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Governing policy experiments in Chinese cities: Lessons on effective climate mitigation

Shiran Victoria Shen

Stanford University, Stanford, California, USA

Correspondence
Shiran Victoria Shen, Stanford University, 473 Via Ortega, Suite 324, Stanford, CA 94305, USA.
Email: svshen@stanford.edu

Abstract

Policy experiments are crucial for fostering innovation and mitigating risks and can serve as catalysts for transformative changes. This study investigates the governance of policy experiments in China, focusing on how political factors shape their outcomes. It emphasizes the need to consider concurrent trials—related policy trials implemented simultaneously in a locality that can influence outcomes—when selecting comparable cases for analysis. Such consideration is critical, especially when the policy issue spans multiple sectors and the level of difficulty differs across sectors. By comparing five cities engaged in the same three decarbonization pilots between 2010 and 2015, Hangzhou and Xiamen are identified to have had similar initial conditions and goals but achieved divergent outcomes. This research uncovers the critical role of political leadership in achieving varying levels of decarbonization progress and identifies policy coherence with broader local priorities to be the key explanation for continued leadership attention and efforts devoted to decarbonization despite turnover. The study contributes to the literature by addressing the under-studied impact of political factors and concurrent trials, offering a replicable procedure for future research and practical policy applications.

KEYWORDS

China, climate change, policy coherence, policy experiment, political leadership

INTRODUCTION

Policy experiments can serve as critical catalysts for transformative changes, shaping the way societies evolve (Ansell & Bartenberger, 2016).[1] The inherently experimental and typically small-scale nature of policy experiments fosters innovation, allowing for the mitigation of risks and the identification of potential flaws (Sabel & Zeitlin, 2012). This aspect is particularly crucial when policies that have proven successful are considered for national roll-out (Sanderson, 2002). Thus, experimentation serves as a crucial instrument for tackling complex policy challenges, particularly in situations characterized by significant uncertainty or ambiguity (Sanderson, 2009).[2]

Internationally, governments have long utilized policy experiments to assess the viability and impact of prospective policies. Notable examples include the deregulation of the airline industry and welfare reforms in the United States, the privatization of nationalized industries in Britain, and the implementation of temporary capital controls in Chile during the 1990s (Majumdar & Mukand, 2004). In China, policy experiments have been central to governance reforms, including efforts to promote low-carbon urban development.

This study delves into the governance of policy experiments in China, exploring how political factors shape their outcomes while explicitly accounting for the under-documented and often neglected role of concurrent trials in case selection. The study makes two primary contributions. First, it highlights the significance of political factors, such as leadership, authority, coordination, and capacity, in determining the success of policy experiments. Much of the existing literature lacks an explicit focus on these dimensions (Graham et al., 2013, 691; Huitema et al., 2018, 154).[3] By addressing this gap, this study enhances our understanding of how political dynamics affect the outcomes of policy experiments.

Second, this study introduces a systematic procedure for choosing comparable cases for analysis and drawing lessons, explicitly considering concurrent trials. Concurrent trials—defined as the simultaneous implementation of multiple related policy trials within a single locality, where each trial has the potential to influence policy outcomes—remain an under-documented phenomenon in Chinese policy experimentation.[4] Although this study does not conceptualize concurrent trials as a theoretical construct, it highlights their importance as a methodological variable to control for when analyzing how political factors shape policy experiment outcomes.

To clarify, concurrent trials are distinct from the different sectors targeted within a single trial. For instance, a locality may conduct two concurrent decarbonization pilots—one targeting power generation sector and another targeting heavy industry se. These constitute two separate trials, each with its own policy objectives and implementation processes, rather than a single trial applied across multiple sectors.

Sectors, by contrast, refer to the domains within which a single trial operates. For instance, decarbonizing heavy industry presents unique challenges, such as high-temperature processes and chemical reactions that are difficult to electrify, often requiring advanced and currently non-commercially viable technologies. In contrast, decarbonizing the power generation sector is more straightforward, with renewable sources more readily available for integration. Recognizing these sectoral differences is critical when analyzing concurrent trials, as the challenges and outcomes can vary significantly depending on the sectors involved.

Therefore, when selecting comparable cases, it is crucial to compare localities engaged in the same set of experiments—that is, trials targeting the same sectors. This approach helps control for variations in abatement challenges across different contexts. By focusing on localities participating in the same experiments, researchers can more reliably isolate the influence of political factors on policy outcomes, ensuring that observed differences are not confounded by sectoral disparities.

This study posits that comparative research on policy experiments should identify localities with similar initial conditions and goals that participated in the same experiments but demonstrated varied policy results. By addressing the common oversight of neglecting concurrent trials as a relevant and significant factor, this study seeks to correct current research practices and improve practical policy application. Overall, it emphasizes the need for meticulous comparative case analysis to avoid misleading conclusions.

To demonstrate this, the study applies the advocated procedure to derive lessons from climate mitigation experiments in China, where several cities conducted concurrent trials. Five cities participated in the same three decarbonization pilots. Among them, Hangzhou and Xiamen had comparable initial conditions, shared decarbonization goals, and were involved in the same three climate mitigation policy experiments between 2010 and 2015, yet they achieved varying levels of decarbonization progress. This analysis utilizes a comprehensive range of sources to unveil both quantitative measures and qualitative evidence for contextual factors. It finds political leadership to be a crucial explanation for divergent outcomes and also considers the impact of political authority, policy coordination, and governmental capacity. Furthermore, it highlights the importance of policy coherence with broader local priorities—a factor understudied in the context of policy experiments—as a crucial force for maintaining continued leadership attention and efforts devoted to decarbonization despite turnover.

The remainder of the paper is organized as follows. The "Political factors and influences on policy experiment outcomes" section explores theoretical perspectives on how political factors shape policy experiment outcomes. The "Methodology" section outlines a general procedure for choosing comparable cases and a specialized procedure to account for concurrent trials, which are both replicable beyond this study. The "Empirical context" section discusses the empirical context of policy experimentation in China, focusing on decarbonization initiatives. The "Empirical analysis" section uses the comparative analysis of Hangzhou and Xiamen to derive lessons on the role of political factors in effective climate mitigation. Finally, the "Discussion and conclusion" section concludes by examining the broader implications of the study's findings and outlining directions for future research across different contexts and policy domains.

POLITICAL FACTORS AND INFLUENCES ON POLICY EXPERIMENT OUTCOMES

The outcomes of policy experiments generally reflect two types of information: insights into the policy itself and an understanding of the surrounding political context (Ansell & Bartenberger, 2016; May, 1992). Information related to the policy includes evidence on the effectiveness of specific interventions within given localities, highlighting what Ansell and Bartenberger (2016) term "epistemic learning," which pertains to the scientific understanding of the world. For instance, in a climate policy experiment, policy information might pertain to the extent to which introducing a certain number of electric vehicles can help a city meet its energy intensity targets.

