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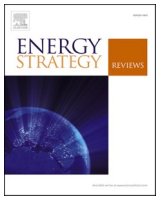

National climate change governance and lock-in: Insights from Korea's conservative and liberal governments' committees

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ABSTRACT

When establishing national climate change response policies, conflicts between various stakeholders may arise. Therefore, we need a collaborative climate change governance to coordinate stakeholders' opinions. Many countries have formed and operated committee-type governance to respond to climate change. Climate change policies require long-term responses. However, the politicization of climate change issues results in rapid policy changes and policy discontinuities. In Korea, climate change policies are showing differences according to partisan polarization. Past conservative and liberal governments formed committees to respond to climate change. Conservative governments operated the Green Growth Committee, and liberal governments operated the Carbon Neutrality Committee. This study analyzed the impact of changes in the Korean political system on climate change governance. We examined whether the difference in political orientation between liberal and conservative governments affected climate change governance, and if not, what factors prevented the path from changing. No significantly different outcome was found between the governance of the conservative and the liberal governments in response to climate change. The cause was the "lock-in" of climate change policies in Korea. Specifically, the response to climate change in Korea has not changed significantly due to political, industrial, institutional, and diplomatic lock-in.

1. Introduction

The risk of climate change is becoming increasingly serious. To deal with its uncertainty and complexity, it is necessary to collect opinions and participation from various stakeholders, including the state and the private sectors (e.g., businesses and civil societies). In this process, sharp conflicts of interest may arise. Thus, the issue of organizing and operating collaborative governance is important to coordinate stakeholders' opinions. Climate change collaborative governance is a difficult challenge in modern political and administrative systems, but can no longer be ignored [1].

Countries worldwide are beginning to organize collaborative governance to respond to climate change. It mainly utilizes the form of a committee as an institutionalized mechanism where participants cooperate to decide and implement policies [2]. The presence or absence of the Climate Change Committee (CCC) and the timing of its establishment are important criteria for responding to climate change. The UK's CCC was the first to emerge, established per the 2008 Climate Change Act. As a legal advisory body with guaranteed independence, it provides key advice on carbon budgets and climate risk adaptation and prepares an annual evaluation report on Nationally Determined Contributions (NDCs). Its pioneering work has established the UK as one of the global climate leaders [3]. Some countries are forming committees by benchmarking the UK's CCC. Germany's Committee of Climate Experts was established by the Federal Climate Act in 2020, and the Danish Council on Climate Change is also active, following the revision of the climate change law in 2020 [13]. The field of climate change governance calls for a two-fold strategy that includes both adaptation and mitigation efforts. Managing society's response to the changing climate and reducing carbon emissions are lengthy processes [1].

Climate change governance can be difficult because these issues can be easily politicized. In particular, in the USA, given the severe polarization of partisanship and the resulting difference in climate change policy preferences, climate change policies fluctuate greatly whenever the regime is replaced [4]. The USA withdrew from the Paris Agreement when President Trump, from a conservative administration, came to

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power, and the response to climate change greatly retreated. However, President Biden, from a liberal administration, is currently in power and actively responding to climate change. In addition to the USA, in several countries such as Australia and Canada, policy execution is unstable as government policy stance changes depending on the ruling party [5].

Likewise, in South Korea, as climate change policy issues become politicized, trust and sustainability in long-term plans become low [6]. The conservative Lee Myung-bak administration (February 2008–February 2013) implemented fossil fuel-based energy demand management and pro-nuclear policies. Contrarily, the Moon Jae-in administration (May 2017–May 2022), a liberal government, announced pledges to phase out coal and nuclear power by temporarily halting the operation of coal power plants and completely halting their construction. Each regime established collaborative governance committees to respond to climate change in line with its political stance. The conservative government formed the Green Growth Committee (GGC), proposing low-carbon green growth. The liberal regime formed the Carbon Neutrality Committee (CNC) while declaring carbon neutrality. The GGC and the CNC are quasi-governmental organizations established via presidential decree to facilitate the alignment of positions across diverse ministries and to incorporate insights from private experts. In Korea, the power and authority of the president are strong because it is based on centralized governance and a strong bureaucratic culture. Therefore, changes in climate change policies and governance following a regime change are inevitable.

Another challenge in climate change policy-making through governance is lock-in. "Lock-in" refers to the inherent path-dependency observed in socio-technical systems, posing a significant barrier to the integration of novel innovations into the domain of climate change governance efforts [1]. Korea is one of the world's top 10 energy-consuming countries, with an economy that consumes considerable energy and depends on fossil fuels. In Korea's energy policy field, technology, markets, businesses, consumers, and the government influence each other, locking the existing fossil fuel-based system. A lock-in in energy policy leads to a lock-in in energy governance. Energy policy is an area where the government's centralized elements are the strongest and administrative regulations are severe [7]. Therefore, energy governance is characterized by centralization, authoritarianism, and closure [8]. In Korea, energy policy has been dismissed as the domain of bureaucrats and experts, with limited citizen participation [5]. Thus, despite lower costs and more forward-looking alternatives, the energy sector is likely to remain locked in by vested interests [9].

This study investigates the impact of changes in the political regime on climate change governance. The ultimate goal is to examine the factors contributing to the phenomenon of lock-in, where climate change governance behaviors and responses remain largely unchanged despite a change in government. The research questions are as follows: First, in Korea, does the difference in political orientation between liberal and conservative governments affect climate change governance? Second, if differences in political orientation do not affect climate change governance despite the president's high interest, what factors prevent the transition?

2. Background and literature review

2.1. Collaborative governance

Collaborative governance refers to the process in which organizations from various sectors come together to discuss, strategize, execute, and evaluate solutions for public policy issues that cannot be easily addressed by a single organization or public sector alone [10]. Upon examining its key contents and features, the following points are evident. First, diverse stakeholders' value judgments, made through interactions, are incorporated into the planning process. Second, emphasis is placed on the interaction between specific plans and the broad planning context or societal value systems surrounding them. Third, it highlights social learning that induces shifts in participants' thinking and cognitive approaches, rather than solely focusing on their interaction. Fourth, it asserts the need to verify whether consensus is translated into execution [11,12]. The essential components of collaborative governance encompass stakeholders, modes of communication, social learning, and the implementation of agreements [13–16]. The necessity for collaborative governance in climate change arises from its association with uncertain and intricate issues that cannot be adequately tackled by a solitary organization or the public sector in isolation. Furthermore, given the ever-evolving nature of climate change concerns, it is imperative to adopt a process-oriented perspective within collaborative governance.

