable matrix of energy. Without distributing energy and electricity in a reliable way through small grids (distributed energy), it is controversial to say that the citizens can count on the affordability and social benefits of the fourth energy transition (Andrews-Speed; Zhang, 2019). This incomplete path towards energy transition happens especially when the political unity, be it cities in a province in an ideal type unit like China (for example, Xiantao, in the Hubei Province) or a continental country like Brazil.

The big problem for these places, and many others around the globe, is when public policies don’t go further than the conventional one flow installed capacity system. The photos, pictures and data in this thesis, for instance, illustrate the conventional one-way flow electricity grids found around the globe, even in the energy transition pioneer states. There is no problem with that, since the conventional systems are the undisputable foundation and background for transformation, generation, distribution and even fueling of other energy systems, the small grid ones included (IEA, 2017; Andrews-Speed; Zhang, 2019; Hochstetler, 2021).

The big issue is: whether in long-established industrialized countries or in those still in the process of industrialization, the fact is that most of these systems relies on fossil-based energy generation. And delivery to the consumer takes place through large gas and electricity distribution networks with great losses, never descending prices and increasing resilience

against new structures and logistics necessary for the fourth energy transition (Andrews-Speed, 2012).

It is interesting to note that Beijing, Haidian province; and Shanghai, Songjiang province, represent provinces with large coverages of small distributed energy networks, an indispensable condition for the fourth energy transition. In the cities of these provinces energy towers with conventional single-flow power distribution systems (Photo 1) are located in industrial districts, along roads and outside urban centers. Differently, in three of the main cities in the Han River Delta: Wuhan, Xiantao and Tianmen, in the Hubei province, conventional energy distribution towers, such as those of the giant State Grid, are located within the city limits.

The big difference among cities like Xiantao (the counterfactual of the counterfactual), Shanghai and Beijing, is that, the latter ones, in addition to large conventional towers in industrial districts, have extensive coverage of small grids within the cities of the provinces they are located. On the other hand, the examples from Hubei Province – Xiantao, for example - (just like most of Brazilian cities, Belo Horizonte included) do not have this coverage of small grids, which reflects the lack of central air conditioning in most of the public and private buildings (In Xiantao, e.g.). In winter, this means having to use heaters in each room; At high temperatures, refrigeration follows the same logic, with an increasing in the final cost on the energy bill. Meanwhile, residents of Shanghai and Beijing have low-cost central air conditioning in most public and private buildings.

From the point of view of the Brazilian case, the incumbent sector of energy capture and generation in the country is linked to hydroelectric sources. In other words, there are patterns of path dependence in the capture, generation, and distribution of energy in Brazil that can be explained by the interests of actors with agenda power, even if interests, by themselves, do not generate results (Hochstetler, 2021). Such patterns of dependence refer to historical institutions present in both democracies and autocratic regimes. Some of these elements go beyond the energy sector, although they can affect it, in addition to being shared between democracies and autocracies.

This, even though democracies may have powerful actors engaged in a more territorially and institutionally dispersed way in certain political sectors than in autocracies (Hochstetler, 2021). So, it can be said that this ethereal entity, the market, is behind the changes (when they happen in favor of the renewables) the same way the market, or market decisions, are behind the resilience against distributed energy through small grids and other necessary spatial, structural and logistic changes in energy generation and distribution.

Policymakers in constitutionally democratic countries, and at the same time a late comer in the field of energy transition, such as Brazil, usually take into account, at least in discursive terms, how political changes can affect the interests of their political base. In the case of China, as well as other developed and developing economies, but especially for early comers in energy transition, investment in sources such as wind and solar has been the most common economic response in terms of energy policy since the 2008 crisis and the consequent strangulation of the global economy (Hochstetler, 2021).

As we can see up to now, Brazil represents an incomplete case of energy security, largely anchored in renewable sources, but it has not yet reached the point of distributing the benefits of the fourth energy transition to its population. The reasons are numerous and have long permeated the internal debate on energy policy, with two significant negative milestones: the 2014 water crisis and the 2021 blackout, which indelibly exposed the weaknesses of the country's energy generation and distribution model, largely based on its vaunted hydropower capacity. This model served, for example, as an inspiration for Chinese investment in its Three Gorges Dam (Santoro & Junqueira, 2023).

This hydropower-based model reveals its fragility as water crises, alongside others stemming from the global climate crisis, become the new normal (UOL, 2024). In Brazil, a lack of rainfall reduces water levels at hydroelectric plants, forcing the National System Operator to intervene to prevent energy shortages. The solution is to rely on thermoelectric plants, the activation of which increases energy bills by R$1.88 for every 100 kWh. Known as the yellow flag, this type of energy price hike is further exacerbated by increasingly warmer winters, which drive up the use of fans and air conditioners in homes, public offices, industry, and commerce. The overall

result is an increase in electricity costs but without any improvement in energy security, since the outdated infrastructure cannot support the rise in energy consumption (ANEEL, 2024)[108].

There have already been 14 blackouts in Brazil in 2024 alone[109]. Of the six major global occurrences, three also happened in Brazil in 1999, 2009, and 2011, respectively[110]. Paradoxically, Brazil, a tropical country with high solar incidence for much of the day and many months of the year, favored thermoelectric power in its last energy auction in 2021[111]. Thermoelectric power costs five times more than solar, which already has good coverage in the country. For example, Minas Gerais boasts seven solar energy generation complexes. However, the challenge is to connect energy sources, not just solar to solar, but all sources within the energy generation and distribution mix.

Nevertheless, experts estimate that Brazil is ten years behind in infrastructure investment. The energy distribution model in Brazil is bankrupt, as evidenced not only by the frequent blackouts but also by the decline in the quality of energy services (Agência Brasil, 2024)[112]. The legislation on energy distribution remains unimplemented, as criticized by those the Minister of Mines and Energy, Alexandre Silveira, was forced to acknowledge at the last G20 meeting. Silveira admitted that CEMIG, one of Brazil's state-owned energy giants, lacks investment in infrastructure compatibility.

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[108] Available from: <Sobre Bandeiras Tarifárias — Agência Nacional de Energia Elétrica>. Accessed Oct 22, 2024.

[109] An article published by the online newspaper *UOL* on October 16, 2024, lists the major nationwide blackouts in Brazil since 1985. In the 2000s, these events have occurred several times each year. The blackout of 2023 affected 25 of the country's 26 states, as well as the Federal District. Only the state of Roraima was spared that year. This year has already seen incidents across the entire national territory, with one of the most severe occurring in São Paulo, where over 2 million people have been affected. Available from: https://noticias.uol.com.br/cotidiano/ultimas-noticias/2024/10/16/apagoes-brasil.htm. Accessed Oct 22, 2024.

[110] Available from: https://www.anacebrasil.org.br/grandes-apagoes-viram-rotina-no-brasil/. Accessed Oct 22 2024.

[111] Comparing Brazil's history of blackouts and energy rationing with data published by the federal government on the website of the Brazilian Institute of Geography and Statistics (IBGE), based on the National Household Sample Survey (PNAD), reveals at least two versions of Brazil: the real one, marked by daily power outages, blackouts, rationing, and high electricity bills; and the one depicted in cold statistics and data presented by the G20, the World Forum, and the federal government (ANEEL, MME/EPE), which highlight positive figures about the energy matrix and household electricity coverage without accounting for the obsolescence of Brazil's energy and electricity distribution model. Available from: MATRIZ ENERGÉTICA Accessed Oct 22 2024.

[112] Available from: Apagão: especialistas apontam falência do modelo de privatização | Agência Brasil Accessed Oct 22 2024.

The most obvious realization is that, before investing in distributed energy, the country must upgrade its existing energy matrix, investing in infrastructure renewal. Without a reliable conventional energy supply structure, there is no way to ensure benefits from investment in small energy grids based on solar, wind, or gas. Furthermore, even if Brazil had a technically reliable conventional energy generation and distribution network connected to small grids powered by renewables (which are also nonexistent or insufficient), the country would still face the challenge of storing energy from sources like solar and wind (Instituto E+, 2020)[113]. Legislation in this regard has yet to be discussed, and the investments required are immense. The forecast is that discussions on sustainable energy storage will not take place until 2025.

