

Perspective

Proposal of Implementation Framework of Cooperative Approaches and Sustainable Development Mechanism

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Abstract: To slow down climate warming and achieve sustainable development, the Paris Agreement attempts to establish cooperative approaches (Article 6.2 in the Paris Agreement) and a sustainable development mechanism (Article 6.4 in the Paris Agreement) for carbon trading. However, deficiencies in implementation exist due to a lack of systematic execution regulations and an integrated management system. To strengthen the effectiveness of the two carbon trading mechanisms for reducing carbon emission, this paper aims to propose an implementation framework of cooperative approaches and a sustainable development mechanism. Based on the international regime theory in global climate change and the nine elements of the market mechanism, the paper makes use of comparative analysis to discuss the type of mechanism, coverage of the system, operational framework, governance framework, and implementation framework of cooperative approaches and a sustainable development mechanism. The main results and conclusions are as follows: (1) Cooperative approaches are considered as project-based and quota-/credit-based carbon market mechanisms. Under cooperative approaches, trading units should be authorized at the international-regional and sub-regional levels. CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃ are the seven types of greenhouse gases that could be traded through cooperative approaches, and they shall be accounted by the unit of CO₂-eq. (2) The sustainable development mechanism is considered as an industry-based and credit-based carbon market framework. Under the sustainable development mechanism, trading units should be authorized at the international level. CO₂, CH₄, N₂O, and PFCs can work in the sustainable development mechanism as subject matters. The unit of gases shall be CO₂-eq as well. (3) The implementation framework of cooperative approaches ought to follow three stages: project preparation, project submission, and auditing, as well as internationally transferred mitigation outcomes transfer. The implementation framework of the sustainable development mechanism ought to contain three stages: project development and review, project implementation and monitoring, and project acceptance and unit transfer. The authors hope it can work as a guideline for the early implementation stage of the cooperative approaches and sustainable development mechanism to stimulate carbon reduction and further slow climate change.

Keywords: cooperative approaches; sustainable development mechanism; fundamental contents; implementation framework; comparative analysis



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1. Introduction

Global warming makes a significant impact on global social, economic, environmental, and biological health [1]. The continuous emission of carbon emissions has been a great concern worldwide [2,3]. It is urgent to make efforts to reduce emissions. Cooperative

Approaches (CAs, which represent Article 6.2 in the Paris Agreement) and a Sustainable Development Mechanism (SDM, which represents Article 6.4 in the Paris Agreement) are the two mechanisms announced in the Paris Agreement. However, the specific operational and management framework of the CAs and SDM has not been clearly raised. The main idea of this paper is to propose an operable and reasonable implementation framework for the CAs and SDM, respectively.

The Paris Agreement is the third landmark international legal text, after the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, in humankind's history to deal with climate change [4]. It aims to keep global warming within 1.5 °C and pursue a more comfortable and healthier life for people and the 2030 Agenda [5], which sounds like difficult work [6]. Carbon emissions of each area shall be controlled at the same time [7,8]. Countries should take distinguished responsibility to achieve the goal [9]. To effectively mitigate GHGs, coordination among countries is essential [10]. The Paris Agreement was finally signed by about 200 parties in the 21st Conference of the Parties (COP21) to deal with critical problems including alleviation of and adaptation to climate change and implementation of climate change policies [11]. With Biden coming to power, the United States will also rejoin the Paris Agreement, promoting global carbon emission reductions to some degree. Intended Nationally Determined Contributions (INDCs) are accepted in the Paris Agreement [12]. As of June 2020, 186 parties have submitted their first INDCs, and 4 parties have submitted their second INDCs to the UNFCCC [13]. Among them, 146 INDCs listed in Table S1 are actual effective records. In the current situation, greenhouse gases (GHGs) in 2030 will be reduced by about 5.5% compared with 2015, significantly lower than the committed emission reductions in the INDCs. New efforts and high execution must proceed [14].

Hasan and his partners [15] analyzed climate change mitigation pathways for the aviation sector and suggested that pragmatic market-based mechanisms such as the Emission Trading Scheme (ETS) and/or carbon tax must be enforced on a global scale to curb CO₂ emissions [15]. Since the signing of the Kyoto Protocol, Joint Implementation (JI), Clean Development Mechanism (CDM), and International Emission Trading (IET) have worked a lot for carbon reduction. Both domestic and international carbon trading mechanisms are important for carbon mitigation and economic strengthening [16]. The European Union's Emissions Trading Scheme (EU-ETS) is a mechanism worthy of reference and learning, which both accelerates carbon reduction and upgrades industrial structures [17,18]. Lu and Liu [19] researched the economic rationality of JI, CDM, and IET and gave a result that carbon trading not only helps increase cost-effectiveness but also strengthens economic development. Several researchers hold the opinion that a carbon emission trading system helps a lot in carbon control [20]. The implementation of a carbon trading mechanism helps the renewable energy industry and affects the structure of energy, the economy, and the environment. Zhao et al. constructed a 3E system simulation model under the carbon trading mechanism and take Beijing-Tianjin-Hebei as an example; the result suggested that increasing carbon trading prices effectively promotes carbon emission reduction [21]. For developing countries, emission trading may be the right way for green economic growth [22]. Blum [23] examined the legitimization of carbon markets by interviewing 37 market stakeholders. The majority of the interviewees believe that carbon markets function well in alleviating climate change.

However, the uncertainty of an incomplete carbon mitigation regime may bring about multifaceted problems [24]. Baseline and additionality determination are the two keys of the Kyoto Mechanism discussed by Michaelowa [25]. Akita et al. [26] and Newell and Bumpus [27] confirmed that "low-hanging fruits" being captured by the market was one of the challenges for CDM. In addition, the imbalance in favor of carbon reduction in the first period slowed down the progress of carbon mitigation [22]. The CAs and SDM were then advanced in the Paris Agreement (in Article 6) for encouraging international collaboration and improving the cost effectiveness of NDCs [25,28].

In the usual sense, CAs allow mechanisms established and operated by governments, non-governmental organizations, or other organizations to transfer and account for international emission reduction units through Internationally Transferred Mitigation Outcomes (ITMOs) [29]. It has been stressed that ITMOs must be real, verified, and additional, and represent emission reductions and removals when internationally transferred [30]. SDM is considered an upgraded CDM, which relates to broader international decisions and aims to promote GHGs mitigation and sustainable development. It enables an indirect connection between emission reductions and regional/sub-regional or national trading systems [31]. The two mechanisms can justify more hope for global carbon trading with grand ambitions [32]. Unfortunately, no specific details are contained in any documents directly for the two mechanisms, and no systematic framework has been formed for global implementation yet. Lacking unified regulations brings about obstacles to successful coordination [33]. This article aims to identify fundamental contents and propose a feasible implementation framework for the CAs and SDM, which gives a chance to stimulus management enhancement.