2.2. Emergence and impact of climate change governance

From the late 1960s environmental governance came into being across the developed world, spreading later to developing countries. The emergence of climate change now requires a further phase of innovation and adjustment to governance practices [1]. Research on shaping and changing climate change governance falls into three categories. First, comparative studies compare the governance of several countries. The emergence of climate governance can be analyzed through the role of elections and political incentives, normative commitments of policymakers, political institutions, and structures, the link between domestic politics and international policy [17], or through the interaction of international flows and bureaucratic structures [2]. Second, as a study targeting a small number of cases, multi-stream model developed by John Kingdon was applied [18,19]. Previous studies show that regime change, which enables institutional change in the political flow, is the most important cause of policy formation and change.

Some studies strive to evaluate the effectiveness of climate change governance. Within the environmental governance literature, a growing body of work advances the notion that the learning that takes place during participatory processes involving diverse stakeholders contributes to improved governance outcomes [20–23]. Studies have evaluated the certainty, predictability, and sustainability of the Climate Change Committee through interviews with the UK Climate Change Act and officials [3,24–29]. Most of them evaluated the committee positively but expressed concerns about its authority and political sustainability.

2.3. Climate change governance and political systems

Climate change governance and political systems are reviewed in terms of the politicization of climate issues and the impact of political institutions on climate change governance. First, to understand the dynamics of climate change policy, it is necessary to observe the political realm where discourse takes place [30]. The biggest feature of climate change in the UK is the politicization of the issue: the more it is politicized, the more hastened the policy decisions. During elections, eco-friendly rhetoric appears as "environmental politics" and "green governance," but after the elections, political popularity on climate change issues declines, and politics soon becomes an obstacle to an effective response to climate change [31].

In particular, since the USA does not have a federal-level law, it fluctuates greatly whenever the government changes. The climate change response policy promoted by Obama retreated when the Trump administration came to power. At present, the Biden government is strongly promoting the climate change policy. Climate change governance does not mediate climate politics, but politics mediates climate change governance [3]. As such, the climate change issue has become polarized among political parties. As a result of analyzing the remarks of US lawmakers, the Liberal Party considered the impact of climate change on public health, opportunities for green growth, and the value of consensus as important. However, Republicans had many opinions about resistance to climate change and opposition to legislation [30].

Studies on how each country's political system affects climate

change issues, budget investment, and committee operation have been actively conducted in comparative politics. Electoral systems and the involvement of interest groups can affect climate change policy investment. Policy changes in regions and countries with consensus-based democratic institutions, such as Northern Europe, Austria, Germany, and Switzerland, are gradual and unlikely to reverse. Whereas, countries such as the USA, Australia, Canada, and the UK have competitive and hostile institutions, undergo radical policy changes, and are at high risk of policy reversal. A good agreement between the parties or a proportional representation results in a tendency to invest heavily in climate policy [5,24]. The larger the difference in political orientation between the conservative and liberal parties, the greater the impact on climate policy and the more limited the climate policy responses. However, the smaller the difference in political orientation, the more supportive the consensus [32].

2.4. Climate change governance and lock-in

Successful climate change governance needs to overcome the path dependence of the technology-institution complex system [1]. Path dependence refers to when past policies set in a specific direction induce future policies in the same direction [33,34]. Once created, the system does not change easily and acts in a path-dependent manner, affecting the next regime [35]. It highlights the imbalances in power relations and unintended consequences of institutional design [36]. Once the direction of an event, policy, or institution is determined, it acquires inertia, resulting in a lock-in phenomenon [37]. Path dependence includes initial route setting; route lock-in refers to the phenomenon of following an existing route [34]. Since the scope of this study does not include the initial route setting, it is examined from the perspective of lock-in.

Studies have analyzed energy policy and climate policy transitions from the perspective of path dependence or lock-in. Because our lives and socio-economic activities depend on energy, climate change policies have a strong lock-in effect [38]. Electric power systems continue to be "carbon lock-in" because many countries heavily depend on fossil fuel-based electricity generation and consumption systems [6,39]. Carbon lock-in refers to a situation where infrastructure, technology, institutions, and actions are in a path-dependent balance with the introduction of large-scale fossil fuel power generation technologies [40,41].

Unruh [42] classified carbon lock-in factors into a technological, institutional, industrial, social, and organizational lock-in. Following this, Jin [34] analyzed why the Moon Jae-in government pledged nuclear power and coal phase-out, and the route is locked in terms of diplomacy, institutions, organization, politics, and industry.

2.5. Climate change governance in Korea

This section explores Korea's climate change governance, encompassing the nation's energy situation, its history of climate change discourse, and the governance attributes of each regime. First, Korea achieved rapid economic development led by the government. It is important to stably secure affordable energy resources for economic growth. Korea cannot connect to the Eurasian continent due to the division of North and South Korea, so it is impossible to import electricity; hence, all electricity is produced domestically. Although a stable power supply is essential within the country, Korea relies on imports for 96 % of its energy sources [43]. Carbon emissions from the Korean power industry have been steadily rising. Therefore, it is not easy to break away from the existing carbon-dependent system. Policy tendencies favoring large-scale power generation facilities based on economic feasibility, low electricity rates, rapid demand for electricity in summer and winter, and the absence of a flexible rate system have led to carbon lock-in Ref. [44].

The climate change debate in Korea began in the late 2000s. First, the Lee Myung-bak administration presented low-carbon, green growth as a national vision. Green growth emphasizes stimulating the domestic economy and job creation through public investment. It was criticized as a greenwash policy because it included projects without any direct connection to climate issues [45]. However, it is meaningful as it made the climate agenda of green growth a national agenda for the first time in Korea.

Among the climate change-related debates in Korea, nuclear power is a highly scientific and political issue [46]. A survey on nuclear power showed that those who support conservative parties tend to prefer nuclear energy [47]. After the Fukushima nuclear power plant accident caused by the earthquake and tsunami in 2011, negative thoughts about nuclear power generation spread among the Korean people, and anxiety increased due to the 2016 earthquake [48,49]. In 2017, President Moon Jae-in, who promised to reduce nuclear power plants, was elected.