The governance of policy experiments is considerably influenced by political factors. I expand upon Peter May's (1992) conception of political factors, which he viewed primarily as elements that policy advocates could leverage to enhance the political feasibility of policy proposals. My broader conceptualization also includes factors crucial during the implementation phase, which is essential for analyzing authoritarian regimes, which often exhibit bigger implementation gaps than democratic systems (Shen, 2024). These encompass a range of elements, including political leadership, political authority, policy coordination, and governmental capacity.

Political leadership is central to the study of politics and policy, affecting both their focus and implementation.[5] Variability in leaders' priorities, driven by diverse incentives and ideological preferences, can lead to a fluctuating emphasis on specific policy initiatives (Besley, 2007). In democracies, partisanship and ideological preferences—comprising the beliefs, values, and principles that shape an incumbent's approach to politics and policymaking—have been documented to influence policy decisions (Cain, 2023; Hinich & Munger, 1994; Ringe, 2005). In both democracies and autocracies, leaders' desires for signature political achievements have fostered differences in prioritized projects across leaders (Shen, 2022). These preferences not only define the policy direction but also affect how policies are prioritized and implemented.

In the realm of policy experimentation, political leaders may engage in policy-based evidence-finding, a process where they, motivated by ideological beliefs or political ideas, decide on a policy and subsequently seek out supporting evidence to justify their decision (Cairney & Oliver, 2017). For instance, Sanderson (2002) finds that the New Labour government in the United Kingdom primarily utilized pilot programs to showcase their preferred approaches rather than conducting open and comprehensive tests of various ideas. Similarly, Brodkin and Kaufman (2000) find that the controlled analyses of three hallmark welfare experiments in the United States were heavily influenced by political ideas and that the findings were used selectively to reinforce and advance existing political agendas rather than challenge them. Additionally, findings from policy experiments that advocate for the initiators' ideas and stances have been used to outmaneuver factional rivals in China (Cai & Treisman, 2006). Therefore, political leadership can directly shape the governance of policy experiments, influencing the direction, extent, and effectiveness of their implementation.

Besides political leadership, another critical factor is political authority. Political authority differs from political leadership in that it embodies the formal power and legitimacy necessary to enforce decisions and mobilize resources efficiently. The effectiveness of resource mobilization for policy experiments significantly depends on the political authority wielded by the policy experiment's leading figure and their capacity to foster effective coordination across various government departments (Shen, 2025). Political authority is essential for marshaling people and resources to meet set goals (Kahler & Lake, 2004). It embodies the power necessary to galvanize collective action and allocate resources efficiently, which is essential for enabling and sustaining a policy experiment (Livermore, 2017). Therefore, political authority is a foundational element in the governance of policy experiments.

Furthermore, policy coordination, a critical factor, entails the harmonization of activities and policies across various governmental agencies to ensure alignment and synergy, preventing overlap or contradictions (Peters, 2018). Strategic coordination, or the coordination of programs around broad strategic government goals, is vital for the seamless execution of policy experiments, ensuring that all relevant government parts contribute effectively to the shared objectives. Effective policy coordination facilitates the integration of diverse policy areas, promotes consistency, and enhances the ability to address complex problems that cut across traditional sectoral boundaries. This is particularly important for policy experiments, which often require cross-sectoral collaboration to succeed. By fostering interdepartmental cooperation and creating unified approaches, policy coordination helps overcome the challenges of fragmented governance structures (Trein et al., 2021). Consequently, well-coordinated policy experiments are more likely to produce coherent and impactful outcomes as they leverage the collective expertise and resources of multiple governmental entities.

Last but not least, having motivation, authority, and coordination is not enough without having governmental capacity. As Mazmanian and Sabatier (1981) articulate, “governmental capacity” refers to the ability of governments and their agencies to design, implement, and assess policy experiments. Government capacity encompasses multiple dimensions, including but not limited to financial, institutional, and administrative capacities. In political science and public policy scholarship, funding and staff are typically seen as the two most critical forms of capacity for policy implementation. Funding, in particular, is paramount for conducting policy experiments, especially those that are novel, large-scale, and cross-sectoral, as they require very substantial financial resources.

METHODOLOGY

General procedure to derive lessons about political factors from comparisons

Scholars and practitioners can derive lessons about how political factors influence the outcomes of policy experiments by systematically comparing localities. Meaningful analysis often involves comparing localities that exhibit divergent policy outcomes while being similar in initial conditions and policy goals. Initial conditions refer to the pre-existing circumstances of a locality before starting a policy experiment that are critical for its potential to achieve set goals. For instance, these might include socioeconomic characteristics and resource endowments. Policy goals represent the intended outcomes or objectives that a policy experiment aims to realize, such as achieving specific decarbonization targets.

This paper does not claim that the findings are universally generalizable across all policy experiments but rather provides a replicable procedure for analyzing cases with shared contexts. The recommended general procedure is as follows (Figure 1), assuming that a locality participates in no more than one policy experiment at a time. First, among the localities that participated in the policy experiment, identify those with similar initial conditions and policy goals but showing variance in outcomes. The

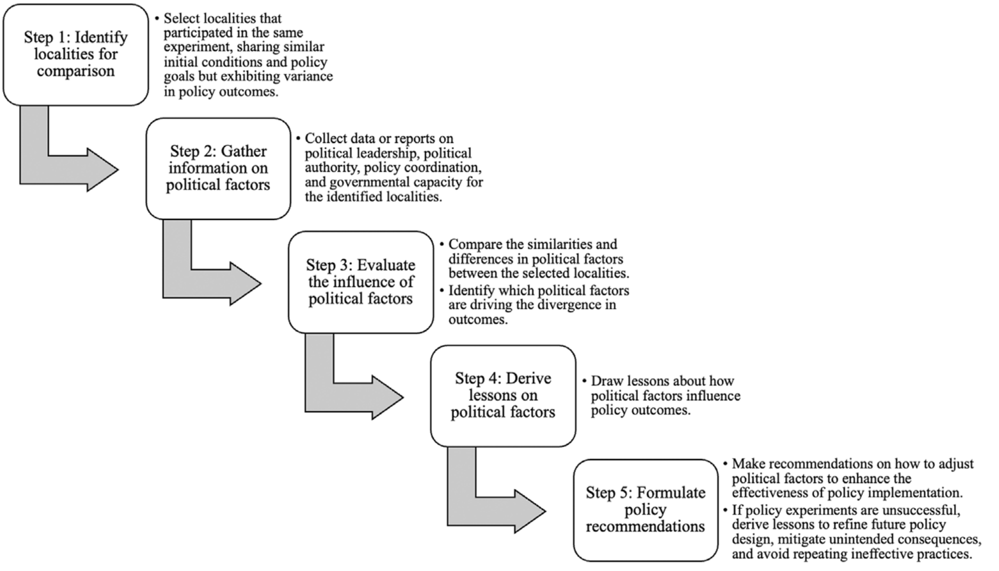

FIGURE 1 General procedure to derive lessons about political factors from comparable localities.

second step is to collect data or reports on political leadership, political authority, policy coordination, and governmental capacity for the identified localities. This data collection aims to compare the similarities and differences in political factors across the localities.

