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New market mechanism and its implication for carbon reduction in China

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HIGHLIGHTS

- The paper aims to contribute to the discussion of the NMM for further development.
- A framework including four key elements to conceptualize the NMM is established.
- The national-level operational framework of the NMM is presented and assessed.
- Four contributions of the NMM are explored for carbon reduction in China.
- Implementation of the NMM at different stages of China's development is explored.

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ABSTRACT

This article presents a detailed review and analysis of the discussions around the new market mechanism (NMM) and explores its potential in China. It contributes to the current discussion of the NMM in three aspects. First, this article attempts to streamline ideas about the NMM. The term NMM is considered to be an umbrella concept for emission trading systems which all Parties can engage in on a voluntary basis in the implementation of their intended nationally determined contributions, and which need to satisfy three criteria: (i) having a large scale scope; (ii) aiming to facilitate a net emission reduction; (iii) allowing flexibility for the host country. We also present a framework to clarify the NMM. Based on this framework, major options with a high implementation potential are identified. Second, we argue that the national-level operational framework determines the chance of successful implementation of the NMM. We identify different options based on a literature survey and evaluate them with respect to effectiveness and efficiency. Third, we choose China, a highly influential country regarding climate change polices, as a case to analyze the potential contributions and challenges of the NMM and its implementation at different stages of national development.

1. Introduction

The idea of the new market-based mechanism (NMM) emerged at the 13th Conference of the Parties (COP) to the United Framework Convention on Climate Change in Bali in 2007. The discussion on the NMM is a continuation of discussion around so-called "sectoral approaches" proposed by developed countries in the hope to scale up developing and emerging countries' mitigation contributions. It is also driven by the need to improve existing project-based mechanisms, such as the Clean Development Mechanism (CDM). After four years of discussion, the COP 17 in Durban agreed to define a NMM and proposed some broad guidance: the NMM is meant to scale up mitigation activities across broad segments of the economy; may operate at sectoral and/or project level; and aims to achieve a net decrease and/or avoidance of greenhouse gas emissions (UNFCCC, 2012). Since Durban, there has been hardly any progress on the NMM, which largely results from the fact that it may not be possible for Parties to give their final decision in advance of more clarity about the Durban Platform for Enhanced Action (ADP) (UNFCCC, 2014a). Notwithstanding, the new agreement of the Paris Climate Change Conference in 2015 established a new international carbon market mechanism ('Sustainable Development Mechanism') and specified some other

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important principles in Article 6 (UNFCCC, 2015a).

There are still many parties who see the relevance of NMM to both pre-2020 and post-2020 climate regimes (Svenningsen, 2013). One reason is that the NMM would achieve a net decrease, since not all emission reductions would be used to offset increased emissions elsewhere, which may increase mitigation actions pre-2020. Another reason is that the NMM could offer countries the ability to use emission reductions outside their borders to achieve their proposed targets. Therefore, the NMM may increase the willingness of countries to raise their ambition level, as stated in their Intended Nationally Determined Contributions (INDC). Indeed, some countries expressed their interest in using international credits in their INDC (e.g. Switzerland, Mexico, Liechtenstein, Canada, Morocco, South Korea, and so on) (Carbon Market Watch, 2015). Besides, some countries have started pilots to facilitate the development of the modalities and procedures for the NMM.

In spite of the slow progress in the global negotiations, the discussions of scaling up existing project-based mechanisms to the sectoral level and introducing sectoral approaches have been continuing in academic circles (e.g. Baron et al., 2009; Schneider and Cames, 2009; Schneider et al., 2014). Although the NMM may contain project-level activities, the sectoral NMM is often the main focus in the literature. This may result from the fact that sectoral actions are an effective means for countries to implement emission reduction plans (Cai, 2013; IPCC, 2014). Hence, many countries are actually piloting NMM activities at sectoral level with the aim to provide input into a potential NMM set-up and to get ready for developing other policy instruments in the future.

The paper makes a three-fold contribution to the current discussions around the NMM. First, because of the many different proposals of Parties and different pilot activities, there is a need to define and unify the overall concept of the NMM at the international level. In Section 2, we define the concept of the NMM, establish a framework to clarify the NMM and identify major options for future implementation. Second, as the NMM is mainly proposed at sectoral scale, the host country government – and not the private sector – will be the major operator. This raises the question of how host country governments can provide incentives to the private sector, who are supposed to make the actual emission reductions. The operational framework at the national level to incentivize emission reductions of the private sector is thus key for successful implementation. Based on a literature survey, Section 3 identifies and evaluates different approaches and options regarding the effectiveness and efficiency of such national frameworks. Third, some developing and emerging countries – such as China, Brazil and Bolivia – are cautious about the NMM and the inclusion of other market mechanisms (UNFCCC, 2015b). Therefore, it is important to clarify whether the NMM will bring benefits to these countries, discuss the challenges and difficulties that have to be solved before the NMM is implemented, and explore how the NMM can be implemented in order to function at different stages of national development. Since the attitude of China – as the largest greenhouse gas emitter in the world – towards the NMM would strongly influence the development and implementation of the NMM globally, China is taken as a case for analyzing the potential contributions and challenges of the NMM and its implementation at different stages of national development. Finally, the paper presents the conclusions and policy implications.