Since the late Park Geun-hye administration, fine dust pollution has emerged as a new national issue. President Moon ordered an emergency reduction of fine dust materials from fossil fuel plants shortly after taking office. He set it as a national agenda, implementing actions such as temporarily suspending the operation of coal-fired power plants. As this issue became serious, a climate environment meeting was organized to solve it [34]. The history of collaborative governance in Korea is not long, and it is questionable whether the national-level governance structure works properly [6]. Given the economic and technological developmental tendencies, energy policy was the domain of experts, excluding public participation [47]. In 2017, President Moon suspended Units 5 and 6 of the Shin-Gori Nuclear Power Plant and conducted a deliberative polling process in this regard. This administration broadened the horizon of participation by expanding it to the general public and publicizing challenging and controversial questions about the future of Korea's nuclear power in its vision of deliberative democracy [46].

3. Research method and analysis framework

3.1. Research method

3.1.1. Research design

This study conducted qualitative research using literature and interviews. Qualitative research was selected because it is well-suited to uncovering intricate processes. Moreover, the complex social dynamics involved in governance processes cannot be fully understood using quantitative methods alone [49]. In order to reveal hidden complexities that cannot be easily quantified, we carefully examined a wide range of textual resources and conducted thematic analysis. This analytical method assisted us in discovering concealed content and common themes, which in turn unveiled deeper meanings through a systematic analysis process guided by the researcher's insights [50,51].

3.1.2. Data collection

First, to examine the composition and governance process of each committee, literature research was conducted, including the minutes of the National Assembly, minutes of each committee, committee-related laws, reports published by state agencies, reports by related researchers, daily newspapers, magazines, and related books. Among the minutes of the National Assembly meeting, the special committee related to climate change response, the environment and labor subcommittee, the budget settlement special committee, the plenary session, and the confirmation hearings related to climate change governance were analyzed intensively. Minutes were collected by dividing them into the time when the GGC (2009–2020) and the CNC (2020–2021) were formed.

Second, interviews were conducted to analyze aspects that are challenging to confirm in the literature, particularly the decision-making and consensus-building processes of each committee. The initial selection of interviewees aimed to gain insights into governance and included members from both GGC and CNC, including the chairman of the CNC. Subsequently, we selected external stakeholders critical to

the governance process by snowball sampling method. To ensure fairness, this group included politicians, academics in the energy sector, and civil society representatives with a strong interest in the two committees. Table 1 provides details about the interviewees.

3.1.3. Data analysis

We conducted a thematic analysis of qualitative data, which included interview transcripts, meeting records, and reports. This analytical approach helped uncover hidden content and shared themes, revealing underlying meanings through a process of systematic analysis, guided by the researcher's insights [49,50].

From this qualitative dataset, we identified recurring key data points and categorized them into three core themes, using a refined interpretive approach. The first theme focuses on how climate change policy evolves across different administrations, while governance practices stay consistent. The second theme conducts a comparative analysis of collaborative governance methods within the two committees. The third theme delves into various contentious aspects within climate change policy and governance.

By carefully interpreting these themes and the supporting data, we formulated the following hypothesis: While the climate change governance in South Korea exhibits variations in policy direction and expert composition based on the political orientation of the ruling government, there are only minimal differences in the actual governance process. Along this analytical journey, the theme of 'lock-in' naturally emerged, shedding light on the intricate complexities that hinder innovative progress within the field of climate change governance.

3.2. Analysis framework

Climate politics, which influence processes of governance formation and transformation, examine international trends, the political environment, and the needs of civil society. Based on previous research on collaborative governance, the composition of stakeholders, communication methods, social learning, consensus building, and enforcement are derived and analyzed as constituent factors of governance. Finally, industrial, political, institutional, and diplomatic lock-ins constraining the planning process are analyzed.

First, climate change governance does not emerge from a blank canvas, rather, it is based on the political interests of the country and the demands of civil society, while following global discourse and trends. Ratifying international agreements and adopting national policies become political decisions [17] in the context of domestic interests, discourse, and political institutions; civil society's demands are also influential.

Second, in collaborative governance, we analyze who the stakeholders are involved with, how they interact, and what was the basic position and attitude of the subject of the action. It was confirmed whether stakeholders representing conflicting values were widely involved in the planning process. At this time, the power and resources of the stakeholders are inevitably different, represented by the size of the circle inside the planning system. We investigated how to communicate with each other to form relationships and exchange knowledge. We considered whether the information is provided or shared and whether social learning takes place based on this. We also examined whether agreements reached through interaction were concretely implemented [11].

Third, the essential and core contents of governance do not change despite external changes due to the inertia of existing institutions or the status quo thinking and belief systems of actors [51]. Korea's industrial structure and technological interrelationships cause industrial lock-in, and government policy intervention, the legal system, and the administrative system can cause administrative institutional lock-in. The inertia of the political system, two-party parliamentary politics, and bureaucracy can lead to political lock-in. Finally, diplomatic lock-in may occur due to international and interstate agreements and international order. We considered together how these lock-in factors structured and constrained the governance planning process. Fig. 1 shows the analysis framework of this study.

Table 1
Interviewee details.

Interviewee	Field	Type of Participation	Date
A	Civic group	Internal member of the Green Growth Committee, Carbon Neutrality Committee	2022.5.24
B	Politics	Energy Transition Policy Expert, External Perspective of the Committee	2022.6.7
C	Enterprise	Internal member of the Green Growth Committee, Carbon Neutrality Committee	2022.6.28
D	Academia	Energy Transition Research Expert, Outside Views of the Committee	2022.7.12
E	Civic group	Representative of civic groups, internal member of the Carbon Neutrality Committee	2022.7.26
F	Academia	Criticism of the Green Growth Committee, internal member of the Carbon Neutrality Committee	2022.8.23

4. Results

4.1. Green Growth Committee and Carbon Neutrality Committee

The GGC and the CNC were launched by presidential decree. The GGC was established in February 2009, immediately after the Lee Myung-bak administration was launched in February 2008; the CNC was launched in May 2021 by the Moon Jae-in administration. The main activity period of the 1st GGC was from 2009–2010, and that of the CNC was from 2021–2022. Both committees enacted related laws after their inauguration and were launched by integrating committees created in the previous administrations. The GGC integrated the Sustainable Development Committee, the National Energy Committee, and the Climate Change Countermeasure Committee; the CNC integrated the GGC and the Climate Environment Conference.

The GGC was established to deliberate on major policies and plans related to the control tower of low-carbon green growth and matters related to their implementation and was actively pursued as a presidential priority policy task. It is an organization with strong bureaucratic influence and can be seen as a form of a task force for efficient policy execution rather than a deliberative body [52]. However, with the inauguration of the Park Geun-hye government, it was downgraded to the Prime Minister's Office and lost its driving force.