Politically, the much-praised Brazilian sustainable matrix represents an incomplete and inefficient investment in energy security, carried out by the Workers' Party (PT) as part of its industrial policy based on resources from the National Bank for Economic and Social Development (BNDES). In other words, the Brazilian energy matrix is indeed a case of fossil fuel reduction towards a carbon-free model (Basso, 2018), but it stems from attempts to provide energy distribution security to the country, not as a deliberate investment to combat the climate crisis[114].

Moreover, the partnership with China should be highlighted in this regard, as Brazil's rise to power was due both to the long-standing partnership and the global food crisis, which placed Brazil in a position to produce the food that many true powers, including the then already ascending China, needed (Cano, 2010). However, Brazil, a contingent power whose deindustrialization process is negative, did not invest in the industrial infrastructure needed to support a real energy transition.

The consequences of these contingencies, and even of the preferences of Chinese companies and the state, have resulted in a mostly sustainable matrix based on hydropower, biomass, and even oil. However, its structures are eroded by time and lack of investment in renewal. This structure is far from the concept of distributed energy, as its incumbents have successfully

[113] Available from: https://emaisenergia.org/. accessed Oct 22 2024.
[114] Available from: https://www.scielo.br/j/bpsr/a/b9R4MbVPmQGBGswkkBJd4LJ/?lang=en&format=pdf. Accessed Oct 22 204.

resisted the necessary integration into small energy grids (Andrews-Speed, 2019; Hochstetler, 2021).

11. CONCLUSION

The puzzle of the fourth energy transition in Brazil is so intricate that only one, two or three separate hypotheses are not able to explain it. A structural and economic analysis shows that the installed capacities of Brazil's energy and electricity matrices follow trajectories of dependence linked to the incumbent hydroelectric, biomass and oil sectors. The predominance of sustainable sources such as hydroelectric power and biomass, which, in principle, are a good first step towards the energy transition, shows, however, through figures related to financial investment and installed capacity, that the incumbent sectors are able to undermine the chances of increasing the presence of solar and wind energy in the national mix. And this is an indispensable condition for Brazil to share the benefits of the fourth energy transition with its citizens (Andrews-Speed; Zhang, 2019; Hochstetler, 2021).

When it comes to politics, at least from 1993 up to 2017, Brazilian partisan politics, the strongest intervening variable, worked to enhance the institutional arrangement between China and Brazil (Maia, 2023). There was big commitment of different ideologically parties in order to raise the investments in energy. The same can be said of Brazilian deindustrialization period, from 1990 to 2010, when four different ideological governments worked in continuity to place Brazil as an Emerging Middle Power.

Nevertheless, we should remember that Brazil was elevated to the status of EMP by international contingency and the need for commodities of the de facto powers, especially the already emerging China (Cano, 2012). At the time, Brazil was a regional leader without followers, because it had no projection and military capacity, it did not have followers of its economic policies and it could not reach consensus with nations such as Argentina, Venezuela and Chile. That is, if a realistic reading of the material and economic resources were made, the term *leader* would not apply.

Back to partisan politics, something changed around the year 2018, advancing the future Bolsonaro’s government anti-China rhetoric and the drastic diminishment of Chinese

investment in Brazil. The distortions applied to the Brazilian institutional energy arrangement from 2019 on, not only favored the interests of national and international agenda power actors as kept Brazil on a trajectory of resilience of the hydroelectric, biomass, and oil sectors in relation to other sources (Maia, 2023).

To make things worse, the Chinese preference for hydroelectric energy (81% of the capital invested), is in line with strengthening the resilience of the incumbent energy sectors in Brazil. In a mix of investments that favors the generation sector (81%) to the detriment of hydroelectric transmission (17%), there is little capital left for the second most financed source, wind (12%), and even less for solar, with 3% of the total invested by China (Barbosa, 2020: 13; Costa; Vasconcelos, 2023: 418).

This scenario of interested actors with agenda power, ideological and non-technical decisions and dependence on structures and patterns of consumption related to the incumbent sectors of energy explain why Brazil does not materialize its energy transition in terms of affordability and social impacts beyond its sustainable energy matrix. Something would change only by getting rid of any ideology when dealing with public policies. More than that, the central government should apply the conceptual differences between policy making (decentralization of competences) and policy-decision making (decentralization of decisory authority) to overcome private interests which damage public ones (Arretche; Vazquez; Gomes, 2012: 146).

In a nutshell, since wind and solar are seen as threats to Brazilian energy incumbent sectors, China's preferences are in accordance with Brazilian incumbent sectors, and there is a trajectory of dependence on hydro, biomass and oil, the only chance for a change in favor of other renewables would be the building of a great consensus among national and international political and market actors. Something like China did when utilized strong regulation to conciliate the autonomy of subnational governments and the interests of market actors with national energy policies. From then on, a new path dependence was created, this time around the fourth energy transition to renewable sources.

12. RECOMMENDATIONS

1. **Policy Reforms**: Considering the existing institutional environment and the specific arrangements within the energy sector regarding a sustainable energy matrix, Brazil should advance and develop comprehensive policies that encourage investment in small power grids and promote decentralized energy solutions. This includes establishing regulatory frameworks based on technical decisions that facilitate the integration of renewable energy sources into existing infrastructure.
2. **Stakeholder Engagement**: Energy transitions, like any other economic transition, are social-technical transformations aimed at addressing social demands. Therefore, Brazilian authorities should involve society as a whole, including local users, in the planning and implementation of energy projects that prioritize social needs over mere market interests. This approach ensures that the real needs of citizens are considered.
3. **Investment in Education and Training**: Consumption patterns are influenced by education, which involves habits and culture as strong informal institutions. Thus, Brazil should prioritize educational programs focused on renewable energy technologies and energy efficiency to culturally and technically prepare the workforce for the transition to a green economy. In doing so, a well-trained workforce would serve as conduits for future knowledge about energy transitions, continuously engaging future generations in new and sustainable consumption patterns.
4. **International Collaboration**: Given that environmental actions have global impacts and that energy transitions are an essential part of global economic transformations, Brazil should foster partnerships with leading international players in renewable energy and sustainable development. The country should not shy away from learning from best practices and global experiences.
5. **Monitoring and Evaluation**: Critics and experts should be consulted to help the country create and implement robust mechanisms for monitoring and evaluating the progress of energy transition initiatives, ensuring that technical decisions are respected in terms of adaptability in policy implementation.

By adopting these recommendations, Brazil could rise to a leadership position among countries that share the benefits of the fourth energy transition with their citizens. This would be a responsible contribution to global efforts to combat climate change and promote sustainable development.

13. DISCLAIMER

This thesis does not aim to delve deeply into the ideologies or regimes of government, whether authoritarian or democratic. Instead, it applies a combination of neo-institutionalist and International Political Economy (IPE) analysis focused on the capacities of the state to manage the social, political, and economic institutions necessary for the energy transition.

14. LIMITATIONS

1. **Interpretative Data Collection**: The research faces the challenge of creating interpretative databases for future researchers, as interpretative approaches focus on interpreting data that remains in the field rather than collecting it. Qualitative data such as sounds, images, and built space are acknowledged as equally valid forms of evidence (Yanow & Schwartz-Shea, 2006: xvii).
2. **Scope of Analysis**: The analysis or modeling of causal relationships related to the fourth energy transition is outside the scope of this thesis. The interpretive design makes it impractical to limit the analysis to a single chapter, although Chapter 10 revisits various theoretical frameworks presented throughout the thesis.
3. **Nature of Case Studies**: The case study methodology employed in this thesis is recognized as an ideal type rather than a rigid method with definitive rules. While the case study provides insights into descriptive phenomena, it does not identify causal effects or estimate probabilities (Gerring, 2004: 349). This research primarily utilizes participant observation, documentary analysis, and unstructured interviews to derive meanings from the context of the study units.
4. **Energy Transition Scope**: The thesis does not address the negative impacts of renewable resources—such as the use of fossil fuels in the construction of solar panels or the large areas rendered unproductive due to wind turbines—due to time and space constraints.
5. **Analytical Ambiguities**: The research acknowledges that energy transition presents difficulties in proof or refutation and that this phenomenon is susceptible to observation and interpretation through assertions about the existing reality (Sartori, 1984; Gerring, 2004: 351). The complexities of the hybrid nature of case studies are acknowledged but not explored in depth.
6. **Exclusion of Certain Energy Sources**: The exclusion of specific energy sources is not seen as a viable solution for the issues related to the fourth energy transition. A balanced energy mix is necessary to achieve an efficient and environmentally friendly energy landscape.