The third step involves analyzing the collected information to identify which political factors are driving the divergence in policy outcomes. When a sufficient number of cases are available for comparison, qualitative comparative analysis becomes an appropriate methodological approach. Based on the analysis, the fourth step is to derive lessons about how different political factors influence policy outcomes. The final step is to formulate recommendations for adjusting political factors to enhance the effectiveness of policy implementation. Alternatively, if experiments reveal how not to proceed, the findings can still provide valuable insights by identifying ineffective practices or unintended consequences, thereby guiding policymakers to avoid similar pitfalls in future initiatives, even if no immediate implementation should follow.

Concurrent trials and an updated procedure for deriving insights on political factors through comparative

In China, localities can participate in multiple experiments simultaneously within the same policy area, such as climate mitigation, leading to instances of concurrent trials. Localities in China are typically eager to host several pilots simultaneously to demonstrate initiative, leadership, and responsiveness to the center's calls. Among the 89 cities participating in national decarbonization policy experiments from 2010 to 2020, 30 (about one-third) engaged in concurrent trials (Table S1). These overlapping initiatives often introduce complexities that can obscure the link between political variables and outcomes—complexities that this approach is designed to address.

The procedure (initially outlined in Figure 1 for a generic case) is updated to fit the Chinese context by first grouping localities by experiment sets (Figure 2). Within each experiment set, localities can be selected for comparison based on similar initial conditions and goals but divergent outcomes. Subsequent steps should be performed separately for each experiment set. To demonstrate and stay within the word limit, the following subsection will apply this updated procedure to draw lessons about political factors from cities within one experiment set.

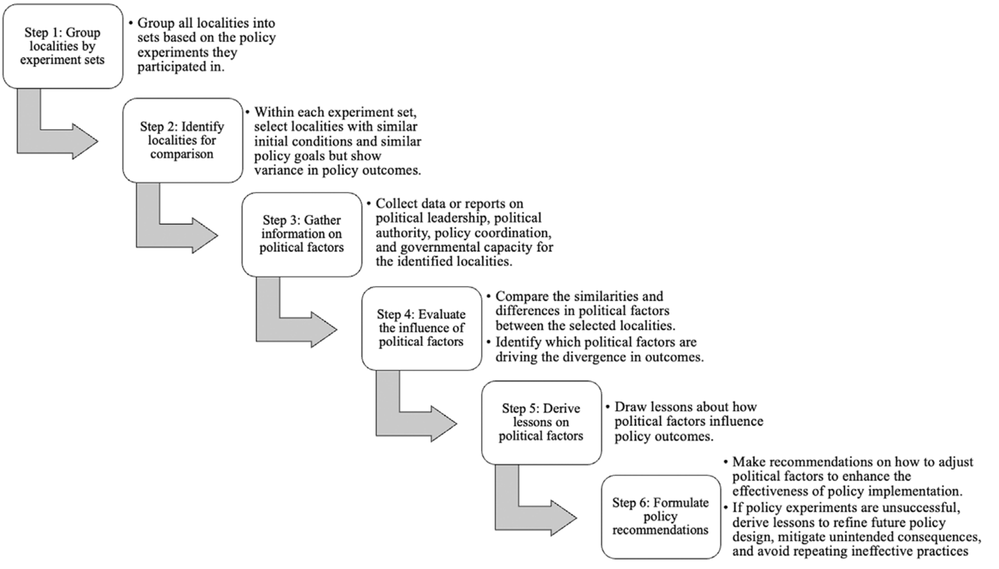

FIGURE 2 Procedure to derive lessons about political factors from comparable localities in China.

EMPIRICAL CONTEXT

Policy experimentation in China

A prominent mechanism for local engagement with national directives is through the application to become policy pilots. In China, policy experimentation initiated and sponsored by the central government is orchestrated top-down, with the central government overseeing the design, implementation, and evaluation of policy experiments (Florini et al., 2012).[6] The Chinese government's approach to policy experimentation is described as "experimentation under hierarchy," where the Party leadership defines policy objectives and sometimes designates policy instruments, while the pilots find innovative policy instruments that leverage local conditions (Heilmann, 2008). The central government either assigns specific localities to certain experiments or solicits voluntary applications, subsequently selecting suitable candidates. The decentralized experimentation carried out by pilots is subject to ad hoc central interference.

In response to the escalating impacts of climate change, the Chinese government kickstarted its first significant national climate mitigation initiative in 2009 through the energy-efficient and new energy vehicle demonstration and promotion pilot, which has primarily been carried out at the city level. Some decarbonization experiments initiated by the central government were supported with central funding, whereas initiatives like the low-carbon city pilot were not. Nonetheless, numerous cities were eager to apply for participation in multiple pilots.

Motivations for local participation

In developed democracies, localities keen on developing and implementing climate policies usually have strong public support, ample economic and institutional resources, and are often directly affected by the impacts of climate change, such as rising sea levels or more frequent extreme weather events (Bernauer & McGrath, 2016; Cain, 2023; Hughes, 2019).

In China, the motivations are different. The prestige and promise of policy experiments are highly attractive—an aspect likely unique to the Chinese experience. Localities vie to be chosen for pilots, seeing them as opportunities to drive development, enhance their reputation, and secure future readiness, which is perceived to benefit local leaders' career trajectories as well (Heilmann, 2008; Shen, 2025; Teets & Hasmath, 2020). A thematic analysis of city climate plans in China, involving systematic reading and summarization of the key motivations within these documents, reveals three primary motivations (Shen, 2025). First, cities aim to rebrand themselves and secure a leading position in the development of climate policies. Second, cities embrace climate initiatives when these align with existing priorities. Finally, some city leaders view climate and sustainability as the emerging frontier, akin to the focus on economic development in past decades, believing that early adoption of low-carbon initiatives will prepare their cities for future development. Notably, concerns about climate change as an existential threat or experiences with worsening climate-related disasters are seldom mentioned as motivating factors.

Despite the absence of central funding for low-carbon pilots, localities in China actively competed for selection. According to confidential statistics obtained from personnel involved in the selection process, 41 cities applied to become second-batch low-carbon pilots, of which 28 were ultimately chosen. This competition highlights the perception among localities that being designated as a pilot city is both an honor and a responsibility (Zhuang, 2020, 24). The pursuit of pilot status underscores the importance placed on policy experimentation as a means of achieving development, gaining prestige, and enhancing future preparedness.

EMPIRICAL ANALYSIS

Sources and materials

This study relies on an extensive array of official policy documents, statistical yearbooks, annual reviews, and media sources, which collectively enable a comprehensive assessment of the quantified progress made and the critical contextual factors through content analysis under climate mitigation policy experiments. The materials were meticulously selected based on their relevance, credibility, and informational value to the research topic.

A thorough examination of central and local government websites yielded key official policy documents, such as low-carbon city implementation plans and annual government work reports. These primary sources are vital, offering authoritative information about the policy frameworks, strategic directions, and outcomes of climate mitigation efforts.

This research also extensively harnessed data from statistical yearbooks and annual reviews, including the China Statistical Yearbooks, China City Statistical Yearbooks, China Low Carbon Yearbooks, China Low Carbon Cycle Yearbooks, and the BP Statistical Review of World Energy. These sources offer a wealth of quantitative data essential for calibrating the initial conditions and monitoring the progress on climate mitigation.