The CNC was established as a control tower for carbon neutrality policies to deliberate and check the implementation of major policies and plans. Opinions from various sectors of society and the general public were collected, and a carbon-neutral scenario was announced. When the 2050 carbon neutral scenario and 2030 NDC were announced, both industry and civic groups protested. It was operated for a short period as it was launched near the end of the term, and the committee is being reformed as a new government is launched.

Both committees have commonalities in their formation, ending, and purpose. Instead of revising the underlying law and initiating a committee, the existing related committees were integrated and launched by presidential decree, and the underlying law was enacted. The active working period was about a year; both committees lost momentum with the next government. Although their purposes were different – "low carbon green growth" and "carbon neutrality" - each served as a control tower, consulting and reviewing major policy plans and implementation. When comparing the deliberation process, both committees showed no noticeable difference except that the term green growth was changed to carbon neutrality [45,46]. The committees were similar in their insufficient policy coordination function and weak sustainability.

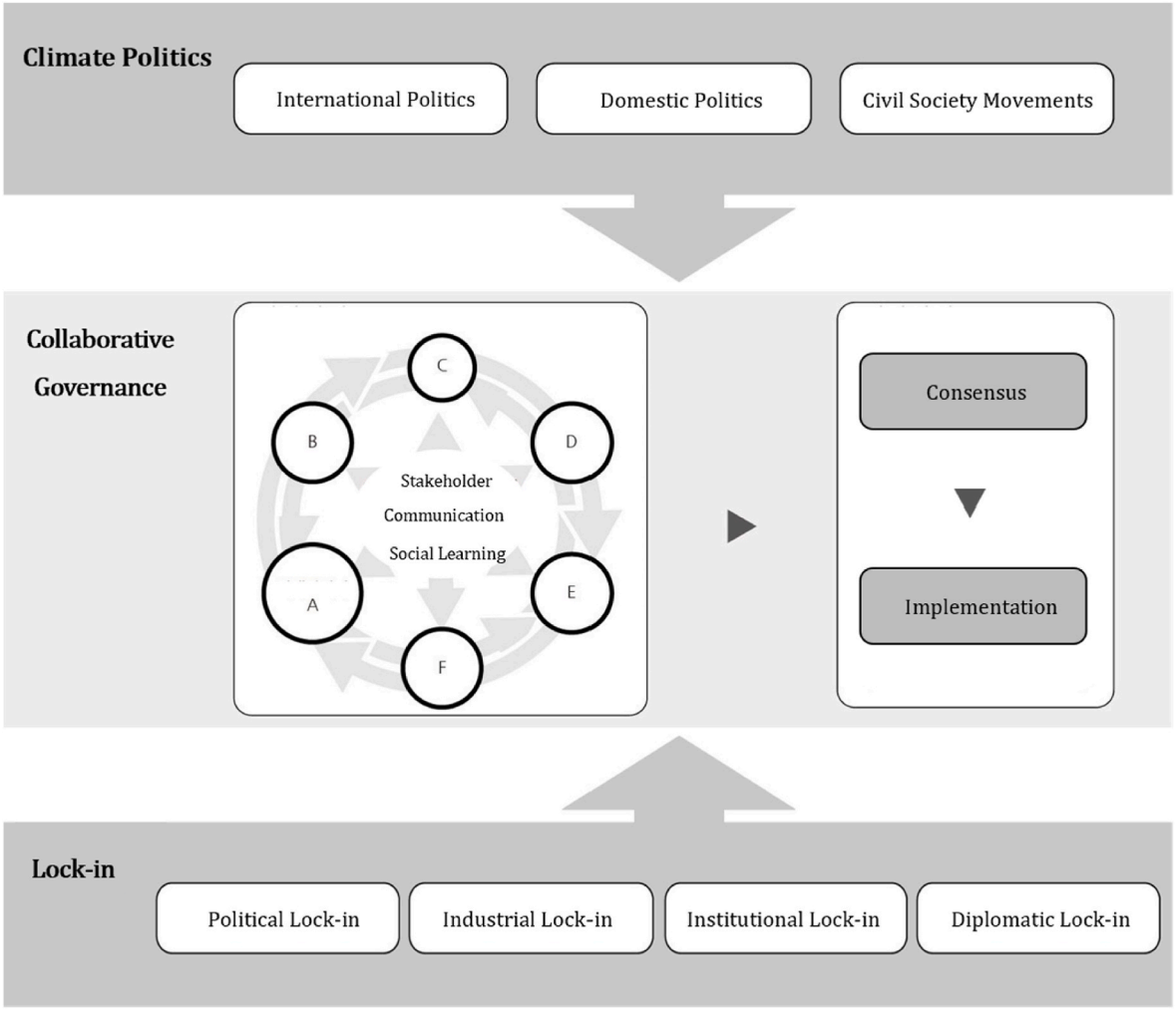

Fig. 1. Analysis framework.

Since relevant laws and plans overlap, plans for which the establishment entity is unclear and sometimes conflict. Key stakeholders involved in the two committees said the following:

> (GGC) "If you look at the process of low-carbon green growth promotion, it seems it is just a name: 'green.' Indeed, the paradigm must change, and the policy must change. However, the contents do not change in the framework of the existing policy. It just means they are increasing the budget." (Member of Parliament Jae-yoon Kim, 2008.11.12)

> (GGC) "Policies change again in the process of promoting low carbon and green growth. When I look at it from the outside, things only go back and forth related to funds. GGC makes plans and appears to provide services, but there is no progress in the work. And then time just passes. I've been receiving business reports, but I don't know what they're doing." (Member of Parliament Doo-eon Jung, 2008.11.12)

> (GGC) "What on earth is green growth? Our lawmakers and government agencies are confused about the restoration of the four major rivers, new green growth engines, and the five-year plan for green growth. I am confused because the plans do not seem to have been organized from the concept." (Member of Parliament Jong-Hyuk Lee, 2009.7.13)

> (GGC, CNC) "It has been more than 20 years since civil society groups and academic experts participated as stakeholders when the state made policy decisions based on theory and law. But over the past 20 years, governance systems have hardly changed … Stakeholder participation is necessary, but I don't think the current format is helpful. Consequently, I don't think there is a big difference in governance between conservative and liberal governments." (Interviewee B, 2022.6.7)

4.2. Formation and change of climate politics and governance

Examining the international trend that led to the GGC, the 4th IPCC Report was published in 2007, just before the Lee Myung-bak administration; this served as an opportunity to order countermeasures from the international community. By adopting a new negotiation track at the 13th United Nations Framework Convention on Climate Change (UNFCCC) held in December 2007 and discussing including developing countries, Korea had to respond to climate change [45]. At the G8 summit held in 2008, although it was a non-mandatory reduction country, Korea announced its mid-term GHG reduction goal and declared that "Korea will become a leading country in climate change" [53]. As for the political background, in February 2008, a conservative government under the banner of "a vibrant market economy and a mature world nation" was launched, and "Low Carbon Green Growth" was presented as an agenda for national affairs in commemoration of the 60th anniversary of the country's founding.