15. BIBLIOGRAPHY

Abrucio, L. F. (2012). A dinâmica federativa da educação brasileira: diagnóstico e propostas de aperfeiçoamento. In P. O. Romualdo & S. Wagner (Eds.), *Educação e Federalismo no Brasil: combater as desigualdades, garantir a diversidade* (pp. 290). Brasília: UNESCO.

Abrucio, F., Franzese, C., & Sano, H. (2010). Coordenação e cooperação no federalismo brasileiro: avanços e desafios. In *Estado, Instituições e democracia: república* (Vol. 9, pp. 177-212). Brasília: IPEA.

ABSOLAR. (2021). *Energia solar fotovoltaica no Brasil: infográfico ABSOLAR*. Available at: https://www.absolar.org.br/wp-content/uploads/2021/09/2021.09.17-Infografico-ABSOLAR-no-35-.pdf. Accessed May 24, 2023.

ABSOLAR. (2024). *Panorama of solar photovoltaic in Brazil and in the world* (Updated January 12). Available at: https://absolar.or.br/en/market/infographic/. Accessed February 5, 2024.

Acemoglu, D., & Robinson, J. (2012). *Por que as nações fracassam? As origens do poder da prosperidade e da pobreza* (C. Serra, Trans.). Elsevier Editora Ltda. [Original work published as *Why Nations Fail*].

Agência Cenário Energia. G20: Grupo de Trabalho de Transições Energéticas em BH Conclui Debates com Foco no Combate à Pobreza Energética. Cenário Energia, 31 de outubro de 2024. Available from: <https://cenarioenergia.com.br/2024/05/31/g20-grupo-de-trabalho-de-transicoes-energeticas-em-bh-conclui-debates-com-foco-no-combate-a-pobreza-energetica/>. Accessed Oct 22, 2024.

Agnew, J. (1998). *Geopolitics: re-visioning world politics*. London and New York: Routledge. Taylor and Francis Group. (2nd ed. 2003).

Agnew, J. (2005). *Hegemony: the new shape of global power*. Philadelphia: Temple University Press.

Agnew, J. (2010). Emerging China and critical geopolitics: between world politics and Chinese particularity. *Eurasian Geography and Economics*, 51(5), 569-582.

Almeida, M. H. T. (2012). Prefácio. In *Democracia, Federalismo e Centralização no Brasil* (pp. 7-9). Rio de Janeiro: Fiocruz/FGV.

American Enterprise Institute; Heritage Foundation. (n.d.). *China Global Investment Tracker*. AEI, Washington. Available at: https://www.aei.org/china-global-investment-tracker/. Accessed January 28, 2024.

ANACE (Agência Nacional dos Consumidores de Energia). Grandes apagões Viram Rotina no Brasil. Feb. 28, 2011. Available from: <Grandes apagões viram rotina no Brasil. – Anace Energia>. Accessed Oct 22, 2024.

Anastasia, F., & Las Casas, L. (2016). Instituições políticas, capacidades estatais e cooperação internacional: África do Sul, Brasil e China. In A. de Ávila Gomide & R. Raul (Eds.), *Capacidades Estatais em Emergentes Países: o Brasil em perspectiva comparada* (pp. 425-472). Rio de Janeiro: IPEA.

Andrews-Speed, P. (2012). *The governance of energy in China: transition to a low-carbon economy*. Basingstoke: Palgrave Macmillan. (xvi + 259 pp.)

Andrews-Speed, P.; Zhang, S. *China as a Global Clean Energy Champion: lifting the veil*. Singapore: Palgrave Macmillan, 2019. 349 pp. eBook.

ANEEL (Agência Nacional de Energia Elétrica). Sobre Bandeiras Tarifárias: Bandeiras tarifárias é o sistema que sinaliza aos consumidores os custos reais da geração de energia elétrica. Publicado em 24/02/2024. Atualizado em 12/06/2024, 07h25. Available from: <Sobre Bandeiras Tarifárias — Agência Nacional de Energia Elétrica>. Accessed Oct. 22, 2024.

Arretche, M.; Vazquez, D.; Gomes, S. As relações verticais na federação: explorando o problema da descentralização e da autonomia. In: Arretche, M. *Democracia, federalismo e centralização no Brasil*. Rio de Janeiro: Fiocruz, 2012. Capítulo 4, pp. 145–171.

Arretche, M. *Democracia, Federalismo e Centralização no Brasil*. Rio de Janeiro: Fiocruz/FGV, 2012. 115 pp.

Augelli, E.; Murphy, C. N. Gramsci and international relations: a general perspective with examples from recent U.S. policy toward the Third World. In: Gill, P. (Ed.). *Gramsci, Historical Materialism and International Relations*. New York: Cambridge University Press, 1993, pp. 127–147.

Banks, D. G. The Rise of China's Civil Nuclear Program and its Impact on U.S. National Interests. American Council for Capital Formation, Center for Policy Research, January 2017. Available at: http://cdn.accf.org/wp-content/uploads/2017/03/ACCF_China_paper_03.pdf. Accessed Sept. 18, 2017.

Barbosa, P. H. B. New Kids on The Block: China's Arrival in Brazil's Electric Sector. In: *Global Development Policy Center*. GCI Working Paper 12, Dec. 2020. Available at: https://www.bu.edu/gdp/gci_working_papers/GCI_WP_012_Pedro_Henrique_Batista_Barbosa.pdf. Accessed Jan. 28, 2024.

Barros, R. Reserva de energia para os próximos 4 anos custará R$ 39 bilhões. *PODER 360*, 2022. Available at: https://www.poder360.com.br/energia/reserva-de-energia-para-os-proximos-4-anos-custara-39-bilhoes/. Accessed May 24, 2023.

Basso, L. De S. Domestic determinants of international cooperation: an analysis of the intricate relationship between energy politics and climate change mitigation. 2018. 261 f., il. Tese (Doutorado em Relações Internacionais) Universidade de Brasília, Brasília, 2018. Available from: <http://icts.unb.br/jspui/handle/10482/32689>. Accessed Oct 22, 2024.

Batista, P. N. O consenso de Washington: a visão neoliberal dos problemas Latinoamericanos. In: Lima Sobrinho; Barbosa *et al*. *Em defesa do interesse nacional: desinformação e a alienação do patrimônio público*. São Paulo: Paz e Terra, 1994.

Beach, D.; Pedersen, R. B. *Process Tracing Methods: foundations and guidelines*. The University of Michigan Press, 2013.

Bennett, A.; Elman, C. Case Study Methods in the International Relations Subfield. *Comparative Political Studies*, vol. 40, no. 2, 2007.

Bennett, A. Process-tracing: a Bayesian perspective. In: Box-Steffensmeier, J. M.; Brady, H. E.; Collier, D. (Eds.). *The Oxford Handbook of Political Methodology*. New York: Oxford University Press, 2008, pp. 702–721.

Bennett, A.; Checkel, J. T. Process Tracing: from philosophical roots to best practices. In: Bennett, A.; Checkel, J. T. (Eds.). *Process Tracing: from metaphor to analytic tool*. Cambridge: Cambridge University Press, 2015, pp. 3–38.

Beurden, B. V.; Wei, L. Advances in Oil and Gas Exploration and Production: China's Energy Revolution in the Context of the Global Energy Transition. (Swennen, R.; Leuven, K. U. - SHELL and DRC Editors). The Hague, The Netherlands, 2020. pp. 734.