International regime theory, the nine elements of the market mechanism, and comparative analysis are employed in the article. Understanding and analyzing international climate change mechanisms helps a lot in grasping the essential requirements of carbon market mechanisms. Krasner established international regime theory in 1983. The theory has been applied in international climate negotiations and the formation of regulations and rules since the 1990s [34]. The theory contains a series of principles, norms, rules, and decision-making procedures, which provide a basic theoretical guideline for flexible carbon trading mechanisms' contents and principles [35]. The theory of the nine elements of the market mechanism was proposed by Bolscher [36] while preparing a design selection and implementation report for the EU. The nine elements of the market mechanism contain the type of mechanism, coverage of the system, sector target or crediting threshold, operational framework, requirements for data collection and MRV (monitoring, reporting, and verification), compliance framework and penalties, governance framework, ways of managing the transition from CDM to the NMM, and financing of the mechanism. The type of mechanism can be determined from the authorization level of the trading unit, the type of subject matter, and the trading unit. Coverage of the system includes sectors, gas types, and the unit used to describe the amount of gases numerically. Sector target or crediting threshold is the baseline of the carbon market. Operational framework designs the generation, allocation, and transference of the subject matters. Requirements for data collection and MRV (monitoring, reporting, and verification) works for the determination of carbon reduction. Compliance framework and penalties are the rules required in the Paris Agreement. The main bodies of the governance framework are international organizations and the government. The transition from CDM to the NMM is a long process, and the problems are more complex. Financing of the mechanism mainly comes from the host country, as well as national and multi-donor contributions. Although the theory was established for the EU, it can work as a reference for mechanism theory internationally. Comparative analysis enables appropriate systematic comparison and judgments between opposing interpretations [37] and has been widely used in the negotiation as well as the evaluation of law enforcement.

Referring to the main questions to be solved for carbon market mechanisms arrived at by Steen [38], and based on international regime theory in the field of global change and the nine elements of the market mechanism, this article describes the fundamental contents of the CAs and SDM, including the type of mechanism and coverage of the system. Moreover, the article proposes the operational framework, governance framework, and implementation framework of the CAs and SDM, respectively. The basic structure can be seen in Figure 1.

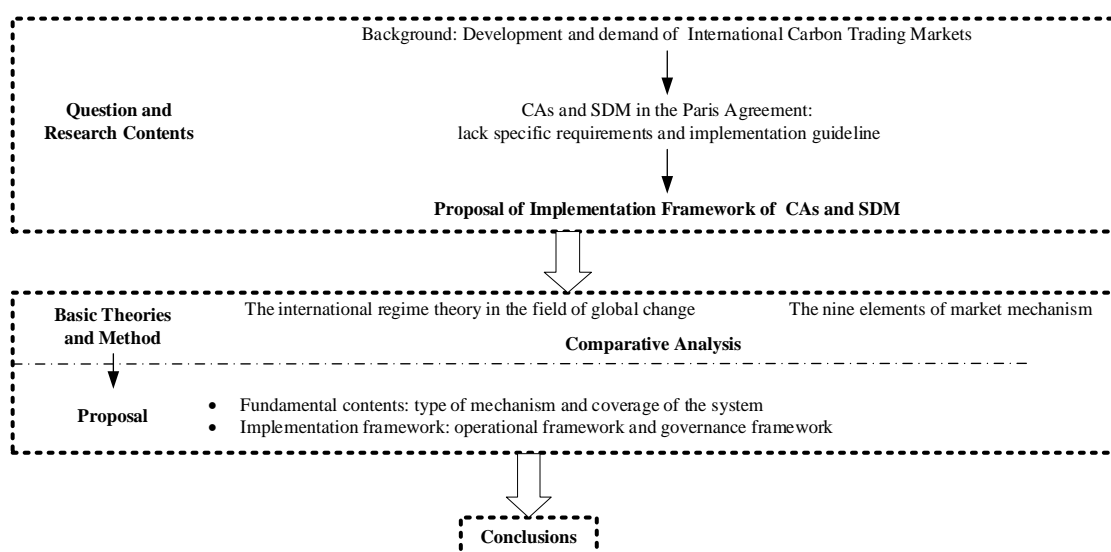


Figure 1. Structure of the work. This article describes the fundamental contents of the CAs and SDM, including the type of mechanism and coverage of the system. Moreover, the article proposes the operational framework, governance framework, and implementation framework of the CAs and SDM, respectively.

The article first explains how we apply international regime theory, the nine elements of the market mechanism, and comparative analysis in the study. Secondly, according to the principles and purposes of the CAs and SDM, it provides a result on the type of mechanism, coverage of the system, operational framework, and governance framework of the two mechanisms. The implementation framework is covered, as well. Thirdly, it demonstrates the rationality of the results. Finally, the article gives conclusions.

2. Theories and Methods

2.1. Basic Theories

International regime theory includes four elements: principles, norms, rules, and decision-making procedures. Principles are beliefs about facts, causality, and justice; norms are standards of conduct defined by rights and obligations; rules are specific provisions or prohibitions on conduct; decision-making procedures contain universal practices for making and implementing collective choices. The four elements are divided into two layers: the principles layer and the rules layer [35], as displayed in Figure 2. The principles of the CAs and SDM are the Paris Agreement and the UNFCCC. The rules layer works as a certain, specific, operable, and predictable standard of behavior, for example, the quantitative emission reduction targets set by developed countries after the Kyoto Protocol. The principles of the CAs and SDM are the Paris Agreement and the UNFCCC. This article focuses on the rules layer to set concrete implementation requirements for CAs and SDM.

The nine elements of the market mechanism put forward by Bolscher [36] include the type of mechanism, coverage of the system, sector target or crediting threshold, operational framework, requirements for data collection and MRV (monitoring, reporting, and verification), compliance framework and penalties, governance framework, ways of managing the transition from CDM to the NMM, and financing of the mechanism. Among the nine elements, compliance framework and penalties are the basis of mechanism contribution. The type of mechanism, operational framework, and governance framework are the basis of mechanism design. Coverage of the system is the basic task of mechanism design. Sector target or crediting threshold is the baseline of carbon mitigation. Ways of managing the transition from the CDM to the NMM make it possible to dock with existing mechanisms. The financing of the mechanism guarantees the normal operation of the mechanism.

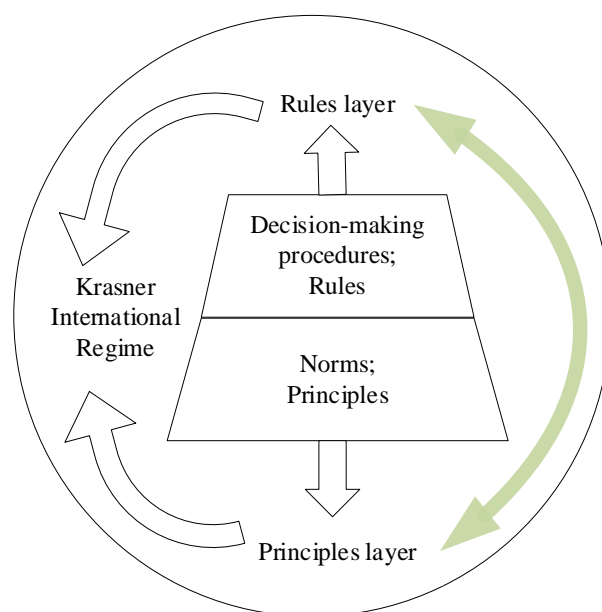


Figure 2. The divided layers of international regime theory. According to Krasner’s theory of the international regime, the rules layer contains certain decision-making procedures and rules, while the principles layer includes norms and principles.