The background of the CNC establishment is as follows. Since adopting the Paris Agreement at the 21st UNFCCC Conference in 2015,

the goal has been to limit global temperature rise to less than 1.5 °C. Since then, the EU declared "2050 carbon neutrality" in 2019, Japan declared "2050 carbon neutrality" in 2020, and even China declared "2060 carbon neutrality." These declarations became a catalyst for Korea to declare carbon neutrality. Its political background began with the inauguration of the liberal government, launched after the impeachment of Park Geun-hye's government. When the National Assembly adopted a resolution calling for an emergency response to the climate crisis, President Moon Jae-in declared carbon neutrality at the National Assembly.

The formation of climate change governance by the GGC and CNC was created due to international trends and political factors as follows:

> (GGC) "There are many requests from the international community for Korea to play a leading role for developing countries in responding to climate change; thus, as a former developing country, we want to act as a bridge between developed and developing countries." (Climate Change Ambassador Sung-hwan Son, 2011.8.29)

> (CNC) "It is said that special envoy John Kerry requested the NDC to be raised by more than 50% from the current level. He called for an early phase-out of coal power generation and an end to public financial support for coal companies." (Member of Parliament Lee-ja Lim, 2021.4.21)

> (CNC) "President Moon Jae-in had no interest in climate issues but was forced to adopt climate change policies because of domestic politicians, civil society, and international changes. He is forced to declare [that his country will be] carbon neutral due to external discussions." (Interviewee D, 2022.7.12)

4.3. Governance planning process analysis

4.3.1. Stakeholder composition

The GGC has three subcommittees: green growth & industry , climate change & energy , and green life & sustainable development. It is composed of the Prime Minister, civilian chairperson, 26 civilian members, and 17 central administrative agencies. The CNC has eight subcommittees: climate change, energy innovation, economy and industry, green life, process conversion, science and technology, international cooperation, and public participation. It is composed of the Prime Minister, the civilian chairperson, 75 civilian members, and 18 central administrative agencies. While the GGC has a high proportion of academics and a small number of experts in the economic field, the CNC is composed of stakeholders from various fields, such as civic groups, youth, and religious groups.

Compared to the GGC, the CNC includes stakeholders from various fields and has expanded in size. While the GGC minimized citizen participation and emphasized efficient operation, the CNC was conducted in a large-scale ceremony. The CNC made efforts to be representative of the country's entire population by distributing them per age, region, and gender; whereas, the GGC included only one civic group.

Although the composition and size of the stakeholders were different, both committees had one thing in common: they were composed of figures chosen or preferred by the government and failed to reflect the voices of social subjects. Partiality in the composition of stakeholders, such as policies, was raised [8,54]. Key stakeholders involved in the two committees said the following:

> (CNC) "The CNC increased the number of people from 25 to 100. But I don't think the governance process has evolved. Because not all 100 people can have a meeting; we only meet twice, at the beginning and the end. Rather, I think it's blocking participation even more … It is not that all organizations must be included in the CNC; instead, it must comprise organizations' representatives. There was no discussion about which groups should be included." (Interviewee B, 2022.6.7)

> (CNC) "The CNC had too many members to focus on. There were a lot of members and quite a few people didn't show up. Because of the number of people, it was distracting and inefficient. Even if we took the time to talk about it, it felt like little had changed." (Interviewee C, 2022.6.28)

4.3.2. Communication method

To examine the communication method, the GGC's plan to set the national GHG reduction target and the CNC's 2050 carbon neutral scenario setting process are reviewed. First, after presenting three scenarios, the GGC held a total of 44 events, including 15 forums organized by GGC, 14 by industry, 3 for the National Assembly, 4 for local public hearings, 5 for industries, and 3 for civic groups [55]. The CNC continued communication through 126 subcommittee meetings, 16 general planning meetings, 4 citizen meeting surveys, 20 roundtable meetings, 12 expert committee meetings, and written submissions of opinions in each field [56].

The GGC conducted three public opinion polls, and the CNC conducted deliberative polling. Opinion polls have limitations such as a superficial attitude where an unspecified majority responds without knowing the issue well. Deliberative polling was developed by James Fishkin, where a response goes through deliberation, such as learning and discussion [57].

The communication method developed outwardly, but there are still limitations in terms of practice. Both committees employed one-way communication processes, and insufficient time was provided for participants to engage in critical discussions and debates. The communication process was not voluntary as there was no opportunity for direct stakeholder participation. The government accepted citizen participation as a paternalistic approach based on professionalism [58]. Key stakeholders involved in the two committees said the following:

> (CNC) "The technical working group is not a member of the CNC, but it pushed the government's plan during the discussion process because of its expertise. It was difficult for carbon-neutral members to comment. It was not a situation that could be accepted even if we talked about it." (CNC member, KBS, 2021.8.10)

> (CNC) "The NDC must be submitted by November, but the CNC was formed only on May 29; the government did not upload the review data until mid-June. Scenario work and NDC had to be done in two and a half months, and it was a process of recruiting citizens, learning, discussing, and even conducting surveys. I had to do a lot in a short period. We worked as if we were being chased." (Interviewee A, 2022.5.24)

> (CNC) "Fifty percent of the regrets about the CNC are that it was not given enough time. Opinion convergence does not take several months. It is important to communicate continuously for at least six months, but the time was too short." (Interviewee E, 2022.7.26)

4.3.3. Information provision and social learning

The CNC has improved more than the GGC in terms of explaining difficult terms, provision and disclosure of data, and frequency and activeness of sharing. However, disclosure and sharing of information were limited to citizens' associations; ordinary citizens could not access it from the homepage. It was unknown who made what remarks, only disclosed opaquely in a summarized state. Both committees used complex terms and language when providing information, making it difficult for citizens to understand. Disclosure of government data or minutes of national committee meetings is a chronic problem. Minutes and data are partially disclosed, but sensitive data are deleted or summarized and disclosed.