Bieler, A., & Morton, A. D. A Critical Theory Route to Hegemony, World Order and Historical Change: neo-Gramscian Perspectives in International Relations. In: *Capital and Class*, v. 28, n. 1, pp. 85-113, 2004.

Bieler, A. European Integration and Eastward Enlargement: A historical materialist understanding of neo-liberal restructuring in Europe. In: Bieler, A.; Bonefeld, W.; Burnham, P.; Morton, A. D. (Eds.). *Global Restructuring, State, Capital and Labour: Contesting Neo-Gramscian Perspectives*. New York: Palgrave MacMillan, 2006.

Boatcă, M. Modernity, Citizenship and Occidentalist Epistemology in Max Weber and Beyond. In: *Trafo – blog for Transregional Research*, June 22, 2017. Available at: https://trafo.hypotheses.org/7005. Accessed April 26, 2021.

Boschi, R. R. (Org.). *Variedades de Capitalismo, Política e Desenvolvimento na América Latina.* Belo Horizonte: Editora UFMG; Rio de Janeiro: IESP; IERJ. 2010. 376 p.

Brasil. Secretaria de Desenvolvimento e Competitividade Industrial (SDCI). Portaria 324 SDCI, de 29-8-2019: Fixados critérios para concessão de Ex-tarifários. Available at: https://contabeis.com.br/Normas/Portaria-324-SDCI/139390/. Accessed Feb. 2, 2024.

Brasil. Ministério da Economia. Portaria ME Nº 309, de 24 de Jun de 2019. (Publicado(a) no DOU de 26/06/2019, seção 1, página 24). Available at: https://www.gov.br/fazenda/pt-br/assuntos/legislacao/portarias/portaria-me-n-309-de-24-de-junho-de-2019. Accessed Feb. 2, 2024.

Brasil. Ministério da Fazenda (NORMAS). Portaria ME Nº 309, de 24 de junho de 2019. Publicado no DOU de 26/06/2019, seção 1, página 24. Available at: https://www.gov.br/fazenda/pt-br/assuntos/legislacao/portarias/portaria-me-n-309-de-24-de-junho-de-2019. Accessed Feb. 2, 2024.

Brasil. Presidência da República. Secretaria-Geral. Subchefia para Assuntos Jurídicos. Lei 14.300, DE 6 DE JANEIRO DE 2022. Institui o marco legal da microgeração e minigeração distribuída, o Sistema de Compensação de Energia Elétrica (SCEE) e o Programa de Energia Renovável Social (PERS); altera as Leis nºs 10.848, de 15 de março de 2004, e 9.427, de 26 de dezembro de 1996; e dá outras providências. Available from: <https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2022/lei/l14300.htm>. Accessed Oct. 22, 2024.

Bulkeley, H.; Castán Broto, V.; Hodson, M.; & Marvin, S. (2011). Cities and Low Carbon Transition. In: Bulkeley, H.; Castán Broto, V.; Hodson, M.; Marvin, S. (Eds.). *Cities and Low Carbon Transition*. London and New York: Routledge, Taylor and Francis Group.

Cano, W. A desindustrialização no Brasil. In: *Economia e Sociedade*, v. 21, Número Especial, pp. 831–851, December 2012.

Cariello, T. Investimentos Chineses no Brasil: histórico, tendências e desafios globais (2007 – 2020). 2021. Available at: https://cebc.org.br/wp-content/uploads/2021/12/INVESTIMENTOS_CHINA_BRASIL_2007-2020_.pdf. Accessed Feb. 1, 2024.

Carmona, R. O Retorno da Geopolítica: a ascensão dos BRICS. In: *Austral - Revista Brasileira de Estratégia e Relações Internacionais*. Porto Alegre, v.3, nº 6, Jul./Dez. pp. 37 – 72. 2014. Disponível em: < http://brasilnomundo.org.br/wpcontent/uploads/2016/07/51286-220135-1-PB.pdf>. Acesso em: 17 ago. 2016.

Carvalho, E. M. Renascimento da Rota da Seda e sua extensão até a América Latina. In: Carvalho, E. M.; Veras, D.; Steenhagen, P. (Eds.). *A China e a Iniciativa Cinturão e Rota: percepções do Brasil*. Rio de Janeiro: FGV Direito Rio, 2023. pp. 17–56.

Carvalho, E. M.; Veras, D.; Steenhagen, P. (Eds.). *A China e a Iniciativa Cinturão e Rota: percepções do Brasil*. Rio de Janeiro: FGV Direito Rio, 2023. pp. 8–13.

Castro, A. C. et al. Políticas de Inovação e Capacidades Estatais Comparadas: Brasil, China e Argentina. In: Gomide, A. de Ávila; Raul, R. (Eds.). *Capacidades Estatais em Países Emergentes: o Brasil em perspectiva comparada*. Rio de Janeiro: IPEA, 2016. pp. 137–170.

Cawthorne, N. *As Maiores Batalhas da História: estratégias e táticas de guerra que definiram a história de países e povos*. São Paulo: MBokks do Brasil Editora Ltda, 2010. Title in English: *History's Greatest Battles: Masterstrokes of War*. Translation by Glauco Peres Dama.

CEBC/APEX. Oportunidades de Comércio e Investimento na China para setores selecionados. 2015. Available at: https://www.cebc.org.br/sites/default/files/pesquisa_cebc_-_apex_versao_final-oficial.pdf. Accessed May 22, 2021.

Congressional Research Service. *U.S.-China Strategic Competition in South and East China Seas: Background and Issues for Congress*. Washington, D.C.: CRS Report, August 6, 2020.

Costa, L. M.; Vasconcelos, D. O. A Estratégia de Investimentos Chineses em Energia Renovável no Brasil: um estudo de caso da Amazônia e do Cerrado. In: Carvalho, E. M.; Veras, D.; Steenhagen, P. (Eds.). *A China e a Iniciativa Cinturão e Rota: percepções do Brasil*. Rio de Janeiro: FGV Direito Rio, 2023. pp. 403–441.

Cox, R. W. (1981). Social Forces, States and World Orders: beyond international relations theory. In: *Millennium Journal of International Studies*, vol. 10, no. 2, pp. 126–155. Available at: http://mil.sagepub.com/content/10/2/126. Accessed August 7, 2015.

Cox, R. W. *Production, Power and World Order: social forces in the making of history*. New York: Columbia University Press, 1987. 463 p.

Cox, R. W., & Schechter, M. G. (2002). *The Political Economy of a Plural World: critical reflections on power, morals, and civilization*. London: Routledge.

CPPCC - The National Committee of the Chinese People's Political Consultative Conference. History. Updated February 11, 2020. Available at: http://www.cppcc.gov.cn/english/2020-02/11/c_1210328893.htm. Accessed Feb. 1, 2024.

Cruz, E.; Guimarães, J. Neoliberalismo e dialética negativa. In: *A Terra é Redonda*, June 2020. Available at: https://aterraeredonda.com.br/neoliberalismo-e-dialetica-negativa/. Accessed April 26, 2021.

Cunha, E. S. M.; Araújo, C. E. L. *Process Tracing nas Ciências Sociais: fundamentos e aplicabilidade*. Brasília: Enap, 2018.

Delgado, I. G. et al. Dilemas de Coordenação e Capacidades do Estado para a Política Industrial: trajetórias e horizontes da China, da Índia e do Brasil. In: Alexandre de Ávila Gomide (Ed.); Renato Raul (Ed.) Capacidades Estatais em Emergentes Países: o Brasil em perspectiva comparada. Rio de Janeiro: IPEA, 2016. 536. Pp. 171-218.

Deng, J. K. Hualong-1: the pride of China's Nuclear Technology. In: Linkedin. Sept. 2015. Available from https://www.linkedin.com/pulse/hualong-1-pride-chinas-nuclear-technology-jeremy-kang-deng. Accessed Sept. 15, 2017.

Dequech, David. Cognitive and Cultural Embeddedness: combining institutional Economics and Economic Sociology. In: Journal of Economic Issues. June 2003.