In accordance with international regime theory, the article categorizes the nine elements in three parts: principles, basic framework layer, and supplement and improvement layer, as shown in Figure 3. The contents involved in the supplement and improvement layer include technical and financial issues, which need complex and thorough analysis and are not essential at the beginning of mechanism construction [39]. This article focuses on the basic framework layer (except for ways of managing the transition from the CDM to the NMM) of the CAs and SDM. Elements contained in the supplement and improvement layer will be determined in a further study. In the nine elements of market mechanisms, the operational framework and governance framework are two separate units. As a matter of fact, during the implementation of carbon market mechanisms, the operation and governance shall be conducted to make the execution more manageable and effective. The article merges the operational framework with the governance framework and forms the implementation framework.

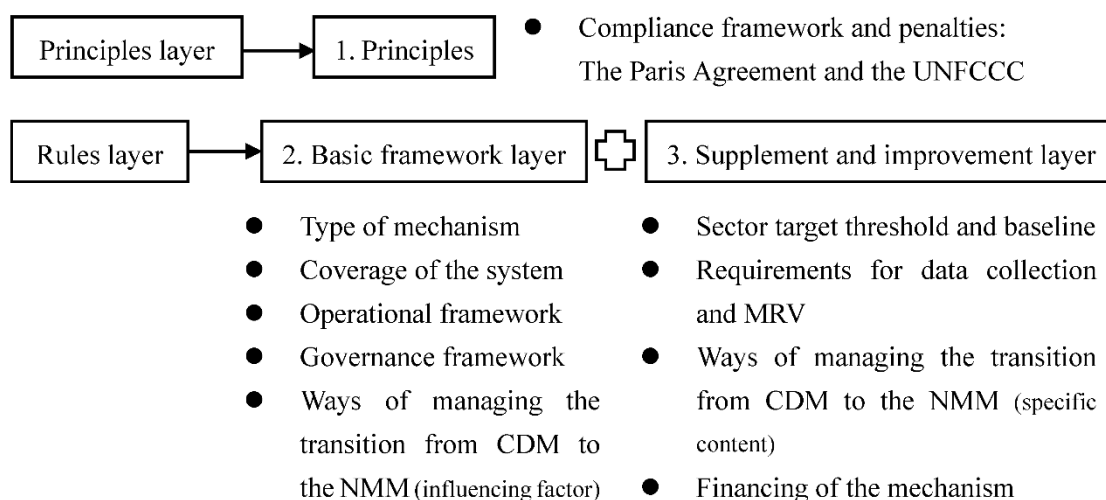


Figure 3. Elements of the market mechanism. It is a long process for managing the transition from the CDM to the NMM because of the more complicated processes. Therefore, in this paper, this element

is mainly considered as an influencing factor. The specific content of managing the transition from the CDM to the NMM belongs to the supplement and improvement layer. The article will not discuss this element.

Environmental integrity is a huge issue for the whole environment and ecosystem; although it is an essential part of the carbon trading mechanism, it shall be discussed together with a specific established case. The authors haven't considered it in this article.

2.2. Comparative Analysis

During the UN negotiations, comparative analysis has become an essential method for coordinating various countries' ideas and reaching a final agreement. The quality management of the Chinese Certified Emissions Reduction (CCER) in the pilot carbon markets was discussed via comparative analysis [40]. Kuiti et al. [41] conducted a comparative analysis of the cap-and-trade policy to identify the strategic decisions in green initiatives. When determining elements of the CAs and SDM, a comparative analysis of existing options can be made as well. The specific contents can be obtained, combined with the actual needs of the mechanism. Keppel [42] conducts comparative analysis in five steps: firstly, describe and collect data; secondly, explain options by the usage of social and scientific methods; thirdly, classify the data; fourthly, compare and plan for operation; and finally, reach the conclusion. In accordance with Keppel's working steps [42], this article makes use of comparative analysis in four steps: describe and explain the existing options in an integrated and objective way; align options to ascertain comparability standard, which offers preliminary comparison results; compare options based on actual requirements; and finally, reach conclusions, as shown in Figure 4.

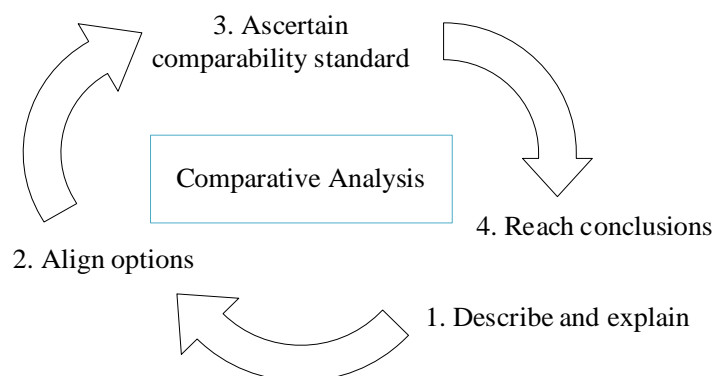


Figure 4. Working steps of comparative analysis. Step 1: Describe and explain. Step 2: Align options. Step 3: Ascertain comparability standard. Step 4: Reach conclusions. Compare and draw certain conclusions. This phase may involve hypothesis testing.

- Step 1: Describe and explain. The situation of options is collected and described as completely, comprehensively, and objectively as possible. All options shall be presented descriptively for further analysis, and then all options will be analyzed and explained.
- Step 2: Align options. Make an initial comparison of options, and classify and process all data.
- Step 3: Ascertain comparability standard, that is, determine the requirements for subsequent selection.
- Step 4: Reach conclusions. Compare and draw certain conclusions. This phase may involve hypothesis testing.

3. Results

3.1. Fundamental Contents

3.1.1. Type of Mechanism

According to the purposes of the CAs and SDM, the authorization level of the trading unit of CAs should be at the international-regional/sub-regional level. The trading units of SDM need to be authored at the international level. Considering the objective of the CAs and SDM, and comparing quota-based to credit-based carbon trading mechanisms, both quota-based and credit-based carbon trading satisfy the transaction requirements in CAs, but credit-based carbon trading will be more suitable in SDM. By analyzing 146 INDCs in Table S1, the article found that CAs ought to adopt a project-based model. An industry-based mode is suggested for SDM.

3.1.2. Coverage of the System

Subject matters refer to the objects to which the rights and obligations of both parties are directed [43]. The subject matters of carbon trading have the characteristics of publicity, fictitiousness, and homogeneity [44]. The Paris Agreement uses ITMOs to achieve NDCs, which indicates that to determine coverage of CAs is to determine contents of ITMOs which are used for parties who have clear quantitative mitigation goals. Referring to 112 parties with clear quantitative mitigation targets, CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃ were chosen as subject matters in CAs. CO₂-eq was suggested as the counting unit. Concerning CDM, cement production, steel, electricity, heat, construction, waste management, aluminum production, and forestry were chosen as pilot industries in the initial SDM implementation stage. Subject matters of SDM are relevant to selected industries, including CO₂, CH₄, N₂O, and PFCs. The basic unit of gases was suggested to be CO₂-eq. Carbon offsets shall be accepted in both CAs and SDM.