The information was provided and shared for promotional purposes,

with a tendency to exclude controversial issues. The CNC can be evaluated as developing governance while conducting social learning for citizens' meetings. However, there were limitations due to the short time for learning and public debate, operating only half the time originally planned. Key stakeholders involved in the two committees said the following:

> (GGC) "Even though I am a secretary of the Environment and Labor Committee and a member of the GGC, the terms are all difficult." (Member of Parliament Won-jin Cho, 2009.7.13)

> (CNC) "There is only a report that a committee has been formed; it has not been disclosed what was discussed. Indeed, the stenographic records were not written at all, and even if they were, the real names were missing. Participants said they could not speak if their comments were known outside the committee. I don't know who talked about what, and I can't get any materials from the meeting." (Interviewee B, 2022.6.7)

> (GGC, CNC) "There is no disclosure of minutes from the National Committee. Because too much of the information is confidential, including domestic information that can cause international problems, some issues cannot be accessed without permission." (Interviewee F, 2022.8.23)

> (CNC) "When the CNC was launched, it was said it would be active for about two years, but it was recently notified that its role had ended. The citizens' assembly process was also planned for two years; but regrettably, it shut down after about a year." (Interviewee A, 2022.5.24)

4.3.4. Consensus building and implementation

In terms of governance, there are two problems with the GGC and the CNC: First, "whether the reached consensus is a genuine consensus," and second, "there are no compulsory measures to reflect the reached agreement in policy implementation." The consensus of the meeting was reached with a lack of enough deliberations or replaced by a government decision. GHG reduction-related policies announced by the GGC were not linked to implementation. The low-carbon vehicle subsidy policy was drafted by the Lee Myung-bak government but implementation was deferred by the subsequent Park Geun-hye government; the Moon Jae-in government abolished that policy. As the regime changed, consensus could not be implemented. In addition, the implementation and decision process were not linked, such as the budget plan for the next year being compiled before the announcement of the 2050 carbon-neutral scenario. Even when actual projects were executed, the non-execution rate was high. Key stakeholders involved in the two committees said the following:

> (CNC) "It was divided into eight departments, but I don't know what criteria they used. Opinions differed between departments. An agreement was reached, but there was a lack of empathy." (Interviewee E, 2022.7.26)

> (GGC) "Social consensus must be reached by public opinion; however, I believe that administration begins with the initiative of leadership. This is the case." (GGC Chairperson Hyung-guk Kim, 2009.4.14)

> (CNC) "The 2050 carbon neutral scenario was announced in August. The public opinion collection went through discussions and formalities—it was called the collection of opinions and the carbon-neutral scenario was announced in less than two months in August and September. However, regardless of the announcement, all budget plans for next year have been compiled." (Member of Parliament Seung-soo Kim, 2021.11.9)

> (GGC, CNC) "Around 37.6%, or KRW 307.9 billion of the total budget of KRW 818.8 billion to expand the supply of eco-friendly vehicles has not been executed. Out of the total hydrogen vehicle budget of KRW 239.2 billion, 53.8%, or KRW 128.6 billion was unused, indicating very low execution performance. Why is the non-execution rate for meaningful projects for carbon neutrality so high?" (Member of Parliament Ki-Dae Yang, 2021.9.7)

5. Discussion

5.1. Lock-in of climate change governance in Korea

When comparing GGC and CNC based on the criteria of 'stakeholder composition,' 'communication methods,' and 'information provision and social learning,' there were superficial differences in the governance planning process. However, in practical terms, both committees had limitations, and ultimately, the actual outcomes of the governance process did not significantly differ because neither GGC nor CNC achieved 'consensus building and implementation.' Evidence that the governance process did not change significantly can be found in the actual energy policy lock-in. While GGC advocated for policies emphasizing fossil fuel-based energy demand management, and CNC declared the phase-out of coal power, the substantive policy landscape remained largely unchanged. This becomes evident when we examine the coal capacity projections outlined in the 9th Basic Plan for Electricity Supply and Demand. According to the plan, coal power capacity is expected to increase from 35,842 MW in 2020 to 40,612 MW in 2024, with no signs of reduction [59]. The projections indicate a peak in 2024 followed by a decline, yet this outcome isn't assured, as there has been a consistent upward trend. In 2021, the newly constructed operation of the Shin Seochun and Goseong coal power plants. Construction continues and is expected to be completed in 2023 (Anin) and 2024 (Samcheok). With this addition, South Korea has increased its coal capacity by 3.1 GW, making it the third-largest coal power-generating country globally, following China and India [60]. The study results indicate no appreciable difference in the actual behavior and outcomes of governance operations, despite changes in policy direction and content.

5.2. Analysis of lock-in factors

5.2.1. Political lock-in

Governance is shaped and structured by past power relations, and countries with a history of strong centralization tend to be difficult to coordinate [11]. Korea has experienced a long history of centralization and is characterized by an imperial presidential system. Government committees are created spontaneously according to the interest of the president without clear standards [61], and the will of the president is the most important in operating the committee. The Korean presidential system adopts a single five-year term. This poses a significant challenge, especially in the context of climate change response policies, which demand a prolonged commitment for their full efficacy to materialize, extending into subsequent governments. Following the Lee Myung-bak administration, the climate change policy during Park Geun-hye's presidency experienced reductions and rollbacks. Subsequently, during the Yoon Seok-yeol administration, which succeeded the Moon Jae-in presidency, climate change concerns were notably absent from the policy agenda, mirroring a recurring trend.

Despite these changes in political power, the governance of climate change policy has not changed significantly. One reason for this political lock-in could be the operation of "politics by bureaucracy" where climate change policy decisions in Korea are not made by the parliament or the public but by public officials. Bureaucracy refers to political interactions within the executive branch, not the legislative branch, the representative state body of democracy [62]. In Korea, government officials mainly lead the climate change issue. Since President Lee Myung-bak's inauguration, when the climate change issue began to become a presidential agenda, the government became a de facto

advocate and controlled it [50]. Even in the Moon Jae-in administration, bureaucratic politics began when the minister and vice minister of the Ministry of Trade, Industry, and Energy (MOTIE), responsible for energy conversion and climate change response, were replaced with former bureaucrats [34]. Bureaucratic politics are possible because the Korean government is strong, but the National Assembly's authority is weak. Policies were promoted without going through the National Assembly, thus, it did not act as a veto point for policies.