De Vaus, David. Research Design in Social Research. Thousand Oaks, CA: Sage, 2001.

Diniz, E. Governabilidade, governance e reforma do Estado: considerações sobre o novo paradigma. Revista do Serviço Público, ano 47, vol. 120, nº 2, 1996.

ELETROBRAS/ELETRONUCLEAR. Panorama da Energia Nuclear no Mundo. Edição de Novembro 2011. http://www.eletronuclear.gov.br/LinkClick.aspx?fileticket=GxTb5TAen5E%3D&tabid. Accessed Dec. 27, 2017.

Evans, P. Autonomia e parceria: Estados e transformação industrial. Rio de Janeiro, Editora UERJ, 2004, cap. 1, pp. 1-13.

Falleti, T. G. The Comparative Sequential Method. In: Advances in Comparative-Historical Analysis. James Mahoney; Kathleen Thelen (Ed.). Cambridge University Press, pp. 211-239, 2015.

Fiani, R. Problematizações acerca do conceito de um "novo" Estado desenvolvimentista. Brasília: Ipea, 2012. (Texto para Discussão, n. 1.749). Available at: <Capa TD 1749 - Problematizações acerca do Conceito (ipea.gov.br)>. Accessed Jan 28, 2024.

Figueiredo Filho, D. B. Métodos Quantitativos em Ciência Política. Curitiba: Intersaberes, 2019.

Flyvbjerg, Bent. Five Misunderstandings About Case-Study Research. Qualitative Inquiry, vol. 12, nº 2, pp. 219-245, 2006.

Fravel, M. Taylor. "China's Strategy in the South China Sea." Contemporary Southeast Asia, vol. 33, no. 3, 2011, pp. 292-319.

Gabaldón, A. J. La descentralización de la gestión ambiental em América Latina. In: Revista del CLAD Reforma y Democracia, nº 45, 2009.

Geels, F. (2011). The role of cities in technological transitions: analytical clarifications and historical examples. In: Cities and Low Carbon Transition. Harriet Bulkeley, Vanesa Castán Broto, Mike Hodson, Simon Marvin (Eds.). London and New York: Routledge, pp. 13–29.

Geertz, Clifford. A Interpretação das Culturas. Rio de Janeiro: LTC, 2008. 1. ed. 13. reimpr. 323 p.

George, Alexander; Bennett, Andrew. Case studies and theory development in the social sciences. The MIT Press: 2005.

Gerring, John. What is a Case Study and What Is It Good for? American Political Science Review. Vol. 98, nº 2, May 2004.

Gerschenkron, A. Economic Backwardness in Historical Perspective: a book of essays. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1962. Pp. 5-51; 353-364.

Gill, Stephen; Law, David. Global Hegemony and the Structural Power of Capital. Gramsci, Historical Materialism and International Relations. Edited by Peter Gill. New York: Cambridge University Press, pp. 93-124, 1993.

Gill, Stephen. Constitutionalising Capital: EMU and Disciplinary Neo-Liberalism. In: Social Forces in the Making of the New Europe: the restructuring of European social relations in the global political economy. Edited by: Andreas Bieler and Adam David Morton. New York: Palgrave MacMillan, pp. 47-69, 2001.

Gilli, M.; Li, Y.; Qian, Jiwei. Logrolling under Fragmented Authoritarianism: theory and evidence from China. University of Milan Bicocca Department of Economics, Management and Statistics Working Paper No. 333, 2016. Available from: https://china.ucsd.edu/_files/pe-2014/10062014_Paper_Li.pdf. Accessed Oct. 18, 2024.

Gilpin, R. A Economia Política das Relações Internacionais. Tradução de Sérgio Bath. Brasília: Editora Universidade de Brasília, 2002. 492 p. – (Coleção Relações Internacionais). Título original: The Political Economy of International Relations.

Goldstein, A. China's Grand Strategy under Xi Jinping: Reassurance, Reform, and Resistance. In: International Security, vol. 45, no. 1, 2020, pp. 164-201.

Gomide, A. A. et al. Capacidades Estatais Públicas em Países Emergentes: (des)vantagens comparativas do Brasil. In: Alexandre de Ávila Gomide (Ed.); Renato Raul (Ed.) Capacidades Estatais em Emergentes Países: o Brasil em perspectiva comparada. Rio de Janeiro: IPEA, 2016. 536. Pp. 15-50.

Gonçalves, W.; Brito, L. B. Relações Brasil-China: Uma Parceria Estratégica? In: SÉCULO XXI, Porto Alegre, v. 1, nº 1, Jan - Dez 2010.

Granovetter, Mark. Economic Action and Social Structure: the problem of embeddedness. In: American Journal of Sociology, Volume 91, Issue 3 (Nov. 1985), pp. 481–510.

Greenner. Estudo Estratégico: mercado fotovoltaico de geração centralizada 2017. In: Greenner, 2018. Disponível em: https://www.greener.com.br/relatorios/estudo-estrategico-mercado-fotovoltaico-de-geracao-centralizada-2017/. Acesso em: 24 mai. 2023.

Greenyellow. Matriz elétrica x Matriz energética: conheça as diferenças. Disponível em: <Matriz elétrica x matriz energética: conheça as diferenças! - GreenYellow>. Acesso em: 28 Jan. 2024.

Guy Peters, B. The Capacity to Govern: moving back to the center? VIII Congreso Internacional del CLAD sobre la Reforma del Estado e da Administração Pública, Panamá, 28-31 Oct. 2003.

Hadfield, A. Energy and foreign policy: EU-Russia energy dynamics. In: Smith, Steve; Hadfield, Amelia; Dunne, Tim, eds. Foreign Policy: Theories, Actors, Cases. London: Oxford University Press, 2008.

Hall, P. A.; Taylor, R. C. R. As Três Versões do Neo-Institucionalismo. In: Lua Nova, Nº 58 (2003).

Heiferman, R. A Segunda Guerra Mundial. In: Guerras do Século XX. Título original: Wars of 20th Century. London: Octopus Book, 1975. Rio de Janeiro: Editora Primor Ltda., 1975. pp. 241–451.

Hensengerth, O.; Lu, Y. Emerging environmental Multi-level Governance in China? Environmental protests, public participation, and local institution-building. Public Policy Adm., 2 (2019), pp. 121–143.

Hochstetler, K. Political Economies of Energy Transition. In: Political Economies of Energy Transition: Wind and Solar Power in Brazil and South Africa. Cambridge University Press, 2021. 295 p.

Holman, Otto. Internationalization and Democratisation: Southern Europe, Latin America and the world economic crisis. In: Gramsci, Historical Materialism and International Relations. Edited by Peter Gill. New York: Cambridge University Press, 1993, pp. 213–236.

IEA (International Energy Agency). World Energy Outlook 2017, OECD/IEA, Paris, 2017a.

Instituto E+. Os 5 Ds da transição energética no Brasil. PÓSPUCPRDIGITAL. Available from: <Os 5 Ds da transição energética no Brasil>. Accessed Oct. 22, 2024.

Jabbour, E.; Rodrigues, B. S. A Iniciativa Cinturão e Rota e as implicações geoeconômicas para o Brasil sob a perspectiva da nova economia do projetamento e da geoeconomia híbrida. In: Carvalho, E. M.; Veras, Daniel; Steenhagen, Pedro (Orgs.). A China e a Iniciativa Cinturão e Rota: percepções do Brasil. Rio de Janeiro: FGV Direito Rio, 2023. 1. Recurso online (640 p.): PDF, pp. 93–141.

Jaffe, A. M. Energy's Digital Future: Harnessing Innovation for American Resilience and National Security. New York: Columbia University Press, 2021. 249 pp.

Jaguaribe, A. Capacidades Estatais Comparadas: a China e a reforma do sistema nacional de inovação. In: Gomide, Alexandre de Ávila; Raul, Renato (Eds.). Capacidades Estatais em Emergentes Países: o Brasil em perspectiva comparada. Rio de Janeiro: IPEA, 2016. Pp. 361–386.