Furthermore, national and local newspapers were systematically examined for information not covered by the aforementioned sources. Additionally, international news outlets were occasionally referenced to fill gaps in national and local reports. Often overlooked in academic research, local newspapers provide rich details about local contexts. A comprehensive list of pertinent national and local newspapers was compiled, and for each one, keywords such as “low-carbon city pilot” were used to search through these newspapers' digital archives to extract and compile the relevant articles. This approach allowed for the collection of detailed local insights, enriching this study's empirical foundation.

A complete inventory of the referenced central and local policy documents, reports, international, national, and local media sources, as well as statistical yearbooks and annual reviews, is provided in Tables S2–S6.

Selection of comparable cities on decarbonization

In the past, studies on what political factors make cities successful at decarbonization often chose cities that were not directly comparable, which goes against the guidelines in Step 1 (Figure 2). For instance, some studies picked cities that had already done well in decarbonization. Sometimes, this was because these high-performing cities were more open to hosting researchers for the positive attention it brought them.[7] Other times, researchers intentionally selected these successful cities to try to elucidate what worked well in decarbonization.[8] However, choosing only successful cities leads to limited differences in outcomes, which can result in biased conclusions.[9]

In addition, prior works have often overlooked the crucial factor of concurrent trials. The content and focus of a policy experiment are essential because they dictate how efforts and resources are allocated to targeted sectors. For example, cities engaged in a green transportation initiative will prioritize the transportation sector. Therefore, to meaningfully compare cities' decarbonization efforts, it is necessary that they participate in the same experiments. As discussed earlier, comparing a city focusing on hard-to-decarbonize sectors with one targeting easier sectors is invalid due to the varying challenges inherent to specific sectors.

The empirical study on Chinese city decarbonization experimentation commences with the identification of cities that engaged in the same national decarbonization experiments. Extensive online research and consultation of China Low Carbon Yearbooks and China Low Carbon Cycle Yearbooks, which include a section listing all active decarbonization experiments for each year, facilitated the compilation of a comprehensive list of national-level decarbonization policy experiments.[10]

From 2009 to 2020, six climate mitigation policy experiments were sponsored by the central government, whose implementation level included prefectural cities, and more than one city participated.[11] These initiatives included the low-carbon pilot, the carbon emissions trading pilot, the green circular and low-carbon transportation system construction pilot, the green finance pilot, the green industrial transformation development pilot, and the energy-efficient and new energy vehicle demonstration and promotion pilot. While the low-carbon pilot was implemented citywide, others were sector-specific. Table 1 presents the duration of these initiatives, detailing the waves in which they were implemented and their units of experimentation.

Sets of cities that participated in the same experiments were identified, totaling 11 in all (see Table S1). For example, five prefectures—Hangzhou, Xiamen, Nanchang, Wuhan, and Kunming—were found to have participated in the same set of three experiments: the low-carbon pilot, the energy-efficient and new energy vehicle demonstration and promotion pilot, and the green circular and low-carbon transportation system construction pilot (Table 2). Due to space constraints, only one set of cities is vetted and analyzed in this paper.

The next step is to compare the initial conditions (Table 3) and the 2015 and 2020 goals (Table 4) of the five cities to identify those with the most similar initial conditions and goals. In China, there is a general trend that localities with higher socioeconomic status exhibit superior sustainability performance (Shen, 2022). To measure socioeconomic status, this study uses prefectural per capita GRP in 2009, a commonly used metric. Hangzhou and Xiamen have comparable per capita GRP levels, which are the highest among the five cities.

Since industrial reliance can influence the difficulty of carbon abatement, the cities' economic structures were also compared, particularly the percentage of GRP in 2009 generated by the primary sector (e.g., agriculture, mining, forestry, and fishing), secondary sector (e.g., construction, manufacturing, and utilities), and tertiary sector (e.g., retail, finance, healthcare, education, and technology services). Hangzhou, Xiamen, and Wuhan exhibit highly similar economic structures.

Additionally, because the targets involved reducing both energy intensity and carbon intensity—and recognizing that the level of difficulty varies based on the starting levels—these measures were also compared. Hangzhou, Xiamen, and Nanchang are comparable in both energy intensity and carbon intensity, while Wuhan and Kunming started significantly higher, making abatement more challenging for these two cities.

Regarding decarbonization goals, the five cities were compared on metrics aligned with national-level announcements, which localities were expected to follow. The 12th and 13th Five-Year Plans (FYPs),

TABLE 1 National-level decarbonization policy experiments during 2009–2020.

Policy experiment	Duration	Unit level
Low-carbon pilot (低碳试点)	2010– (3 waves, starting in 2010, 2012, 2017, respectively)	Prefecture (primary), province, county
Carbon emissions trading pilot (碳排放权交易试点)	2011–2021 (1 wave)	Centrally-administered city, province, prefecture
Green circular and low-carbon transportation system construction pilot (绿色循环低碳交通运输体系建设试点)	2011–2020 (2 waves, starting in 2011 and 2012, respectively)	Centrally-administered city, prefecture
Green finance pilot zone (绿色金融改革创新试验区)	2017– (2 waves, starting in 2017 and 2019, respectively)	Prefecture, district
Green industrial transformation development pilot (工业绿色转型发展试点)	2015–2018 (1 wave)	Prefecture
Energy-efficient and new energy vehicle demonstration and promotion pilot (节能与新能源汽车示范推广试点)	2009– (2 waves, starting in 2009 and 2010, respectively)	Prefecture

Source: National Development and Reform Commission (2010, 2012, 2017); General Office of National Development and Reform Commission (2011); Ministry of Transportation (2011); People's Daily (2017); Gansu Daily (2019); Xinhua (2015); Ministry of Finance and Ministry of Science and Technology (2009a, 2009b); Ministry of Finance, Ministry of Science and Technology, Ministry of Industry and Information Technology, and National Development and Reform Commission (2010).

TABLE 2 Participation (year selected) in decarbonization experimentation, 2009–2020.

Prefecture	Low-carbon city pilot	Energy-efficient and new energy vehicle demonstration and promotion pilot	Green circular and low-carbon transportation system construction pilot
Hangzhou	2010	2009	2011
Xiamen	2010	2010	2011
Nanchang	2010	2009	2011
Wuhan	2012	2009	2011
Kunming	2012	2009	2012

covering 2011–2015 and 2016–2020, respectively, set out targets in the following four areas: carbon intensity, percentage of GRP from the tertiary sector, energy intensity, and proportion of non-fossil energy in primary energy consumption. Across the five cities, Hangzhou and Xiamen exhibit the closest alignment in their decarbonization goals for both 2015 and 2020. As a result, considering both the initial conditions and decarbonization goals, it would be most appropriate to compare Hangzhou and Xiamen.

Divergent outcomes in Hangzhou and Xiamen

Despite sharing many similarities, Hangzhou and Xiamen experienced divergent decarbonization progress and outcomes from 2010 to 2015 while participating in the same three decarbonization policy experiments. According to official documents, the active experimentation period for these three experiments concluded in 2015.