For CNC, citizens were recruited and a deliberative polling process was conducted; however, there were limitations due to Korea's unique politics and discussion culture and time limits. Democracy was transplanted from the West in Korea, but Confucian tradition is strongly embedded in its political culture. Under total monarchy and Japanese colonial rule, an authoritative political culture was formed, with a tendency to obey domination and power [63]. For complex issues such as climate change, there is a latent tendency to prefer immediate and decisive decisions by objective experts and technical bureaucrats [64]. In many cases, it was a one-way process of conveying opinions rather than a discussion; the communication process was also used in substitution for policy promotion. The key stakeholders said as follows:

> (GGC) "Low carbon, green growth, an unfamiliar slogan to the people, suddenly started being used by the president." (Member of Parliament In-je Lee, 2008.11.12)
>
> (GGC) "This is the current state of our overall low-carbon, green growth. When the president says something, they just rush out." (Member of Parliament Je-chang Woo, 2008.11.12)
>
> (GGC) "Since the establishment of the government, they have spent all their time making plans, and I wonder when they will be able to do the work." (Member of Parliament Doo-eon Jeong, 2009.7.13)
>
> (GGC) "No matter which administration comes next, the next government must succeed and develop the policies of the previous government. Without a solid and sophisticated strategy, it could be another tailless policy, ending with this government." (Member of Parliament Jong-hyeok Lee, 2009.7.13)
>
> (GGC) "The Roh Moo-hyun administration placed the Sustainable Development Committee under the president and set it as an important policy agenda. It was an important policy agenda at the time, but are you saying that it is not anymore after it suddenly came over to the Lee Myung-bak administration?" (Member of Parliament Minhee Choi, 2014.3.3)
>
> (GGC, CNC) "Even though Korea's energy policy is very important, it is not treated as an important issue. Members of the National Assembly did not deal with it as an agenda, and it did not enter the presidential pledge. I think the reason is politics by bureaucracy. It is apparent that energy policy was not a decision made by the people or by representative members of the National Assembly, but that it was a process in which bureaucrats sorted out most situations and decided." (Interviewee D, 22.7.12)

5.2.2. Institutional lock-in

The Moon Jae-in administration was also unable to escape the legal system created by the Lee Myung-bak administration. This administration was launched in a hurry after the impeachment of President Park Geun-hye, and the government was inherited without any system improvement [34]. The Framework Act on Green Growth and policies related to green growth created by the Lee Myung-bak administration act as a legacy of climate change policy.

The formal governance role of Korea's committees is also a factor contributing to institutional lock-in. The committee has been formed to derive consensus from experts or groups with various interests, breaking away from hierarchical decision-making at the level of democracy and participatory politics. However, it has been abused as a symbolic system to compensate for the lack of legitimacy of authoritarian regimes [65]. Rather than being a channel for citizen participation, the committee is being used to justify government policies that utilize citizen participation [61].

Since the GGC and the CNC reviewed greenhouse gas (GHG) reduction targets and scenarios based on the data and proposals provided by the government's technical working group, it was difficult to make a decision that deviated from the government's plan. Many government committees and government-funded research institutes tend not to make proposals deviating from the government policy stance because they are directly or indirectly pressured to conform to it [58].

Complex administrative procedures, insufficient budget, and poor execution performance can be seen as a lock-in of the administrative system. Even after the launch of the CNC, the budget was not allocated, the website was not created, and it was set up as a government organization; thus, it underwent complicated procedures. Such inefficient administrative practices homogenized the operation of the committee. The key stakeholders indicated these institutional lock-in examples as follows:

> (GGC) "Green growth has no responsible department. In the manufacturing and industrial sectors, the Ministry of Knowledge Economy is involved; as for people, various related ministries such as the Ministry of Environment and the Ministry of Culture and Tourism are involved. The department in charge should be the center, but it is not. This is likely to be duplication of work, competition, and chaos." (Member of Parliament Won-woo Baek, 2009.2.20)
>
> (GGC, CNC) "Both the GGC and the CNC did not have information disclosure issues or a democratic decision structure. It was a chronic problem, with access rights to government data and information asymmetry among participating members." (Interviewee B, 2022.6.7)
>
> (CNC) "We need to increase the budget in the National Assembly, but the opposition party in our country's politics is opposed to it. The most absurd thing is that when the committee was launched, of course, there would be a website. It took over three months to make it. The budget itself was not allocated; since this is a state organization, to prevent hacking, I had to go through too many procedures, including procedures at the NIS (National Intelligence Service) and a public offering procedure— I went through too many bureaucratic things … There were so many mountains to overcome." (Interviewee F, 2022.8.23)

5.2.3. Industrial lock-in

During the industrial growth period, Korea achieved rapid economic growth based on an industrial structure centered on the manufacturing industry, especially the heavy chemical industry, according to the government-led top-down industry development plan. It still has an industrial structure centered on manufacturing, an energy-consuming industry. The share of manufacturing in total value-added production was 27.1 % as of 2020, ranking second among OECD countries (National Statistics Portal). To maintain the current industrial structure, Korea's electricity supply generation is largely dependent on traditional fossil fuels; national electricity sources include coal (36.65 %), nuclear power (29 %), and gas (26.4 %) [66].

It is not easy to shift the existing energy industry structure within a short period. The Moon Jae-in administration has introduced policies to phase out coal and nuclear power plants but it could not reduce coal power generation and nuclear power plant capacity. Construction of seven new coal-fired power plants will be completed by 2024, and nuclear power generation is also increasing [54]. MOTIE expressed that support for the nuclear power industry is being promoted consistently as in the past [23]. The Lee Myung-bak administration provided support for private companies to enter coal-fired power plants to improve electricity market efficiency, but they have not yet withdrawn. In Korea,

while implementing policies to phase out coal and nuclear power plants, Korea continued to invest in overseas coal power plants and was criticized for its duplicity in trying to export nuclear power plants to the UAE. The key stakeholders said as follows:

(GGC) "Korea has a particularly high share of energy-consuming industries, such as steel, petrochemicals, cement, and heavy industry. The supply and demand of alternative fuels is very poor. I am concerned about changes in the industrial structure." (Member of Parliament Je-chang Woo, 2009.4.14)

(GGC) "In general, the understanding of climate change and low-carbon green growth in the industry remains insufficient. The industry has almost no idea about the low-carbon sector and is focusing only on new growth. The industry is very negligent in its immediate obligation to reduce carbon emissions, and there is a lot of public opinion that actively opposes Cap and Trade." (Member of Parliament Ki-jun Yu, 2009.9.21)