Jordaan, E. The concept of a middle power in international relations: distinguishing between emerging and traditional middle powers. In: Politikon, Nov. 2003, 30(2), 165–181.

Joyner, Daniel H. Interpreting the Nuclear Non-Proliferation Treaty. Oxford: Oxford University Press, 2011.

Kennedy, S. The Business of Lobbying in China. Harvard University Press, 2005.

Keohane, Robert O. International Institutions and State Power: essays in international relations theory. Boulder: Westview Press, 1989.

King, Gary; Keohane, Robert; Verba, Sidney. Designing Social Inquiry: Scientific Inference. In: Qualitative Research. Princeton University Press, 1994.

Krasner, S. D. Structural Causes and Regime Consequences: Regimes as Intervening Variables. In: International Organization, Vol. 36, No. 2, International Regimes (Spring 1982a), pp. 185–205.

Krasner, S. D. Regimes and the Limits of Realism: Regimes as Autonomous Variables. In: International Organization, Vol. 36, No. 2, International Regimes (Spring 1982b), pp. 497–510.

Lampis, A.; Bermann, Célio. Public Policy and Governance Narratives of Distributed Energy Resources in Brazil. In: Ambiente e Sociedade, São Paulo, Vol. 25, 2022. Available from: https://scielo.br/j/asoc/a/9gJr5tRkqLw6zvgxttdT5hL/?format=pdf&lang=en. Accessed on: Jan. 28, 2024.

Le Billon, P. The Geopolitical Economy of 'Resource Wars'. Frank Cass & Company Ltd., 2004. Available from: https://is.cuni.cz/studium/predmety/index.php?do=download&did=42331&kod=JMMZ175. Accessed on: Apr. 7, 2015.

Lee, I. Can North Korea Follow China's Path? A Comparative Study of the Nexus Between National Security and Economic Reforms. In: Pacific Focus, Vol. 34, No. 1, 2019, pp. 102–126.

Leysens, Anthony. The Critical Theory of Robert W. Cox: fugitive or guru? New York: Palgrave Macmillan, 2008. 170 pp. Available from: http://spmehazem.yolasite.com/resources/the%20critical%20theory%20of%20robert%20cox.pdf. Accessed on: Aug. 7, 2015.

Liu, C.; Hale, T.; Urpelainen, J. Explaining the energy mix in China's electricity projects under the Belt and Road Initiative. In: Environmental Politics, 2022, 32(7), 1117–1139. Available from: https://doi.org/10.1080/09644016.2022.2087355. Accessed Oct. 19, 2024.

Löffler, E. A gestão da responsabilização nas parcerias intergovernamentais. In: Revista do Serviço Público. Ano 51, Nº 2, Abr-Jun 2000.

Lowi, Theodore J. American Business, Public Policy, Case-Studies, and Political Theory. In: Bauer, Raymond A.; Pool, Ithiel de Sola; Dexter, Lewis A. American Business and Public Policy: the politics of foreign trade. New York: Atherton Press, 1964, pp. 679–715.

Machado, J. A.; Andrade, M. L. C. Cooperação intergovernamental, consórcios públicos e sistemas de distribuição de custos e benefícios. In: Revista da Administração Pública, Rio de Janeiro, 48(3), pp. 695–720, May/Jun. 2014.

Mahoney, J.; Thelen, K. Comparative-Historical Analysis in Contemporary Political Science. In: Mahoney, James; Thelen, Katlheen (Eds.). Advances in Comparative-Historical Analysis. Cambridge University Press, 2015. Pp. 3–33.

Maia, C. C. Uma visão a partir do Parlamento: a inclusão do Brasil na Iniciativa Cinturão e Rota como curva ontológica e atalho estratégico. In: Carvalho, E. M.; Veras, Daniel; Steenhagen, Pedro (Orgs.). A China e a Iniciativa Cinturão e Rota: percepções do Brasil. Rio de Janeiro: FGV Direito Rio, 2023. 1. Recurso online (640p.): PDF. Pp. 57–91.

Mainwaring, S.; Pérez-Liñan, A. Democracies and Dictatorships in Latin America: Emergence, Survival and Fall. Cambridge: Cambridge University Press, 2013.

Malesky, E. J. Enhancing Research on Authoritarian Regimes through Detailed Comparisons of China and Vietnam. In: Problems of Post Communism, 2021, 68(3), 163–170. DOI: 10.1080/10758216.2020.1865822. Available from: file:///C:/Users/Luiz/Downloads/Enhancing%20Research%20on%20Authoritarian%20Regimes%20through%20Detailed%20Comparisons%20of%20China%20and%20Vietnam.pdf. Accessed Oct. 18, 2024.

Maluf, A. O Investimento das Indústrias Chinesas no Brasil: o caso do setor fotovoltaico. In: Carvalho, E. M.; Veras, Daniel; Steenhagen, Pedro (Orgs.). A China e a Iniciativa Cinturão e Rota: percepções do Brasil. Rio de Janeiro: FGV Direito Rio, 2023. 1. Recurso online (640p.): PDF. Pp. 371–402.

March, J. G.; Olsen, J. P. The New Institutionalism: Organizational Factors in Political Life. In: The American Political Science Review, Vol. 78, No. 3 (Sep., 1984), pp. 734–749.

Meckling, Jonas, & Nahm, Jonas. The Power of Process: State Capacity and Climate Policy. In: Governance, 2018, 31, pp. 741–757.

Mendes, M. Como o gasto público desequilibra a economia brasileira? In: CLP Papers, No. 4. Centro de Liderança Pública, 2010.

Mendes, Vinícius, & Viola, Eduardo. Interest Groups in Brazilian Climate Policy: an Analysis of the Agricultural and Energy Sectors. *Brazilian Political Science Review*, rev. 17 (3) • 2023. Available from: https://www.scielo.br/j/bpsr/a/b9R4MbVPmQGBGswkkBJd4LJ/?format=html&lang=en#. Accessed Oct. 22, 2024.

Miller, G. J. The Political Evolution of Principal-Agent Models. In: Review of Political Science, 2005, 8, pp. 203–225.

MINISTÉRIO DAS MINAS E ENERGIA – Secretaria de Planejamento e Desenvolvimento Energético. Resenha Energética Brasileira: Ano Base 2020. Edição de 9 de julho de 2021.

MINISTÉRIO DAS MINAS E ENERGIA – EMPRESA DE PESQUISA ENERGÉTICA. Matriz energética e Elétrica. Available from: https://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/Matriz-Energetica-e-Eletrica. Accessed Jan 28, 2024.

MERCOSUL. Acordo sobre Comércio Eletrônico do Mercosul. MERCOSUL/CMC/DEC. Nº 15/20, 2021. Available from: https://www.mercosur.int/documento/acordo-sobre-o-comercio-eletronico-do-mercosul. Accessed Feb. 2, 2024.

Nahas, M. I. P. Indicadores de Qualidade de Vida Urbana: aspectos teórico-metodológicos. In: Nahas, Maria Inês Pedrosa (Org.). Qualidade de Vida Urbana: abordagens, indicadores e experiências internacionais. Belo Horizonte: C/Arte, 2015, pp. 23–29.

Nahas, M. I. P., & Esteves, O. A. Metodologia do Índice de Qualidade de Vida Urbana e suas aplicações. In: Nahas, Maria Inês Pedrosa (Org.). Qualidade de Vida Urbana: abordagens, indicadores e experiências internacionais. Belo Horizonte: C/Arte, 2015, pp. 101–118.

Neves, M. A. Cemig se reúne com representantes da geração distribuída. *Diário do Comércio*, 19 de outubro de 2023. Available from: https://diariodocomercio.com.br/economia/cemig-se-reune-com-representantes-da-geracao-distribuida/. Accessed Oct. 22, 2024.

Niu, H. Emerging Global Partnership: Brazil and China. In: Revista Brasileira de Política Internacional, Brasília, 53(spe), Dec. 2010. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-73292010000300011&lng=en&nrm=iso. Accessed Apr. 23, 2014.

Oliveira, H. A. Brasil-China: trinta anos de uma parceria estratégica. In: Revista Brasileira de Política Internacional, 47(1), pp. 7–30, 2004.