2. New market mechanism and its major options

2.1. New market mechanism and its relationship with existing market-based instruments

The concept of the NMM can be clarified in relation to existing market-based mitigation instruments. Emission Trading System (ETS) and carbon taxes are two independent market-based instruments that can internalize environmental externalities. A carbon tax is levied on production activities or services that generate carbon emissions. The prices of such products or services increase because of the tax, thereby reducing the demand for them. An ETS sets a total amount of carbon emissions and allows emission units to be traded at market prices. The new market mechanism is classified as emission trading system. The emission trading system involves two mechanisms. The first one is a trading mechanism, also known as cap-and-trade system, which is widely applied globally (e.g. European Union, China, California). Another one is the crediting mechanism, also known as baseline-and-credit system, which is mainly used in the CDM and Joint Implementation (JI) under the Kyoto Protocol. As mentioned above, since the proposals around the NMM are partly driven by the need for improving the existing CDM, there is a strong relationship between the CDM and the NMM. On the one hand, the purpose and function of the NMM are the same as the CDM, promoting the cooperation among Parties and allowing Parties to use “international transferred mitigation outcomes” to meet their reduction targets. On the other hand, the NMM is “new” compared to the CDM in five main ways: (i) it can be applied by all countries, and not only by developing countries; (ii) the host country government has a more important role, including initiating the NMM and facilitating emission reductions; (iii) the NMM should go beyond the pure offset mechanism (i.e. CDM) to achieve a net decrease by implementing more ambitious policy or emission targets, discounting at issuance, or shortening crediting periods (Wehnert et al., 2013); (iv) the scope must be scaled up to broad segments of the economy; (v) both the trading and crediting mechanisms can be applied in the NMM.

To date, there has been no common understanding of what the NMM should be like, while such a common understanding is needed at the international level. Based on a comparative analysis with the existing project-based CDM, diverse proposals of Parties and current pilot activities, we explore the concept of the NMM. According to Lehmann et al. (2014) and Article 6 of the Paris agreement (UNFCCC, 2015a), the term new market mechanism is considered as an umbrella concept for those emission trading systems which all Parties can engage in on a voluntary basis in order to achieve their intended nationally determined contributions, and which need to satisfy three criteria: (i) having a large scale scope; (ii) aiming to facilitate net emission reductions; and (iii) allowing flexibility for the host country. In other words, the NMM can be used to contribute to the reduction of emission levels in the host Party, and, at the same time, the emission reductions from the NMM can also be transferred through carbon market to another Party to fulfill its INDC. The next part develops those criteria into a framework to define the NMM at the international level.

2.2. A framework to clarify NMM

Based on research of IGES (2013), we identify the key elements of the NMM, as the basis to clarify the overall concept of the NMM (see Fig. 1).

2.2.1. Governance

The governance of the NMM could either be centralized or decentralized. Similar to the CDM and JI, a centrally governed NMM would set and approve common rules, procedures and methodologies that apply to all countries in the COP. In contrast,

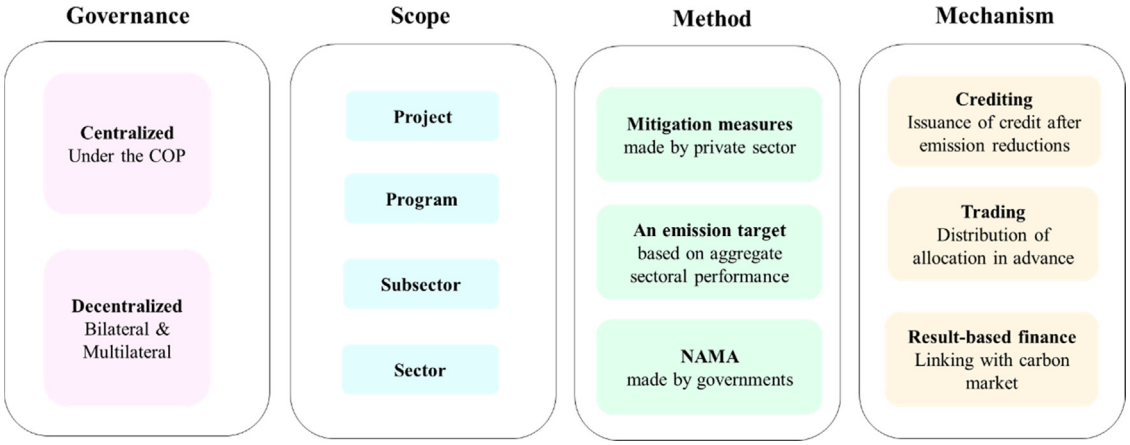

Fig. 1. A framework to clarify NMM.