Hangzhou not only met but also exceeded its decarbonization targets in several metrics, including carbon intensity, percentage of GRP from the tertiary sector, and energy intensity. Hangzhou's performance was seen as proactive and impressive, while Xiamen appeared more passive, preferring to follow others rather than initiate new projects (Zhuang, 2020, 24–25).

Regarding metrics, Xiamen underperformed relative to Hangzhou in multiple dimensions. Specifically, Xiamen struggled to meet its goal in GRP from the tertiary sector, did not set a goal for the

TABLE 3 The initial conditions of the four cities.

Prefecture	Per capita GRP (RMB)	Economic structure (% GRP from each sector)			Energy intensity (ton standard coal/10,000 RMB)	Carbon intensity (tons/10,000 RMB)
		Pri.	Sec.	Ter.		
Hangzhou	63,333 (2009)	3.74 (2009)	46.92 (2009)	49.33 (2009)	0.70 (2009)	1.70 (2010)
Xiamen	68,938 (2009)	1.18 (2009)	47.26 (2009)	51.56 (2009)	0.579 (2009)	1.42 (2010)
Nanchang	39,669 (2009)	6.09 (2009)	55.32 (2009)	38.59 (2009)	0.855 (2009)	1.59 (2010)
Wuhan	51,144 (2009)	3.23 (2009)	46.36 (2009)	50.42 (2009)	1.112 (2009)	2.31 (2010)
Kunming	25,826 (2009)	6.31 (2009)	45.59 (2009)	48.10 (2009)	1.223 (2009)	2.656 (2010)
National	25,575 (2009)	10.6 (2009)	46.8 (2009)	42.6 (2009)	1.034 (2010)	2.02 (2010)

Note: 2010 data were used when 2009 data were unavailable.

Source: National Bureau of Statistics (2010c); Hangzhou Development and Reform Commission (2011); Zhou (2012); Xiamen Development and Reform Commission (2011); Nanchang Municipal People's Government (2011); Wuhan Municipal People's Government (2013); Kunming Daily (2011); National Bureau of Statistics (2010a); State Council (2012); BP (2010); National Bureau of Statistics (2010b); estimates calculated by the author based on the statistics provided in the aforementioned official sources.

TABLE 4 Decarbonization goals of the four pilots.

Prefecture	Carbon intensity (ton CO_2/10,000 RMB)	% GRP from the tertiary sector	Energy intensity (ton standard coal/10,000 RMB)	Proportion of non-fossil energy in primary energy consumption
Hangzhou	Reduce by more than 40% in 2015 and more than 50% in 2020, based on the 2005 level • ≤1.30 (2015) • ≤1.09 (2020)	Reach 54% in 2015 and 60% in 2020 • 54% (2015) • 60% (2020)	Limit to around 0.55 by 2015 Reduce by 22% in 2020 based on the 2015 level • ≅0.55 (2015) • 0.34 (2020)	Reach 10% in 2015 and 15% in 2020 • 10% (2015) • 15% (2020)
Xiamen	Reduce by 33% in 2015 and more than 45% in 2020, based on the 2005 level • 1.072 (2015) • ≤0.88 (2020)	Increase by 5% in 2015 based on the 2010 level and strive to reach 60% in 2020 • 51.6% (2015) • 60% (2020)	Reduce by 10% in 2015 based on the 2010 level Reduce by 12% in 2020 based on the 2015 level • 0.47 (2015) • 0.38 (2020)	Reach 21.6% in 2020 • Not set (2015) • 21.6% (2020)
Nanchang	Reduce by 38% in 2015 and 45–48% in 2020, based on the 2005 level • 2.015 (2015) • 1.69–1.788 (2020)	Reach 43% in 2015 and 47.5% in 2020 • 43% (2015) • 47.5% (2020)	Reduce by 16% in 2015 based on the 2010 level Reduce by 16% in 2020 based on the 2015 level • 0.706 (2015) • 0.307 (2020)	Reach 7% in 2015 and 15% in 2020 • 7% (2015) • 15% (2020)
Wuhan	For 2015, reduce by 20% based on the 2010 level (and around 45% based on the 2005 level) Reduce by around 56% in 2020 based on the 2005 level • ≅1.859 (2015) • ≅1.487 (2020) • ≅1.487 (2020)	Reach 52% in 2015 and 55% in 2020 • 52% (2015) • 55% (2020)	Reduce by 18% in 2015 based on the 2010 level Reduce by 17% in 2020 based on the 2015 level • 0.869 (2015) • 0.455 (2020)	Exceed 8% in 2015 and 10% in 2020 • >8% (2015) • 10% (2020)
Kunming	Reduce by at least 20% in 2015 based on 2010 level and by at least 23% in 2020 based on 2015 level • ≤2.125 (2015) • ≤1.483 (2020)	NA	Reduce by at least 18% in 2015 based on 2010 level and by at least 13% in 2020 based on 2015 level • ≤0.923 (2015) • ≤0.736 (2020)	Reach at least 15% in 2015 and at least 20% in 2020 • ≥15% (2015) • ≥20% (2020)
National	Reduce by 17% in 2015 based on the 2010 level Reduce by 18% in 2020 based on the 2015 level • 2.764 (2015) • 1.099 (2020)	Increase by 4% in 2015 based on the 2010 level • 47% (2015) • 56% (2020)	Reduce by 16% in 2015 based on the 2010 level Achieve 0.869 in 2015 (2005 pricing) Reduce by 15% based on the 2015 level • 0.869 (2015) • 0.536 (2020)	Reach 11.4% in 2015 Reach 15% in 2020 • 11.4% (2015) • 15.3% (2020)

Source: National Bureau of Statistics (2016a, 2021a); Hangzhou Development and Reform Commission (2011); Zhou (2012); Xiamen Development and Reform Commission (2011); Nanchang Municipal People's Government (2011); Nanchang Municipal People's Government (2010); Wuhan Municipal People's Government (2013); Kunming Municipal Government Office (2016); Yunnan Provincial People's Government (2017); Kunming Municipal Bureau of Statistics (2016); State Council (2012); National Bureau of Statistics (2016b, 2021b); Reuters (2014); People's Daily (2020); estimates calculated by the author based on the statistics provided in the aforementioned official sources.

proportion of non-fossil energy in primary energy consumption, and did not publicly report statistics for carbon intensity in 2015 to avoid public scrutiny and potential backlash.

A study referencing official statistics reported from 2010 to 2014 found that Hangzhou reduced its carbon intensity at an average annual rate of 8.34%, while Xiamen only managed a 4.31% reduction during the same period (Deng, 2016). The absence of 2015 carbon intensity data for Xiamen further highlights its lack of transparency, possibly to avoid revealing weak performance, in stark contrast to Hangzhou's public reporting and notable progress. Collectively, these metrics indicate that Hangzhou achieved significantly more progress than Xiamen during the 12th FYP (Table 5).