Table 1 lists the proposed fundamental contents of the CAs and SDM.

Table 1. Fundamental contents of the CAs and SDM. The first column lists the fundamental contents contained in this part. The second column expresses the proposed fundamental contents of CAs. The third column expresses the proposed fundamental contents of the SDM.

Contents	CAs	SDM
Authorization level of the trading unit	International-regional/sub-regional level	International level
Type of subject matters	Quota-based, credit-based	Credit-based
Project/industry	Project	Industry
Covered sectors	All industries	Cement production, steel, electricity, heat, construction, waste management, aluminum production, and forestry.
Subject matters (GHGs covered)	CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ and NF ₃	CO ₂ , CH ₄ , N ₂ O, and PFCs
Unit	CO ₂ equivalent	CO ₂ equivalent
Whether to include carbon offsets	Yes	Yes

3.2. Proposal of Operational Framework

3.2.1. For CAs

As mentioned above, CAs should adopt international cooperation based on the project level. CAs may transfer generated and approved emission/reduction results from one enterprise to another. The emission/reduction results can be reflected in the INDCs of each country. By analyzing the difference between those with and without bilateral/multilateral cooperation agreements, different operational frameworks for Parties were designed, as Figures 5 and 6 present. The operational framework of CAs should contain the identification of transaction objects and transaction of emission/reduction results that meet international standards.

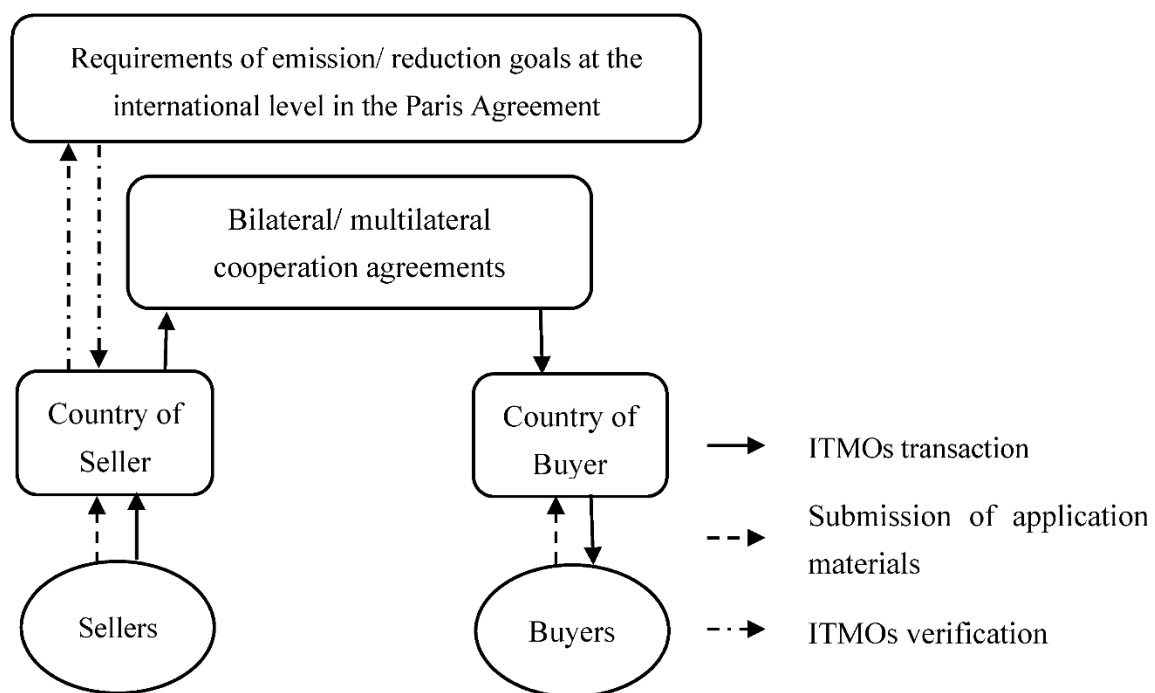


Figure 5. The operational framework of CAs (with bilateral/multilateral cooperation agreements). ITMOs transaction via bilateral/multilateral cooperation agreements.

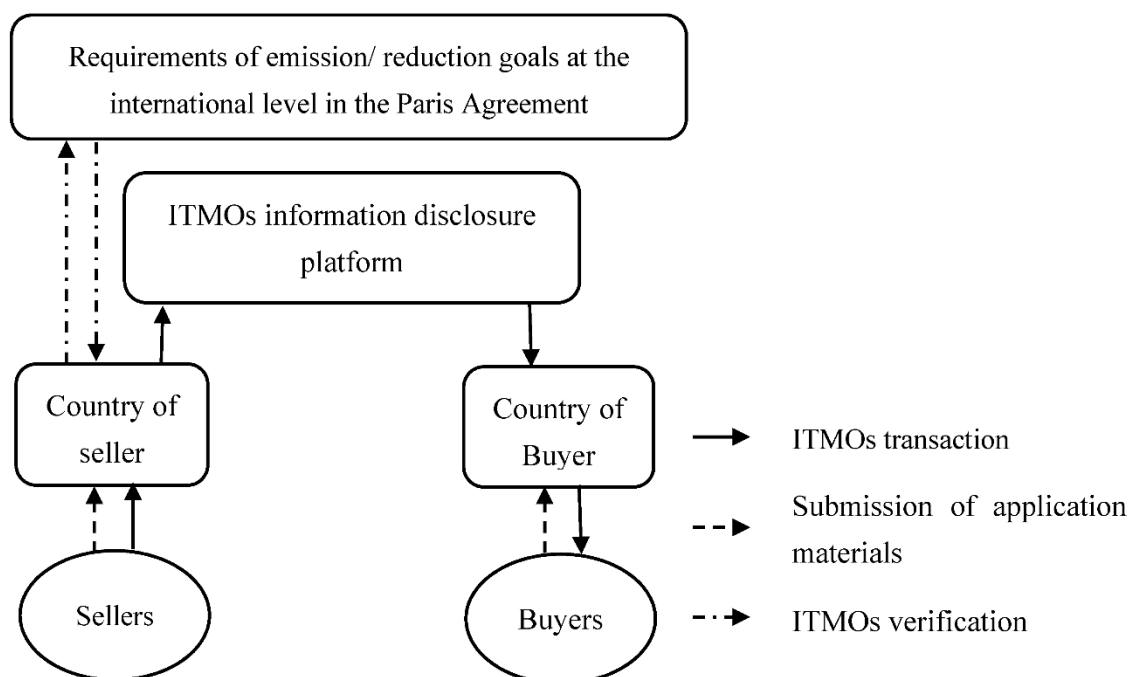


Figure 6. The operational framework of CAs (without bilateral/multilateral cooperation agreements). ITMOs information disclosure platform is established for countries without bilateral/multilateral cooperation agreements to conduct ITMOs transactions.