the role of the COP under a decentralized NMM could either set minimum mandatory standards or set voluntary best practice guidelines to provide more flexibility for the host country (UNFCCC, 2014a). Most Parties consider the NMM as a centralized mechanism which would operate under the supervision of the COP. However, some Parties (such as Japan) expect the NMM could be built in a decentralized way to reflect individual national circumstances. Besides, current bilateral and multilateral pilots are developed in the absence of internationally approved rules and provisions. Therefore, both the centralized and decentralized options need to be incorporated at the current stage.

2.2.2. Scope

The idea that the NMM would have to be scaled up to 'broad segments of the economy' is ambiguous and needs to be defined by the Parties. It is commonly understood that the NMM will cover mitigation activities at sectoral, sub-sectoral or cross-sectoral levels (IGES, 2014). However, the term 'sector' is also ambiguous and is open to various interpretations. A sector might cover an entire sector, installations above a certain threshold, or installations in specific regions (such as large cities). That is why 'segments' also refers to 'groups of emitters' (Prag and Briner, 2012). Furthermore, there is a wealth of experience and expertize with the CDM and JI, as well as the great interest of some countries (e.g. China, Brazil), to continue project-based market mechanisms. Therefore, a simplified and improved CDM and JI could be consolidated into the NMM, with 'project' and 'program' windows, as well as (sub-) sectoral windows (UNFCCC, 2014a).

2.2.3. Method

Emission reductions can be achieved by concrete mitigation measures of the private sector or the government promising to achieve an agreed emission target based on aggregate sectoral performance. The government can also use Nationally Appropriate Mitigation Actions (NAMAs) to mitigate emissions, which refer to any policy and action that reduces emissions in developing countries. The NAMAs currently proposed and planned are typically in the form of concrete policies and measures (PAMs), e.g. energy efficiency standards, feed-in tariff policies, or removal of environmentally harmful subsidies. These are similar to the concept of 'policy-based mitigation' proposed by the World Bank (UNFCCC, 2014b), which refers to emission reductions resulting from the implementation of specific policies and measures.

2.2.4. Mechanism

The main difference between crediting and trading depends on whether the units are issued ex-post or ex-ante and whether they are non-binding or mandatory (Ecorys, 2012). Under a crediting mechanism, the issuance of credits is ex-post if the host country successfully implements those PAMs, or achieves the agreed emission targets. If the host country fails, there is no penalty due to its non-binding nature. This is different for a trading mechanism involving mandatory ex-ante issuance of tradable units. In this case, the host country will receive tradable units according to the agreed target of emissions in advance, for example start-up funds for low carbon investments. If the target is overachieved, the host country will get a surplus of units to be sold. If the target is not met, the host country needs to buy units to cover the excess emissions. A lot of literature and analysis on the NMM focuses on the crediting mechanism, but whether such a trading mechanism would be incorporated is uncertain and needs to be clarified in negotiations.

Under result-based finance (RBF), a funder commits to pay an agreed amount for each ton of emission reduction to a project implementer through a contract. This can be a powerful catalyst for low-carbon investments by providing predictable funds, especially given the current situation characterized as "lack of demand". That is why most current pilot activities are framed as RBF. Although RBF is not a market mechanism per se, it could be a bridge to crediting. There are two ways for it to link with carbon markets (World Bank, 2013): (i) setting a price floor – the funder guarantees price certainty while providing potentially higher revenues than the market price by setting a price floor. If the market price is lower than the price floor, the funder pays the difference. Otherwise, the funder pays nothing and the released funds can be re-invested in other projects; (ii) establishing a tradable put option – the option allows the holder to sell an agreed amount of emission reductions to the funder at a fixed price on or before a certain date. If the market price exceeds the fixed price, the holder sells the emission reductions into the market and the option ends. Otherwise, the option will come into force. The option could be transferable to effectively reduce non-delivery risks.

2.3. Major options of the NMM

According to the proposals of Parties and pilot activities, this section sets out several major options of NMM that derive from the wide range of studies, submissions of Parties and current pilots. These options usually include a combination of the elements from the framework above. Table 1 presents the options, key elements and leading advocates.