Oliveira, T. de A. (2010). *A nova política externa brasileira: pluralismo e continuidade*. PUFBA. [Title translated: The New Brazilian Foreign Policy: Pluralism and Continuity].

Pachirat, T. We Call It a Grain of Sand: The Interpretive Orientation and a Human Social Science. In: Yanow, D., & Schwartz-Shea, P. (Eds.). Interpretation and Method: Empirical Research Methods and the Interpretive Turn. Armonk, NY; London: M. E. Sharpe Inc., pp. 373–379.

Pader, E. Seeing with an Ethnographic Sensibility: Explorations Beneath the Surface of Public Policies. In: Yanow, D., & Schwartz-Shea, P. (Eds.). Interpretation and Method: Empirical Research Methods and the Interpretive Turn. Armonk, NY; London: M. E. Sharpe Inc., pp. 161–175.

Peneluppi Jr., J. R. Da China para o mundo: eficiência energética, comercial e ambiental pelas novas Rotas da Seda. In: Carvalho, E. M., Veras, Daniel, & Steenhagen, Pedro (Org.). A China e a Iniciativa Cinturão e Rota: percepções do Brasil. Rio de Janeiro: FGV Direito Rio, 2023. Recurso online (640p.): PDF, pp. 335–370.

Pereira, João Márcio Mendes. O Banco Mundial como ator político, intelectual e financeiro (1944–2008). Tese (Pós-graduação). Niterói: Universidade Federal Fluminense, 2009. 386 p.

Pereira, L. B. V., & Ribeiro, L. S. Iniciativa Cinturão e Rota: em que ponto os interesses brasileiros podem encontrar os interesses chineses? In: Carvalho, E. M., Veras, Daniel, &

Steenhagen, Pedro (Org.). A China e a Iniciativa Cinturão e Rota: percepções do Brasil. Rio de Janeiro: FGV Direito Rio, 2023. Recurso online (640p.): PDF, pp. 143–182.

Pires, R. R. C., & Gomide, A. A. Burocracia, Democracia e Políticas Públicas: arranjos institucionais de políticas de desenvolvimento. In: Texto para Discussão, No. 1940. Instituto de Pesquisa Econômica Aplicada – IPEA, Brasília: Rio de Janeiro, 2014.

Polanyi, K. El Sistema Económico como Proceso Institucionalizado: el enfoque substantivista. In: Godelier, M. (Ed.). Antropología y Economía. Barcelona: Anagrama, 1976.

Polanyi, K. Our Obsolete Mercantile Mentality. RTHI-Revista Trimestral de Histórias e Ideias {S.I.}, 1978, 1, pp. 7–20.

Polanyi, K. A Grande Transformação: as origens de nossa época. Rio de Janeiro: Campus, 2ª Edição, 2000.

Poulantzas, N. Classes in Contemporary Capitalism. Translated from the French by David Fernbach. First published as *Les Classes Sociales dans Le Capitalisme Aujourd'hui* by Édition du Seuil, 1974. This edition first published 1975. London: NLB, 1975. Available from: http://busin.biz/library/misc/Classes-in-Contemporary-Capitalism.pdf. Accessed Feb. 2, 2017.

Ragin, C. C. The Comparative Method: moving beyond qualitative and quantitative strategies. Berkeley and Los Angeles: University of California Press, 1987.

Robinson, William I., & Harris, Jerry. Towards a Global Ruling Class? Globalization and the Transnational Capital Class. In: Science & Society, vol. 64, no. 1, spring 2000, pp. 11–54. Available from: http://www.net4dem.org/mayglobal/Papers/RobinsonHarris7_16.pdf. Accessed Aug. 7, 2015.

Robinson, William I. Capitalist Globalization and the Transnationalization of the State. In: Little, Richard, & Smith, Michael (Eds.). Perspectives in World Politics, 3rd Edition. London/New York: Routledge. Reprint of chapter in Rupert & Smith (Eds.), Historical Materialism and Globalisation, 2002. Available from: http://courses.arch.vt.edu/courses/wdunaway/gia5524/robinson.pdf. Accessed Aug. 5, 2015.

Rodriguez, J. C. C. Chacal ou Cordeiro? O Brasil frente aos desafios e oportunidades do sistema internacional. Revista Brasileira de Política Internacional, 55(2), 70–89, 2012.

Rongping, Mu. Development of Science and Technology Policy in China. Tokyo: Nistep, 2004. Available from: http://www.nistep.go.jp/IC/ic040913/pdf/30_04ftx.pdf. Accessed April 4, 2021; August 8, 2024.

Rueschemeyer, D., & Evans, P. B. The state and economic transformation: toward an analysis of the conditions underlying effective intervention. In: Evans, P. B., & Skocpol, T. (Eds.). *Bringing the State Back In.* Cambridge: Cambridge University Press, 1985.

Santana, C. H. V. et al. Políticas de Infraestrutura Energética e Capacidades Estatais nos BRICS. In: Gomide, A. A., & Pires, R. R. C. (Eds.), *Capacidades Estatais em Países Emergentes: o Brasil em Perspectiva Comparada.* Rio de Janeiro: IPEA, 2016, pp. 219–258.

Santoro, M., & Junqueira, P. A. Uma Rota, Muitos Caminhos: os investimentos chineses em energia elétrica no Brasil e no Paquistão. In: Carvalho, E. M., Veras, Daniel, & Steenhagen, Pedro (Orgs.). *A China e a Iniciativa Cinturão e Rota: Percepções do Brasil.* Rio de Janeiro: FGV Direito Rio, 2023. Recurso online (640p.): PDF, pp. 443–473.

Sartori, G. Guidelines for Concept Analysis. In: *Social Science Concepts: A Systematic Analysis.* Beverly Hills, CA: Sage, 1984, pp. 97–150.

Scissors, D. China's Overseas Investment Starts the Long Climb Back. In: *American Enterprise Institute*. Available from: https://www.aei.org/china-global-investment-tracker/. Accessed Jan 28, 2024.

Sebrae. Cadeia de Valor da Energia Solar Fotovoltaica no Brasil: Projeto Plataforma. Brasília: Sebrae, 2018. 324 p. Available from: https://www.sebrae.com.br/sites/PortalSebrae/. Accessed Feb. 2, 2024.

Senado Federal. Constituição da República Federativa do Brasil: Edição administrativa do texto constitucional promulgado em 5 de outubro de 1988, compilado até a Emenda Constitucional nº 128/2022. Available from: https://www.senado.leg.br/atividade/const/constituicao_emendas.asp. Accessed Feb. 2, 2024.

Shapiro, S. P. Agency Theory. *Annual Review in Political Science*, 31, 263–284, 2005.

Shehata, Samer. Ethnography, Identity, and the Production of Knowledge. In: Yanow, D., & Schwartz-Shea, P. (Eds.). *Interpretation and Method: Empirical Research Methods and the Interpretive Turn.* Armonk, NY: M. E. Sharp Inc., 2006, pp. 244–263.

Sheng, C., Cao, Y., & Xue, B. Residential Energy Sustainability in China and Germany: The Impact of National Energy Policy System. *Sustainability*, 10(12), 4535, 2018. Available from: https://www.mdpi.com/journal/sustainability. Accessed Jan. 28, 2024.

Sheng, C. Not just the state: the role of entrepreneurs in China's energy transition. *Energy Research and Social Science*, 70, December 2020, 101814. Available from: https://doi.org/10.1016/j.erss.2020.101814. Accessed Jan. 2024.

Sheng, C., & Liu, J. A systematic analysis of stakeholder interaction and the barriers towards upscaling urban residential solar PV: the case of Shanghai, China. *Energy Strategy Reviews*, 50 (2023) 101259. Available from: <www.elsevier.com/locate/esr>. Accessed Jan. 2024.

Sheng, C., Liu, Y., & Liu, J. Multi-level governance and competing sustainability aims: Politics of renewable energy development and nature conservation in Changdao, China. *Energy Research & Social Science*, 97 (2023) 103001. Available from: <www.elsevier.com/locate/erss>. Accessed Jan. 2024.