3.2.2. For SDM

The operational framework of the SDM (expressed in Figure 7) was described based on analysis of the implementation of carbon emission reductions at various industry levels. In the SDM, industry associations may participate in carbon emission reduction activities by promoting technological improvements, which helps international emission reduction agencies better grasp the industry's sustainable development level. The operational frame-

work of SDM ought to include project initiation and registration, project implementation and emission reduction generation, and verification of emission reduction results and completion of the transaction.

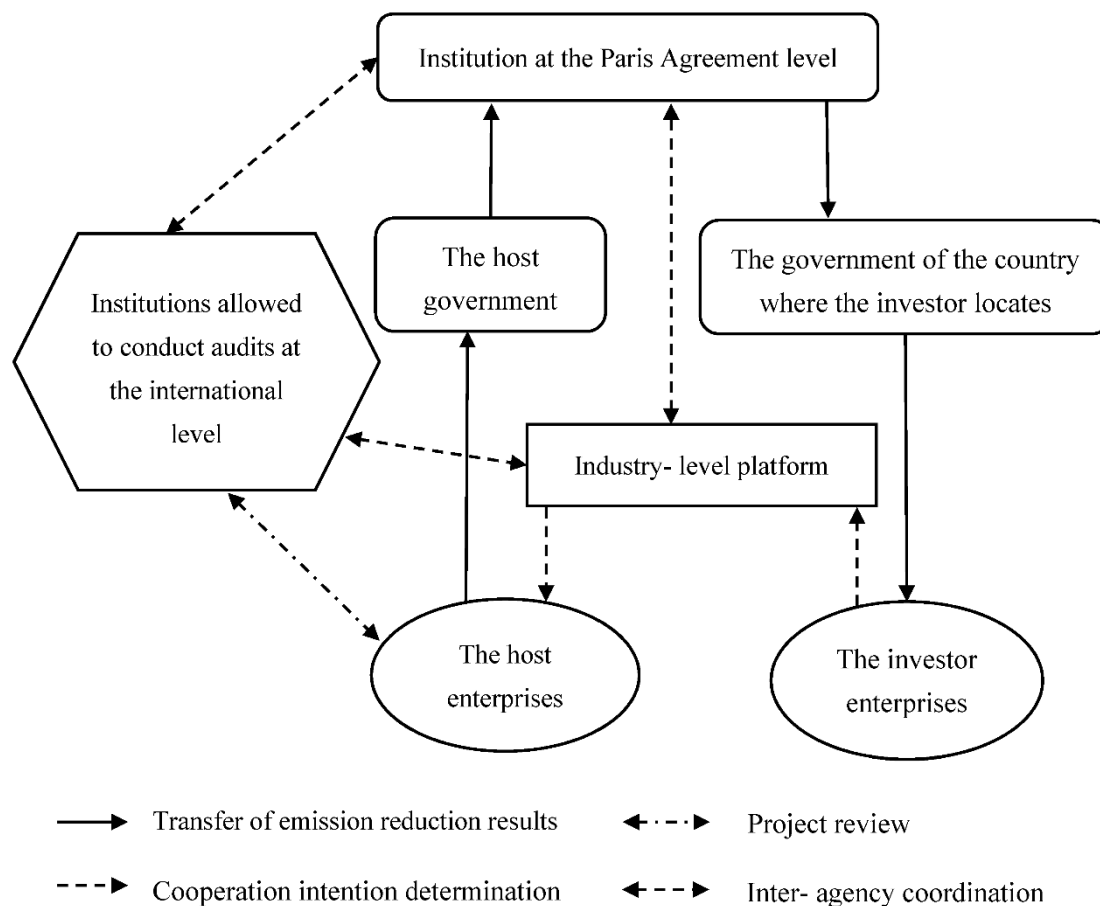


Figure 7. The operational framework of SDM. Including project initiation and registration, project implementation and emission reduction generation, and verification of emission reduction results and completion of the transaction.

3.3. Proposal of the Governance Framework

3.3.1. For CAs

A comparative analysis was made among four scenarios (fully decentralized, semi-decentralized, semi-centralized, and fully centralized scenario) classified by the World Bank. The result refuses to use semi-decentralized or semi-centralized scenarios to govern CAs. Figure 8 demonstrates the governance framework of CAs. CAs may give regional/sub-regional and national discretion. For parties with bilateral/multilateral cooperation agreements, ITMOs should satisfy international standards to insist on environmental integrity. Only emissions or reductions that meet the requirements can be put into the market. The COP may help during this process to avoid interference of political factors in various countries. Furthermore, an eligibility review of subject matters should be conducted by international third-party agencies. For parties without individual cooperative partners, the ITMOs information disclosure platform should work at the international level to meet carbon reduction goals, which indicates that the platform can be implemented and governed by agencies under the COP.

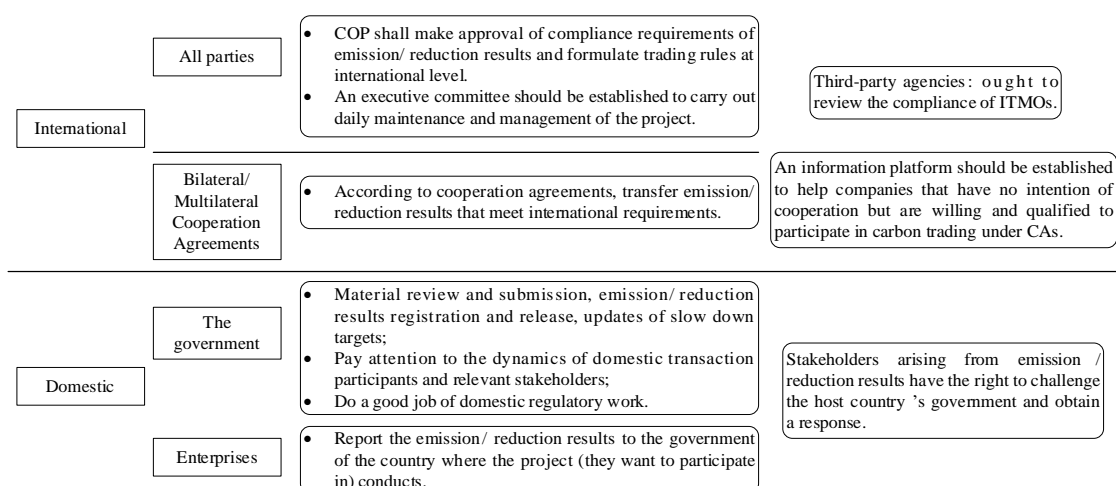


Figure 8. The governance framework of CAs. International third-party agencies shall be involved to review the compliance of ITMOs.