Some may wonder if external factors, such as preparations for major international events like the G20 Summit and the Asian Games, influenced Hangzhou's climate actions. However, for this study focusing on 2010–2015, when the three decarbonization experiments were actively ongoing, preparations for these events began after this period. The decision for Hangzhou to host the 2016 G20 Summit was announced in November 2015, and the selection for the 2022 Asian Games occurred in September 2015. Thus, preparations started after the study period ended and would not affect the comparison between Hangzhou and Xiamen.

Understanding which political factor(s) explained the divergence

Political factors played a significant role in the divergent outcomes observed between Hangzhou and Xiamen, where success is assessed in terms of target attainment and the magnitude of progress made. This analysis explores which elements—political authority, policy coordination, governmental capacity, and political leadership—accounted for the differences between the two cities. The variation in city decarbonization progress was largely explained by political leadership and, relatedly, the degree of policy alignment between decarbonization efforts and leadership policies. That alignment, known as "policy coherence," occurs when "various policies go together because they share a set of ideas or objectives" (May et al., 2006, 382).

Political authority

Political authority was assessed based on the seniority of the leading figure in a city's Leading Group (领导小组) or Coordination Group (协调小组) for each experiment.[12] The role of the prefectural party secretary, the first-in-command, is particularly important; their advocacy is essential for advancing any policy initiative, especially in new policy areas (Shen, 2022, 2025; Wang et al., 2020; Zhuang, 2020, 5).

Both Hangzhou and Xiamen conferred similar levels of political authority on their decarbonization pilots (Table 6). Both appointed their party secretaries to lead their low-carbon city pilot Leading

TABLE 5 City achievements in 2015 and 2020.

Prefecture	Carbon intensity (ton CO_2/10,000 RMB)	% GRP from the tertiary sector	Energy intensity (ton standard coal/10,000 RMB)	Proportion of non-fossil energy in primary energy consumption
Hangzhou	0.731 (2015) 0.548 (2020)	58.2% (2015) 68.1% (2020)	0.43 (2015) 0.29 (2020)	10.7% (2015) 15.5% (2020)
Xiamen	Figures not publicly reported	55.8% (2015) 60.1% (2020)	0.437 (2015) 0.282 (2020)	Figures not publicly reported

Note: Figures for 2020 are included for reader interest but are not directly relevant to the scope of this comparative study.

Source: Wang et al. (2019); Hangzhou Bureau of Statistics (2016, 2021); General Office of Hangzhou Municipal People's Government (2016); Hangzhou Development and Reform Commission (2021); Hangzhou Development and Reform Commission (2023); Xiamen Bureau of Statistics (2021); Fujian Provincial Bureau of Statistics, Fujian Provincial Economic and Information Commission, and Fujian Provincial Development and Reform Commission (2016); Xiamen Net (2021); Xiamen Municipal People's Government (2021); estimates calculated by the author based on the statistics provided by the aforementioned official sources.

Groups, while deputy mayors headed their energy-efficient and new energy vehicle demonstration and promotion pilot leading groups. Hangzhou appointed its municipal transportation bureau chief as the Leader of its green circular and low-carbon transportation system construction leading group, whereas Xiamen assigned this role to the deputy mayor.

Policy coordination

Hangzhou and Xiamen displayed similar levels of policy coordination, measured by the involvement of various bureaus, governments, and departments in their Leading and Coordination Groups. For the low-carbon city pilot, both Hangzhou and Xiamen involved an extensive and comprehensive array of relevant departments (e.g., science and technology bureau, economic development bureau, construction bureau, electric power bureau, municipal garden bureau) and district governments in their Leading Groups. For the energy-efficient and new energy vehicle demonstration and promotion pilot, both incorporated the heads of the most pertinent bureaus to participate. As for the green circular and low-carbon transportation system construction city pilot, it was mandated by the Ministry of Transportation that a four-level coordination mechanism be formed. The mechanism included the Ministry of Transportation, the Provincial Transportation Department, the Pilot City Transportation Department, and the pilot project's implementing body, aiming to facilitate and streamline the greening of the transportation sector.

Some may argue that while this approach reflects the extent of coordination, it does not necessarily indicate its effectiveness. However, in China, the practical functioning of coordination largely depends on key local leaders, particularly the Group Leader and, to a lesser extent, the Vice Group Leader (Shen, 2025; Zhuang, 2020, 25). These leaders typically possess the authority and ability to mobilize resources and coordinate departments, which is crucial for tasks involving multiple departments and levels of participation. With their attention and support, effective coordination is more likely where coordination structures exist.

Governmental capacity

The most important measure of governmental capacity is funding, especially for financially demanding decarbonization policy experiments. Both the energy-efficient and new energy vehicle demonstration and promotion pilot and the green circular and low-carbon transportation system construction city pilot primarily received funding from the central government, with local matching funds expected. In contrast, the low-carbon city pilot lacked initial central funding, necessitating the pilot cities to raise their funds.

Hangzhou and Xiamen were part of the first batch of low-carbon city pilots designated by the central government, which considered financial capacity and resource availability (Zhuang, 2020, 22). Although exact budget details are undisclosed, media reports indicate that both cities were proactive in building financial capacity. By March 2010, Hangzhou had established a "low-carbon industry fund" and was prepared to quickly set up a special fund aimed at fostering and steering the growth of low-carbon industries (China Intelligent Building Information Network, 2010). Similarly, Xiamen actively allocated significant sums for enterprise decarbonization and secured substantial pCDM funds from international sources (China Business News, 2012; Xiamen Business Daily, 2010).

Leadership priorities and commitments

The divergent decarbonization outcomes between Hangzhou and Xiamen during 2010–2015 can plausibly be attributed to differences in leadership priorities and levels of commitment. To explore this dimension, I draw on both government work reports and media reports.

A focused content analysis of annual prefectural government work reports (市政府工作报告) sheds light on the policy priorities and efforts of both cities. These reports summarize the government's

TABLE 6 Political authority (Leading Group leader) and policy coordination (Leading Group members) by experimental initiative.

		Leading group		
Pilot initiative	**Cities**	**Leader**	**Participating units**	**Funds raised/ awarded**
Low-carbon city pilot	Hangzhou Xiamen	Party secretary Party secretary	Relevant departments and districts	Funds raised or enabled by the city governments
Energy-efficient and new energy vehicle demonstration and promotion pilot	Hangzhou Xiamen	Deputy mayor Deputy mayor	Bureau of Science and Technology, Transportation Commission, Development and Reform Commission, Bureau of Finance, Bureau of Economic Development	Funds from the central government, coupled with local fiscal matching funds
Green circular and low-carbon transportation system construction city pilot	Hangzhou Xiamen	Municipal transportation bureau chief Deputy mayor	Four-level coordination mechanism among the Ministry of Transportation, the Provincial Transportation Department, the Pilot City Transportation Department, and the pilot project implementing body	Funds from the central government, coupled with local fiscal matching funds

Source: Hangzhou Development and Reform Commission (2011); Xiamen Development and Reform Commission (2011); Ministry of Science and Technology (2009); General Office of the Xiamen Municipal People's Government (2010); Ministry of Finance and Ministry of Science and Technology (2009a, 2009b); General Office of the Xiamen Municipal People's Government (2011); Ministry of Transportation (2011).

performance in the past year and outline plans for the current year. Metrics like keyword frequencies offer insights into the government's policy priorities and efforts. The adjusted counts (i.e., word counts divided by the total word count in the document and multiplied by 1000) were measured for two keywords directly related to climate goals—emissions reduction (减排) and energy intensity (单位生产总值能耗). The lines in Figure 3 indicate the average adjusted counts for the two keywords in Hangzhou and Xiamen over two distinct periods: 2010–2012 and 2013–2015, with the leadership change in 2013 marked for both cities.