Skocpol, T. *Bringing the State Back In.* Cambridge: Cambridge University Press, 1985.

Souza, C. Capacidade estatal: notas sobre definição, dimensões e componentes. Brasília: Ipea, 2012. Unpublished work.

Souza, C. Capacidade Burocrática no Brasil e na Argentina: quando a política faz a diferença. In: Gomide, A. A., & Pires, R. R. C. (Eds.). *Capacidades Estatais em Países Emergentes: o Brasil em Perspectiva Comparada.* Rio de Janeiro: IPEA, 2016, pp. 51–103.

Spínola, V. *Let's Trade in English.* 3rd ed., São Paulo: Lex Editora, 2012.

Strüver, G. China's Partnership Diplomacy: International Alignment Based on Interests or Ideology. *The Chinese Journal of International Politics*, 10(1), 31–65, 2017.

Tasca, M. S. A. PIS e COFINS: conheça esses tributos e entenda o funcionamento. Available from: https://www.politize.com.br. Accessed Feb. 2, 2024.

Teng, F., & Wang, P. The evolution of climate governance in China: drivers, features, and effectiveness. *Environmental Politics*, 30(sup1), 141–161, 2021. Available from: https://doi.org/10.1080/09644016.2021.1985221. Accessed Oct. 18, 2024.

Teschke, B. Marxismo. In: Reus-Smit, C., & Snidal, D. (Eds.). *The Oxford Handbook of International Relations.* Oxford: Oxford University Press, 2008.

Thomas, C. Max Weber, Talcott Parsons and the Sociology of Legal Reform: a reassessment with implications for law and development. *Minnesota Journal of International Law*, 15, 386-424, 2006.

Tilly, C. *Coercion, Capital and European States, AD 990–1990.* Cambridge, Massachusetts: Basil Blackwell Publishers, 1990.

Tjia, L. Y. Fragmented but enduring authoritarianism: supply-side reform and subnational entrepreneurialism in China's rail delivery service. *The China Quarterly*, 256, 905–918, 2023. Available from: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/B3172FCD3AFB63780A3ECFBADACC3432/S0305741023000516a.pdf. Accessed Oct 18, 2024.

Tsampasis, E., Bargiotas, D., Elias, C., & Sarakis, L. Communication challenges in Smart Grid. *MATEC Web of Conferences*, 41, 01004, 2016. Available from: https://www.researchgate.net/publication/299560519_Communication_challenges_in_Smart_Grid. Accessed Feb. 3, 2024.

UOL. Dias sem luz e blecaute em vários estados: a história dos apagões no Brasil. Cotidiano, 16/10/2024, 05h30. Available at: <Dias na escuridão: relembre apagões que já afetaram o Brasil>. Accessed Oct. 22, 2024.

Van Apeldoorn, B. The Struggle over European Order: transnational class agency in the making of 'embedded neo-liberalism.' In: Bieler, A., & Morton, A. D. (Eds.). *Social Forces in the*

Making of the New Europe: The Restructuring of European Social Relations in the Global Political Economy. New York: Palgrave MacMillan, 2001, pp. 70–89.

VIVID ECONOMICS. Overview: High-Quality Energy for High-Quality Growth: China's Energy Revolution in the New Era. Available from: https://www.researchgate.net/figure/There-have-been-four-global-transitions-in-energy-supply-since-1800-Source-Vivid_fig2_341744254. Accessed Feb. 3, 2024.

Vreeland, J. R. *The International Monetary Fund: Politics of Conditional Lending.* London and New York: Routledge, 2005.

Wallerstein, I. *The Modern World-System: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century.* New York: Academic Press, 1976. Available from: http://media.pfeiffer.edu/lridener/courses/WORLDSYS.HTML. Accessed Aug. 6, 2015.

Wang, X., Nie, S., & Wang, Y. Special Report 1: A Study of China's Energy Supply Revolution. In: Swennen, R., Leuven, K. U., & SHELL DRC (Eds.). *China's Energy Revolution in the Context of the Global Energy Transition.* The Hague: Advances in Oil and Gas Exploration and Production, 2020, pp. 41–212.

Weber, M. *The Methodology of the Social Sciences.* Translated and edited by Shils, E. A., & Finch, H. A. Illinois: The Free Press of Glencoe, 1st ed., 1949. Available from: http://archive.org/stream/maxweberonmethod00webe/maxweberonmethod00webe_djvu.txt. Accessed Aug. 3, 2015.

Weber, M. *Ensaios de Sociologia.* 5th ed. Rio de Janeiro: LTC Editora, 1979. Translation: Waltensir Dutra. Available from: http://www.ldaceliaoliveira.seed.pr.gov.br/redeescola/escolas/18/1380/184/arquivos/File/materiais/2014/sociologia/Ensaios_de_Sociologia_-_Max_Weber.pdf. Accessed Aug. 6, 2017.

Weber, M. A política como vocação. In: Gerth, H. H. (Ed.). *Ensaios de Sociologia.* Rio de Janeiro: Ed. Guanabara, 1982, pp. 97–153.
Weber, M. Burocracia. In: Gerth, H. H. (Ed.). *Ensaios de Sociologia.* Rio de Janeiro: Ed. Guanabara, 1982, pp. 229–282.

Weber, M. *Economia e Sociedade: fundamentos da sociologia compreensiva.* Brasília: Editora Universidade de Brasília; São Paulo: Imprensa Oficial do Estado de São Paulo, 1999, Vol. 1, 464 p. Translation: Regis Barbosa & Karen Elsabe Barbosa. Technical review: Gabriel Cohn.

Wedeen, L. *Ambiguities of Domination: politics, rhetoric and symbols in contemporary Syria.* Chicago/London: The University of Chicago Press, 1999. 256 pp.

World Nuclear Association. Nuclear Power in China. England/Wales, September 2017. Available from: http://www.world-nuclear.org/information-library/country-profiles/countries-a-f/china-nuclear-power.aspx. Accessed Sept. 20, 2017.

Xinbo, W. Cooperation, Competition and Shaping the Outlook: The United States and China's Neighbourhood Diplomacy. *International Affairs*, 92(4), 849-867, 2016.

Xu, C. The fundamental institutions of China's reform and development. *Journal of Economic Literature*, 49, 41076-1151, 2011. Available from: https://down.aefweb.net/WorkingPapers/w621.pdf. Accessed Oct 18, 2024.

Yanow, D. How built spaces mean: A semiotic of space. In: Yanow, D., & Schwartz-Shea, P. (Eds.). *Interpretation and Method: Empirical Research Methods and the Interpretive Turn.* Armonk, New York; London, England: M. E. Sharp Inc., pp. 349–367, 2006.

Yanow, D., & Schwartz-Shea, P. Doing Social Science in a Humanistic Manner. In: Yanow, D., & Schwartz-Shea, P. (Eds.). *Interpretation and Method: Empirical Research Methods and the Interpretive Turn.* Armonk, New York; London, England: M. E. Sharp Inc., pp. 380–395, 2006.

Ying, F., & Shicun, W. South China Sea: How We Got to This Stage. *The National Interest*, May 9, 2016. Available from: https://nationalinterest.org/feature/south-china-sea-how-we-got-stage-16118. Accessed Oct 18, 2024.

Zhang, F. Chinese Thinking on the South China Sea and the Future of Regional Security. *Political Science Quarterly*, 132(2), 435-466, 2017.

Zhaoyuan, X., & Ishwaran, M. Overview: High-Quality Energy for High-Quality Growth: China's Energy Revolution in the New Era. In: Swennen, R., Leuven, K. U., & SHELL DRC (Eds.). *China's Energy Revolution in the Context of the Global Energy Transition.* The Hague, The Netherlands: Advances in Oil and Gas Exploration and Production, 2020, pp. v–iv, 1–39.

Zheng, Y., & Lye, L. F. China's Foreign Policy: The Unveiling of President Xi Jinping's Grand Strategy. *East Asian Policy*, 7(1), 62-82, 2015.