3.3.2. For SDM

Since the primary purpose of the SDM is to help parties discover more emission reductions and pursue sustainability, a fully centralized scenario with strong binding force may be the most suitable governance model for SDM, that is, verify and approve emission reduction results at the international level under internationally unified environmental standards [22]. The article referred to CDM's experience; classified and described functions of the agencies at the international level, namely international industry associations, third-party organizations, and the COP; and finally, proposed a governance framework of the SDM, as shown in Figure 9.

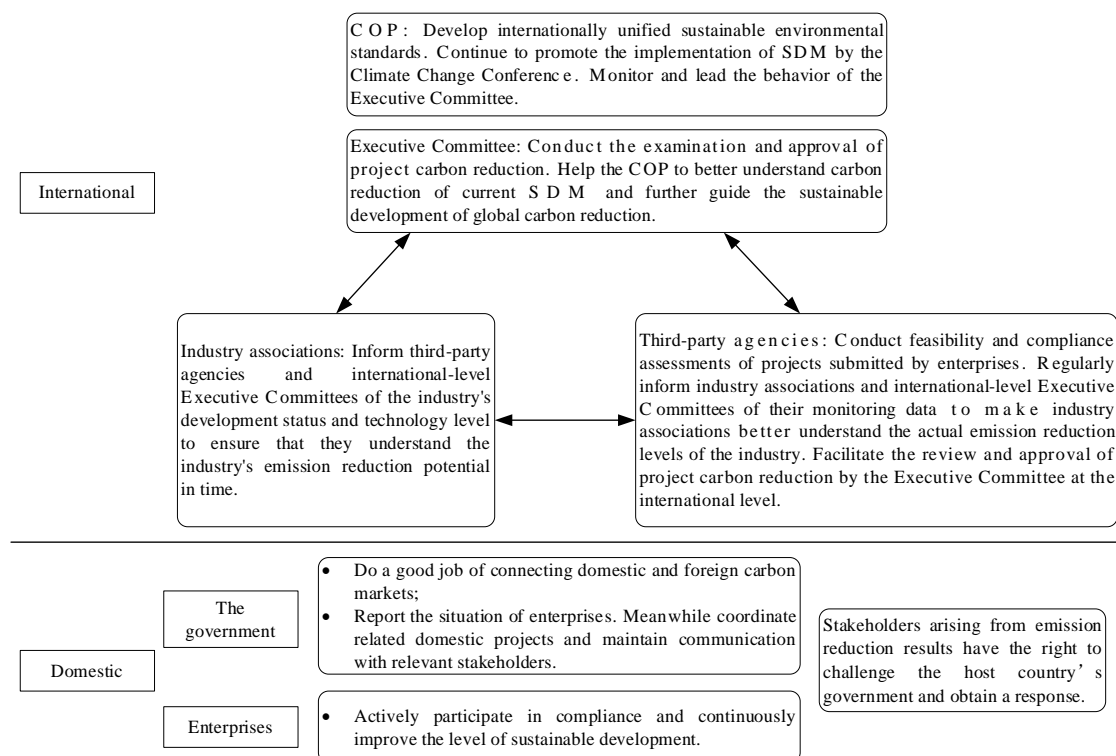


Figure 9. The governance framework of the SDM. Third-party agencies shall be involved in the governance framework. The proposed governance framework of SDM refers to CDM's experience.

3.4. Proposal of the Implementation Framework

As a development of the nine elements of the market mechanism, the article combined the operational framework and governance framework of the two mechanisms separately and formulated the implementation framework of the CAs and SDM. The implementation framework of CAs (see Figure S1) was proposed to contain three stages: project preparation, project submission and auditing, and ITMOs transfer. The implementation framework of the SDM (see Figure S2) should consist of three stages: project development and review, project implementation and monitoring, and project acceptance and unit transfer.

4. Implications

4.1. Fundamental Contents Analysis

4.1.1. Type of Mechanism

Regarding the trading unit's authorization level, the global carbon trading mechanism is mainly formed and developed by the UNFCCC. Trading units are usually set according to regional/sub-regional and national standards, such as the EU carbon emissions trading system [45]. The trading units issued are authorized by the UNFCCC, such as JI and CDM.

The purpose of CAs is to help countries achieve INDCs through international cooperation. Due to the Paris Agreement's extensive participation, CAs break through the limitation of original mandatory emission reductions under the UNFCCC framework while adhering to the "common but differentiated" principle. CAs can make full use of regional/sub-regional and bilateral/multilateral agreements among countries to provide parties with the most room for an independent decision. The SDM adopts international harmonization coordination to select baselines, technology transfer, financial support, and verification of emission reduction results to help developing countries, small island developing states, and least-developed countries [46]. As a result, CAs shall work at the international-regional/sub-regional level, and the SDM shall work under international-level authorization.

The quota-based carbon trading mechanism is used to mitigate planned carbon emissions to the type of subject matter. A credit-based carbon trading mechanism is used for long-term carbon reduction to promote sustainable development. In a disequilibrium economy, traders need to obtain quantitative information to adjust demand and supply based on market price. The specific form of quantity adjustment is a quota, and the transaction can be completed quickly [47]. However, it is necessary to estimate the number of carbon reductions and transactions after the accounting of generated carbon reductions [48]. Compared to the two mechanism types, in this case, for CAs, both quota and credits can function well. The SDM aims to promote long-term sustainable development, which indicates that the credit-based mechanism should be better.

Concerning the basic unit of the transaction, whether there are specific requirements or target restrictions on the industry level in various countries' performance targets shall be considered. At the G8 summit, a statement that establishing emission reduction plans for critical industries will help achieve GHGs reductions was mentioned [49]. Adding credit into the sector-based carbon market mechanism may help with the sustaining goal [50].

The comparison among submitted INDCs showed that the emission reduction industries involved are mainly from the emission industries in the IPCC national GHGs emission inventory. An inappropriate number of industries covered may increase parties' pressure for technical improvement and carbon reduction arrangements' integrity. A project-based mechanism may work well for CAs.

SDM plays an essential role in sustainable development. Specific industries have great potential for carbon reduction, so a sector-based mechanism is more suitable for SDM. On the one hand, the sector-based approach may avoid the situation where cross-border investment fails to meet sustainable development requirements more effectively. On the other hand, it can help regulate carbon emission reductions within the industry and further promote low-carbon development.

4.1.2. Coverage of the System

Table S1 shows 146 countries' willingness and efforts on carbon reduction. CO₂, CH₄, and N₂O are contained in 43 INDCs; 15 INDCs control CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆; and 20 INDCs include emission targets of CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃. However, the number of parties that contain seven types of GHGs is less than that of parties that contain three types of GHGs. Countries containing seven types of GHGs are mostly developed countries that account for a large degree of international carbon market participation. Therefore, the article posits that CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃ shall be covered in CAs. In this case, a standard unit of measurement that unifies different GHGs is required. Global Warming Potential (GWP) was accepted in the IPCC First Assessment Report and has been broadly used since UNFCCC and the Kyoto Protocol [10]. In the NDCs of parties, GHGs were measured by carbon dioxide equivalent (CO₂-eq), which indicates the unit is suitable to be widely used in CAs. Michaelowa's new study also supports that ITMOs can be measured in tCO₂e [30].