Hangzhou consistently demonstrated a higher average level of commitment to decarbonization initiatives across both periods, as reflected in the higher adjusted keyword counts in government work reports.[13] Furthermore, the discrepancy in attention between the two periods was much smaller for Hangzhou than for Xiamen, indicating greater consistency in commitment under different leaderships. In contrast, Xiamen exhibited a more pronounced fluctuation in attention, with a notable decline following its leadership change in 2013. These findings highlight the relative prioritization and stability of decarbonization efforts in Hangzhou compared to Xiamen amid leadership transitions.

The shift in Xiamen's prefectural party secretary leadership from Yu Weiguo to Wang Menghui, marked a significant change in policy priorities. Yu prioritized decarbonization, integrating it into Xiamen's development strategy and actively leading efforts for the city to be a national low-carbon pilot in 2010 (China National Radio, 2011). Yu was actively involved in issuing numerous directives, steering the low-carbon initiative, and bearing the responsibility to position Xiamen to pioneer and cultivate a low-carbon economy (China National Radio, 2011).

However, under Wang Menghui, the focus shifted to the Beautiful Xiamen initiative, which emphasized urban and economic development over decarbonization (Xiamen Municipal Bureau of Natural Resources and Planning, 2016). This initiative propelled Xiamen into high-tech, optoelectronic display, and international shipping, significantly improving the city's business environment and economic outcomes. Beautiful Xiamen also paid attention to ecological restoration, but both words and deeds fell behind regarding decarbonization.

Hangzhou maintained a consistent commitment to decarbonization across different leadership tenures. This continuity was supported by the alignment of decarbonization goals with local, provincial, and national priorities. Such policy coherence enabled continuous focus and investment in low-carbon initiatives by the city's top leadership, ensuring that decarbonization efforts remained a consistent part of the city's policy agenda.

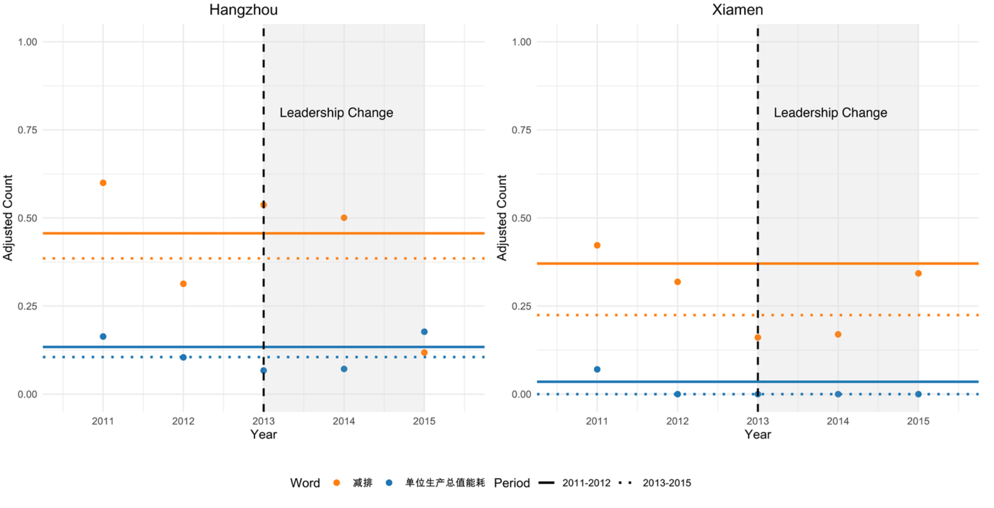

FIGURE 3 Adjusted counts of keywords related to decarbonization in the annual government work report for Hangzhou (left) and Xiamen (right) between 2010 and 2015.

Former party secretary Wang Guoping emphasized the necessity of low-carbon development for enhancing Hangzhou's ecological environment and competitive edge as a tourist city. He stated at the mobilization meeting for building a low-carbon city in Hangzhou in December 2009:

> In a tourist city, the environment is both a source of productivity and a competitive edge. Developing Hangzhou as a low-carbon city represents a significant advancement in executing the 'environment defines the city' (环境立市) strategy and enhancing its ecological environment. Furthermore, the transition towards a low-carbon urban model stands as a pivotal strategy to boost Hangzhou's popularity, reputation, and competitiveness, simultaneously elevating the residents' quality of life.
>
> (Zhejiang Online, 2009)

His successors, such as Huang Kunming and Gong Zheng, continued these efforts, integrating low-carbon strategies into broader urban planning and environmental protection initiatives. For instance, during the Zhejiang Provincial Private Economy Conference in January 2012, Huang Kunming stated:

> The shift towards low carbon emerges from our critical reflection on the path of urban development within the context of industrial civilization. It marks a pivotal step in redefining the concepts, trajectories, and models of urban development. Such progress signifies a crucial direction for the evolution of cities in the future.
>
> (Economic Daily, 2012)

Furthermore, Hangzhou's green transportation initiatives aligned with provincial and national priorities. The city's efforts were part of a cohesive strategy, leveraging regional collaborations and investments to maximize impact. Zhejiang's 12th FYP for highway and waterway transportation emphasized the need for low-carbon solutions, integrating comprehensive, regional, and urban–rural transportation systems and developing large ports, expansive road networks, and substantial logistics capabilities (Zhejiang Online, 2010). Leading cities within Zhejiang, including Hangzhou and Huzhou, have collaborated to foster a low-carbon economy in transportation.

The comparative case study of Hangzhou and Xiamen highlights the crucial role of political leadership in achieving low-carbon policy outcomes, as well as the importance of policy coherence to minimize disruption from leadership turnover. The comparative study emphasizes how leadership vision, political incentives, and alignment with existing and higher-level priorities are essential for success in policy experimentation.

DISCUSSION AND CONCLUSION

This study examines a critical but understudied aspect of the governance of policy experiments in China—how political factors shape their outcomes. By focusing on the comparative analysis of cities with similar initial conditions and policy goals but divergent outcomes, this research provides a replicable procedure for selecting and analyzing cases in policy experimentation. The procedure explicitly accounts for concurrent trials—a prevalent but often ignored aspect of Chinese policy experimentation in both research and practice. Comparing localities participating in the same experiments is especially critical for issues involving multiple sectors, where the difficulty of achieving desired policy outcomes differs significantly across sectors. This study demonstrates that fair and meaningful comparisons require selecting localities targeting the same sectors.