(CNC) "Not long ago, I went to the UAE with the Speaker of the National Assembly. We declared that we will not reduce or almost not reduce nuclear power plants in Korea; but I felt our assertion that we will export and manage nuclear power plants to the UAE or our foreign policy, is not very reliable." (Member of Parliament Hyung-dong Kim, 2021.3.3)

(CNC) "Isn't the president going back and forth even with the nuclear power plant? The President said in Korea, 'We will abolish the nuclear power plant-centered development policy and move toward an era of nuclear disarmament.' What does he say abroad? In the Czech Republic, 'we need to expand cooperation to nuclear power plants and the defense industry.' In Slovakia, 'we want to establish a stronger relationship by expanding to nuclear power plants.' In Hungary, even 'carbon neutrality is impossible without using nuclear energy is a common intention of both countries.'" (Member of Parliament Seung-soo Kim, 2021.11.9)

5.2.4. Diplomatic lock-in

Due to the limited domestic market and export-driven economic structure, Korea's trade dependence is 66.08 % as of 2019, very high compared to major developed countries such as the USA (19.34 %) (National Statistics Portal). The USA, which has a large population and a large domestic market, is relatively free from international pressure, while Korea, which is highly dependent on trade, is inevitably vulnerable to changes in the international environment and the resulting expectations, demands, and pressure.

The Korean government's policy decisions are heavily influenced by the international community. In particular, since Korea is the 11th largest GHG emitter in the world as of 2017, it is under international pressure to perform mandatory GHG reductions. Both conservative and liberal presidents were passive about climate issues in the early stages, but President Lee Myung-bak recognized its seriousness while participating in climate-related international conferences, such as the G8, and President Moon Jae-in, such as the UN Climate Action Summit and Climate Summit [45].

Korea's proposed reduction targets are voluntary, non-committal, and non-fulfillment, and not subject to punishment. Though it cannot be forced, through the Naming and Shaming strategy, international pressure and disgrace and national prestige and trust between countries come to mind. Additionally, NDCs set in advance cause diplomatic lock-in as they have the principle of progress and the duty to pursue ambitious goals. Diplomatic lock-in is a positive lock-in factor for climate change response, and international commitments such as climate change agreements can act as a driver toward carbon neutrality. The key stakeholders said as follows:

(GGC) "If our economy is one of the 10 largest trading countries, what would it be like to call it global moral pressure? Can't you just ignore this? Shouldn't we do something for the sake of international voices or moral decency?" (GGC Chairperson Hyung-guk Kim, 2009.4.14).

(GGC) "Since Korea is the world's 10th largest emitter of greenhouse gases, international pressure for incorporation into a country obligated to reduce greenhouse gases will intensify." (Chief of the Prime Minister's Office Joong-pyo Jo, 2008.11.12).

6. Conclusions and policy implications

Climate Change Governance is central to helping countries achieve their climate goals. Korea's participatory governance is a political outcome, and the political value of the president determines climate change policy. As the government changed, the direction and content of climate change policies changed significantly, along with the name and composition of governance. Lee Myung-bak's conservative administration implemented a pro-nuclear policy under the GGC. Moon Jae-in's liberal government's CNC reduced nuclear power and expanded renewable energy. Recently, Yoon Seok-Yeol 's conservative government was launched, raising the proportion of nuclear power and reducing the proportion of renewable energy. The CNC is being reconstructed per the revised energy policy. Nonetheless, the current committee-type governance in Korea may be difficult to break out of lock-in. Indeed, decisions made by these committees often lacked concrete links to actual implementation. To enhance the effectiveness of the current committee organization and bolster its enforcement capabilities, it is crucial to institutionalize the consensus's contents and establish a dedicated professional enforcement agency. Additionally, exploring methods to delegate authority, such as policy decisions and budget allocations, to entities that have formed a consensus or sharing responsibilities is essential.

Korea's centralized governance, developmental state heritage, strong bureaucratic culture, bondages of industrial and economic interests, high trade dependence, and geographic isolation have resulted in climate change policy and governance lock-in in politics, institutions, industry, and diplomacy. The beginning of governance was different depending on the political orientation, but it went through an isomorphism process as it was a product of political compromise. Path dependence and institutions form while reflecting the necessity and power relationship at different times; hence, they are in a relationship of mutual conflict and contradiction [37]. Therefore, improving or changing governance without considering the complementarity or suitability of the overall system is likely to remain an incomplete reform. Climate change policy shifts are incomplete and potentially reversible.

Methods to mitigate these lock-in effects are needed. It is acknowledged that catalysts triggering institutional change or actions, concentration events, or external shocks (such as international events) can present opportunities to overcome lock-in Ref. [42]. Hence, we can consider some fundamental and theoretical strategies such as forming coalitions, establishing new centers of economic power, creating fresh institutional actors, reconciling legal rights and responsibilities, and changing prevailing ideas, norms, and expectations [1]. However, in terms of more practical approaches, Korea could leverage opportunities to escape lock-in through external shocks like international events. The study revealed that diplomatic lock-in is the only positive factor associated with lock-in. Consequently, the industrial and diplomatic sectors can serve as instrumental factors for escaping lock-in. Given that companies tend to respond more promptly to international regulations and trends than administrative institutions, applying an international external shock might potentially facilitate an escape from lock-in, enabling a practical response to climate change.

This study can contribute to interpreting the black box of climate change "governance." Governance can be both a means of legitimizing government policy and political rhetoric. Collaborative governance tends to make naive propositions that overlook the importance of the

structural elements of power because the legacy of economic, institutional, social, and cultural power relations operates at a micro level. In particular, operating collaborative governance at the national level is more difficult than at the regional and corporate levels because the level of interest becomes shallow and wide as indirect stakeholders participate when the scale increases. Therefore, when organizing and operating governance, it is necessary to ask who the real stakeholders are. In addition, we need to ask who ultimately makes the final decision and what the decision-making rules are.

Due to the relatively short history of climate change governance in Korea, there is a limitation in covering only the committees of the two administrations in this study. Therefore, it is necessary to include the current government's Carbon Neutrality and Green Growth Commission in future research.

Credit author statement

Bong-Kyung Cho: Conceptualization, Methodology, Investigation, Formal analysis, Writing - Original Draft, Reviewing and Editing; **Jibum Chung**: Supervising, Writing - Original Draft, Reviewing and Editing; **Chang-Keun Song**: Funding, Supervising.

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Declaration of competing interest

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Data availability

Data will be made available on request.

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