According to the NDCs of parties, most countries make efforts to decrease carbon emissions from energy, industrial processes, and transportation. However, various sectors emit GHGs in various amounts and types. Because of the difference of carbon emission and mitigation abilities among various industries, in the early stage of the implementation of the SDM, only some industries should be included. With the development of international trading, "dirty" sectors such as fuel burning generate and emit plenty of CO₂ [51]. In annual reports of the International Energy Agency (IEA) [52–55], statistics on carbon emissions emitted by energy combustion activities indicate that the primary carbon emission industries were concentrated in power, heat, processing and manufacturing, construction, and transportation industries. The cement industry is vital for the development of countries and is regarded as one of the most important sources of carbon dioxides [56]. The Emissions Database for Global Atmospheric Research (EDGAR) shows that cement production emissions account for 80% of category 2A [57]. It has been found that steel, copper, and aluminum contribute the most to the carbon footprint through life cycle analysis [58]. Blok et al. [59] assessed emission reduction potential for agriculture, construction, energy, forestry, and other land use, industry, and transportation. Energy demand is a huge source of carbon emissions. Regarding sustainable development, fossil fuel isn't a wise choice [60]. The result suggests that the energy industry has the most enormous carbon emission reduction potential (12.2 GtCO₂e by 2030), approximately one-third of the global total reduction potential. Projects registered in CDM focus on energy, waste management, and manufacturing [61]. Dong et al. [62] arrived at a result that electricity production generates the highest carbon emissions and has the highest carbon reduction potentials. Combining the above records with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, it turns out that cement production, steel, electricity, heat, construction, waste management, aluminum production, and forestry can represent most carbon emission industries and have considerable potential for carbon reduction.

The subject matter of the SDM is emitted by relevant industries, indicating that the highest gas emission types of subject industries in the SDM shall be the subject matter. Table 2 shows the highest gas emission types of the subject industries contained in the SDM [63,64]. As a result, CO₂, CH₄, N₂O, and PFCs shall work as the subject matters in SDM. Similar to CAs, CO₂-eq should be used as an accounting unit.

Chen et al. [65] conducted an empirical study of willingness regarding renewable energy installation in Taiwan, and suggested that the most urgent work for the government is to achieve low-interest loans, concessionary financing, and tax relief for enterprises. To increase related industries' and parties' willingness regarding carbon mitigation, the government should offer better administrated support and reward policies for external motivation, so offsets shall be contained in the CAs and SDM.

Table 2. Industries covered in the SDM and related gas emission types. The first column contains industries that are suggested to be contained in the SDM. The second column contains the types of gases emitted by the corresponding industry.

Industry	Gas Types
Cement production	CO ₂
Steel	CO ₂
Electricity	CO ₂
Heat	CO ₂
Construction	CO ₂
Waste management	CO ₂ , CH ₄ , N ₂ O
Aluminum production	CO ₂ , PFCs

Table S2 shows the basic characteristics of the CAs and SDM. When it comes to transaction contents, CAs should transfer carbon emissions and reductions, but the SDM should only transfer carbon reductions. Only countries with clear carbon reduction goals can transfer carbon reductions to ITMOs and then function in the market under CAs. The SDM is available to parties who voluntarily participated in the international market mechanism. Therefore, the subject matters of the SDM can be included in the ITMOs of CAs.

Moreover, as the corresponding emission reduction results generated by the industry and gas types in the SDM have been recognized at the international level, the emission reduction results generated can directly enter into the transaction and connect with CAs without re-accounting, thereby reducing transaction costs and streamlining processes. Carbon offsets can compensate GHGs emissions through energy transfer, higher energy effectiveness, and forestry, which is regarded as an essential element in carbon mitigation and promoting sustainable development. It is a possible measure for carbon mitigation in the CAs and SDM.

4.2. Implementation Framework Analysis

4.2.1. Explanation of the Operational Framework

The Paris Agreement has the support of all parties to adopt the long-term goal of collective climate change mitigation. Unlike the single “top-down” set-up of the Kyoto Protocol, the Paris Agreement sets action objectives “bottom-up” in a way that helps to motivate countries. Based on national development stages, national capacities, and historical responsibilities, the parties set contributions autonomously, which promotes the achievement of global coverage of action to address climate change. At the same time, the “top-down” determination of accounting, transparency, and compliance rules in the Paris Agreement help countries to share operational experiences, conduct assessments and self-assessments, enhance the operational intensity, and comprehensively assess the strength and progress of global actions [66].

While designing the operational framework of CAs, it should be noted that: (i) The enterprise is the implementation body of various emission reduction activities, so the ignition of all projects shall consider enterprises’ behavior. (ii) CAs help parties to achieve mitigation goals clearly defined in their INDCs. Therefore, participants must establish relevant departments responsible for registering emission/reduction units. (iii) Whether the emission/reduction units obey environmental integrity needs to determine by the responsible agency’s standards at the Paris Agreement [67].

For parties with bilateral/multilateral cooperation agreements, ITMOs of the seller can be transferred to the buyer after verification by the institution set under the Paris Agreement. Compared to parties with bilateral/multilateral cooperation agreements, an ITMOs information disclosure platform may allow interested Parties without bilateral/multilateral cooperation agreements to register themselves in the system and then make carbon transactions inside the relevant system, like the carbon trading operational framework in the pilot phase of China’s carbon market.

Different from CAs, the SDM ought to only transfer carbon emission reduction results. The SDM can be invested in by enterprises that want to obtain emission reduction credits and achieve certain technologies. Local enterprises shall submit applications to the government of the country first. Then, the applications shall be audited and reviewed by the agency set under the Paris Agreement. If it meets the requirements, the project's approved emission reductions will be issued to the country's government where the party is located, and then the government will release funds to the investor's enterprise.

The investing country's government should be included in the carbon emission reduction contribution of the investment enterprises. However, the SDM should not be limited to foreign investment by developed countries. It shall have new stimuli and restrictions at the industry level, which is stricter than CDM. Industry associations shall be built to strengthen technical development for carbon emission and participate in carbon trading.

4.2.2. Coordination in the Governance Framework

Effective management works a lot for the system [68]. The World Bank classifies four scenarios of management for carbon market mechanism, namely fully decentralized (without any global standards), semi-decentralized (some minimal environmental standards provided by an international body as guidance), semi-centralized (must observe environmental standards but no approval required), and fully centralized (global environmental standards must be observed, compliance under the Paris Agreement) [69]. Considering the requirements of ITMOs results in CAs, the article did not accept the suggestion put forward by the World Bank. Multi-level organizations and governance may be helpful for the better functioning of carbon trading mechanisms [70]. The unit review should be carried out at the international level to ensure environmental integrity. However, other content can be managed by relevant regional/sub-regional or domestic agencies.