A thorough search identified all national climate mitigation policy experiments and all cities' participation. Five cities were identified as having participated in the same three experiments—the comprehensive low-carbon city pilots and two pilots targeting the transportation sector. Data collection and contextual details were compiled based on a thorough review of key official documents from central and local government websites, statistical yearbooks, and annual reviews of various kinds, as well as local, national, and international newspapers.

Among the five cities participating in the same three experiments, two cities—Hangzhou and Xiamen—shared similar initial conditions and climate goals but achieved divergent progress under the 12th FYP. Four political factors identified as critical in policy experimentation by existing scholarship are political leadership, political authority, policy coordination, and governmental capacity. Hangzhou and Xiamen were similar in the latter three dimensions, but Hangzhou's leadership showed more consistent attention to decarbonization, according to both focused content analysis of government work reports and media reports. The continued leadership attention and efforts were aided by coherent policy integration with broader government priorities. A change of leadership in Xiamen shifted some attention from decarbonization to other areas. This highlights a fifth political factor—policy coherence—in guarding against potential disruption from leadership turnover in policy experimentation, an area understudied in the governance of policy experiments.

This study contributes to the literature on governance and policy experimentation in three main ways. First, it bridges insights from political science and public policy to explore the interaction between political dynamics and experimental outcomes—an area that is critical but under-studied (Ansell & Bartenberger, 2016; May, 1992). Consistent with prior works on the role of leadership and policy coherence (Besley, 2007; Cain, 2023; Hinich & Munger, 1994; May et al., 2006; Ringe, 2005), this study illustrates how they ensure the viability of policy objectives, even under conditions of uncertainty. Second, this study systematically examines concurrent trials in China, challenging the conventional wisdom of analyzing single trials in isolation (Fischer, 1995). This factor, while complicating comparative analysis, is essential to account for in case selection. Third, and methodologically, this study lays out a generalized procedure that can be replicated for future analysis of policy experiments.

The findings of this study provide actionable insights for policymakers and practitioners, particularly in China. First, they underscore the importance of integrating decarbonization goals into broader development strategies to ensure their prioritization, especially in contexts where climate priorities have yet to be institutionalized. Second, the study highlights the need for leadership evaluation systems that incentivize sustained attention to long-term initiatives, such as decarbonization. By embedding these incentives, governments can reduce the risk of policy discontinuity and maintain progress across leadership transitions.

Looking ahead, this study lays the foundation for deeper and broader exploration. Future research could replicate the advocated procedure to compare cities that participated in other identical sets of experiments. For instance, Table S1 identifies 10 additional sets of cities that participated in identical experiments, which could be further vetted to establish comparability—work that is not done in this study due to space constraints. This would provide opportunities to investigate the influence of political factors beyond leadership and policy coherence on decarbonization progress.

Beyond climate mitigation, future research could apply the proposed methodology to other policy areas, such as public health or urban planning, to understand how various political factors influence experimental outcomes across different contexts. These avenues offer significant potential to expand our understanding of the governance of policy experiments and the role of political factors in shaping their success.

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CONFLICT OF INTEREST STATEMENT

The author has no conflict of interest to declare.

ORCID

Shiran Victoria Shen https://orcid.org/0000-0003-2773-9318

Endnotes

[1] In this study, "policy experiment," "trial," and "pilot" are used interchangeably to refer to a government-sponsored policy initiative that is novel to the locality and whose implementation is evaluated against existing criteria (McFadgen & Huitema, 2018).

[2] Policy uncertainty refers to the lack of predictability in the outcomes and implications of a policy, while policy ambiguity occurs when a policy is open to multiple interpretations due to unclear or broad language. Complex policy issues are those with unclear cause-and-effect relationships and structural or procedural complexity.

[3] For instance, this gap is evident in policy-oriented research that seeks to prescribe recommendations for successful decarbonization in China conducted by affiliates of the Chinese Academy of Social Sciences, a ministry-level state research institute under the State Council, which serves as China's chief administrative authority and national cabinet (Bai et al., 2012; Zhou et al., 2018).

[4] It is particularly noteworthy to highlight this point, given the prevailing view in the policy sciences literature that experimentation typically tests a single idea at a time (Fischer, 1995). However, in practice, experimentation has sometimes been employed to test multiple ideas simultaneously.

[5] Some may argue that strategies should be analyzed separately. However, strategies and approaches are intermediaries shaped by leadership. Leadership directly influences the design and implementation of strategies, which, in turn, determine the outcomes of policy experiments. Therefore, strategies should not be treated as independent variables but rather as components within the causal pathway linking leadership to outcomes.

[6] In recent years, certain localities have been permitted to conduct experiments at the local level for local use, such as a province initiating trials among its counties. While insights from these experiments typically remain confined to local applications, exceptional cases exist where successful trials are scaled up to influence national policy.

[7] For instance, Zhang (2021) selected Shanghai, Qingdao, and Hangzhou, all of which had done well in decarbonization during the experimentation period.

[8] For example, Mai and Francesch-Huidobro (2014) selected Guangzhou, Shenzhen, and Hong Kong for their comparative case study, noting that these cities had already achieved significant carbon reductions and were progressing towards further decarbonization successes.

[9] Choosing only cities that have achieved significant decarbonization leads to selection bias, which occurs when the sample is not representative of the entire population. In this context, selecting only high-performing cities means the study does not consider cities that struggled in their decarbonization efforts. This results in limited variation in outcomes, meaning there is not enough difference in the success levels among the selected cities to understand what factors truly drive success. Without comparing cities that made sufficiently varying degrees of progress, it becomes difficult to identify the specific political factors that lead to effective decarbonization. Consequently, the conclusions drawn from such studies might be biased or incomplete because they only reflect the characteristics of successful cities. This makes it hard to apply the findings to a broader range of cities with different challenges and circumstances.

[10] Publication of the China Low Carbon Yearbook ceased in 2017. Subsequently, the China Low Carbon Cycle Yearbook has been utilized, given its substantial overlap in content with the earlier China Low Carbon Yearbook, for the period post-2017.

[11] Experiments organized by local governments, under the permission or sponsorship of the central government, are not included in this list.

[12] A Leading Group or Coordination Group consists of a Leader, Vice Leader, and Members. The Leader role is typically occupied by the prefectural party secretary, mayor, executive deputy mayor, or a deputy mayor, in that order of seniority. The Vice Leader holds a position subordinate to the Leader, while Members are generally the heads of relevant bureaus.

[13] The trends remain consistent when plotting raw keyword counts instead of adjusted counts. The average trend is more relevant than individual year values because it captures the overall level of attention sustained across a leadership period, aligning with the analysis' focus on understanding differences in political priorities under different leaderships. Furthermore, Hangzhou's lower frequency count for "emissions reduction" in 2015 was at least partly due to its significant progress by 2014, having already exceeded both provincial targets and 12th FYP expectations, while Xiamen was playing catch-up.

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AUTHOR BIOGRAPHY

Shiran Victoria Shen is a Senior Research Scholar and leads the China Energy Program at the Precourt Institute for Energy, Stanford Doerr Schoolof Sustainability. She is also a Faculty Affiliate at the Stanford Center on China's Economy and Institutions. Her research primarily focuses on understanding how incentives and institutions shape climate and environmental actions.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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