For parties with bilateral/multilateral cooperation agreements, there are two ways to measure the environmental integrity of selected ITMOs. The agency reviews one under the Paris Agreement, and a third-party agency reviews the other at the international level, which has been selected in this article. The former agency reviews subject matters submitted by the buyer's country's government following compliance requirements approved by the COP. The latter has been used in CDM. A total of 30 designated operating entities with rich experiences have conducted CDM project verification at present [71]. To meet the Paris Agreement's new standards, the third-party agencies only need to train for rules and characteristic standard requirements for emission reduction results in CAs. Compared to the former, the Paris Agreement only requires rulemaking at the international level and does not require specific review. For parties interested in CAs without bilateral/multilateral cooperation agreements, the ITMOs information disclosure platform should help them participate in carbon transactions. Therefore, it is unnecessary to verify the business itself.

The SDM aims to discover more emission reductions and to promote sustainable development. As it has been proposed that the SDM functions at the international level and that transaction units are authorized at the international level, the governance framework of the SDM should adopt uniform international environmental standards. The emission reduction results shall be verified and approved at the international level as well. Therefore, it is rational to choose a fully centralized scenario as the governance model for the SDM.

Similar to CAs, environmental integrity shall be enhanced and maintained in the SDM. The critical issue of the SDM is the coordination among the executive committee, industry associations, and third-party verification agencies at the international level to maintain integrity and synchronicity [72]. The industry associations at the international level should be composed of enterprises, non-governmental organizations, and individuals. Third-party organizations should function as third-party organizations under CDM that assess carbon reduction results and post relevant reports [73]. The COP needs to develop institutional rules and uniform sustainable environmental standards at the international level for parties to comply. Furthermore, a unique agency under the Paris Agreement shall be established

to manage the SDM, responsible for reviewing and approving national proposals and the release of emission reductions during mechanism operation.

4.2.3. Explanation of Implementation Framework

Implementation, the operational framework, and the governance framework of flexible carbon market mechanisms shall ensure carbon transfer's effectiveness and rationality. To make the mechanisms more practical, it is beneficial to combine the operational framework with the governance framework. Thus, the article proposed an implementation framework for the CAs and SDM, respectively, which develops the nine elements of the market mechanism to some extent.

Under CAs, participating companies must come from parties that have quantified emission reduction targets. Once the emission reduction results are approved, they shall be completely transferred from the seller to the buyer's government and used by the companies who bought them. The implementation framework of CAs contains three stages (see Figure S1):

1. The first stage: project preparation. Enterprises that intend to take part in CAs deliver emission reduction results to a third party for review. A compliance report of reduction results will then be issued to explain environmental integrity. Enterprises identify trade objects through bilateral/multilateral cooperation agreements or ITMOs information disclosure platforms;
2. The second stage: project submission and auditing. The compliance reports of ITMOs shall be delivered to the local government or the International Executive Committee for review. All information on transaction projects shall be announced to the public for questions;
3. The third stage: ITMOs transfer. After the government of both parties and the International Executive Committee review, the two governments shall register the confirmed ITMOs on INDCs. Then, the transaction can be done.

Unlike CAs, the primary purpose of the SDM is guiding and promoting sustainable development. Thus, whether or not the party has proposed clear mitigation goals in INDCs, it can participate in carbon trading. Investors of different projects can obtain corresponding emission reduction credits after completing the project and calculate emission reduction units by the third-party agency. Accordingly, if the reduction credits are included in the host country's independent contribution, they should also be recorded and should not be counted as the host country's emission reductions. This rule is formed to prevent double accounting. The implementation framework of the SDM was proposed to include three stages (see Figure S2):

1. The first stage: project development and review. Enterprises of investing country first communicate with enterprises of the host country for local information and data. A project investment plan shall then be composed and assessed by a qualified third-party agency to ensure feasibility and compliance. After that, relevant reports may be posted to the local government. The project's host country shall submit all reports and project applications to the International Executive Committee for auditing and registering;
2. The second stage: project implementation and monitoring. Enterprises in the investing country need to regularly appoint a third-party agency to monitor emission reduction results during project implementation. The third-party agency shall measure and calculate actual emission reduction results according to the methods and standards of the sustainable verification of emission reduction results under the Paris Agreement. The host government and the Executive Committee shall record monitoring results and promptly indicate any problems;
3. The third stage: project acceptance and unit transfer. Based on the second stage, the project's actual emission reduction results shall faithfully comply with a report on the calculation of emission reduction results. The Executive Committee ought to issue corresponding emission reduction units to the investing country. Once

the government of both transaction sides has registered INDCs, enterprises in the investing country should obtain corresponding emission reduction units. Then, the transaction can be done.

5. Conclusions

This paper combined international regime theory with the nine elements of the market mechanism and used comparative analysis to propose a reference guideline of the CAs' and SDM's fundamental contents and implementation framework based on the Paris Agreement and the UNFCCC. The proposal fulfills the systematic execution regulations and an integrated management system of carbon market mechanisms, which provides a possibility to compensate for the lack of a systematic and concrete government and implementation framework of the CAs and SDM. Following is the main body of the proposal.

1. CAs ought to work as a project-based trading mechanism and transfer international-regional/sub-regional-authorized quotas/credits, which consist of CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃, to achieve INDCs. The SDM should work as a sector-based mechanism and transfer international authorized credits including CO₂, CH₄, N₂O, and PFCs produced in cement production, steel, electricity, heat, construction, and waste management, aluminum production, and forestry. Both mechanisms shall use CO₂-eq as the unit of covered GHGs.
2. The operation of CAs may function in two different circumstances: parties with bilateral/multilateral agreements can transfer internationally approved ITMOs; parties without bilateral/multilateral agreements shall learn about ITMOs through an ITMOs information disclosure platform to identify transaction objects and complete the trading under CAs. The SDM can transfer carbon reduction from the host country to the investor country via an industry-level platform.
3. The international-level standards and regional/sub-regional requirements shall govern CAs together. For the SDM, a fully centralized scenario is suggested for the governance framework.
4. The implementation framework of CAs ought to contain three stages: project preparation, project submission and auditing, and ITMOs transfer. The implementation framework of SDM should include three stages: project development and review, project implementation and monitoring, and project acceptance and unit transfer.

The paper provides a proposal for the construction and implementation of the basic framework of the CAs and SDM, enriches the system construction of the two mechanisms, and provides support for carbon reduction and mitigating global warming. The implementation framework of the CAs and SDM make up for the lack of systematic enforcement regulations and a hierarchical management system.

There are also some limitations of the proposal. Firstly, the paper only focuses on the basic framework layer and ignores the supplement and improvement layer, which is not a comprehensive framework. Secondly, the chosen elements contained in the fundamental contents are based on the INDCs of the parties but not from the actual contributions. Moreover, the proposal has not been taken into trial at this stage. In a later period, the authors will continue to discuss the supplement and improvement layer elements, and then build a specific case to certify the environmental integrity of the proposed implementation framework.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su14020655/s1>, Figure S1: Proposed implementation framework of CAs. EC: Executive Committee. IEC: International Executive Committee; Figure S2: Proposed implementation framework of SDM; Table S1: The Parties' NDCs comparison table (until June 2020*). BAU: Business-as-usual. LDC: Least Developed Country. LULUCF: Land Use, Land-use Change and Forestry. SIDS: Small Island Developing States; Table S2: Proposed type of mechanism and coverage of CAs, SDM.

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