2.3.1. Enhanced CDM

Some countries in the negotiations, such as China, Brazil and Environmental Integrity Group (Liechtenstein, Mexico, Monaco, Korea and Switzerland), render great interest in continuing

Table 1
Major options for the NMM.

	Governance	Scope	Method	Mechanism	Leading Advocate
Enhanced CDM (CDM+)	Centralized	Project/Program	Mitigation measures	Crediting	Brazil (UNFCCC, 2014c)
NAMA crediting	Centralized/ Decentralized	Subsector/ Sector/	NAMA	Crediting	Colombia, Mexico, Peru, Vietnam (World Bank, 2015); Tunisia (GIZ, 2013)
Sectoral crediting mechanism (SCM)	Centralized	Subsector/Sector	An emission target	Crediting	Morocco, Tunisia (World Bank, 2015); European Union (UNFCCC, 2011) Ecorys (Ecorys, 2012)
Sectoral trading mechanism (STM)	Centralized	Subsector/Sector	An emission target	Trading	European Union (UNFCCC, 2011) Ecorys (Ecorys, 2012)
Bilateral crediting mechanism	Decentralized	Project/ Program/ Subsector/ Sector	Mitigation measures/ An emission target/ NAMA	Crediting	Japan (Le and Delbosc, 2012) Warnecke and Fekete (2013)
Project-based RBF	Decentralized	Project/Program	Mitigation measures	Price floor/Tradable put option	World Bank (2013)
Sectoral RBF	Decentralized	Subsector/ Sector	NAMA/An emission target	Price floor/Tradable put option	Indonesia, Latin America (Kfw, 2013a and 2013b)

project-based market mechanisms. Marcu (2014) also suggests that it is important to continue the experience and knowledge accumulated by the project-based mechanisms over ten years. Thus, enhanced CDM with necessary modification in its modalities, procedures and methodologies may be consolidated into the NMM, with a continued focus on project and program level activities.

2.3.2. NAMA crediting

Most current NMM pilots are typically in the form of NAMA crediting at current stage. For example, Mexico plans to implement three sectoral NAMA crediting in urban communities, urban transport and refrigeration respectively (World Bank, 2015). The Tunisian Government has designed a NAMA crediting in the cement sector by introducing lower content of clinker, low-carbon content fuels and wind power (GIZ, 2013). The issuance of credits is linked with adoption, implementation and enforcement of PAMs at sectoral or program level. Due to lack of data, most countries use PAMs to reduce emissions to implement PAMs rather than setting an emission target for a certain sector. Moreover, some PAMs (such as feed-in tariffs) already exist and have been proven to be effective. In the short term, therefore, strengthening an existing and successful policy can be an effective approach (Sterk et al., 2014). However, emission reductions from some PAMs are difficult to measure, report and verify (MRV), which makes them ineligible for crediting (Cai, 2010). In addition, the cost-effectiveness of a NMM depends on the flexibility for the private sector to autonomously choose mitigation measures (Butzengeiger-Geyer et al., 2010). Usually, specific measures and actions required to achieve mitigation vary from company to company. If PAMs take the form of taxes, the flexibility for the private sector is high. But if the PAMs, for example, take the form of introducing energy efficient refrigerators with low or zero GWP refrigerants (as in Mexico), the flexibility is low. Thus, the flexibility of the private sector offered by the PAMs is uncertain and depends on the specific measures implemented by the government.

2.3.3. Sectoral market mechanism

A sectoral market mechanism (SMM), containing both sectoral crediting and sectoral trading mechanisms, was initially proposed by the European Union (EU). Unlike the crediting mechanism, there is uncertainty about whether the sectoral trading mechanism will be incorporated in the NMM. Some countries argue that the trading mechanism may increase the likelihood of overlap between the NMM and a future global emissions trading system. Besides, the binding nature of a trading mechanism may lead to a weak target and thus have negative environmental effectiveness. Moreover, while SMM is the focus in a major part of the literature (e.g. Schneider and Cames, 2009; Ecorys, 2012; Cai et al., 2012; Millard-Ball, 2013; Wang et al., 2015; Gao et al., 2016), it does not seem to be the first priority among current pilots. The reason, as mentioned above, is that consistent and reliable data on emissions is unavailable for setting an emission target in some countries. If such a target could be set, however, it would offer high flexibility for the private sector and thus increase the cost-effectiveness of the mechanism.

2.3.4. Bilateral crediting mechanism

The success of market mechanisms relies on a stable demand of carbon units and a price that is high enough to stimulate emission reduction investment. Using bilateral agreements in pilot activities could be effective in light of the current demand scarcity. Warnecke and Fekete (2013) chose the electricity sector in Chile and the building sector in South Africa to develop bilateral agreements to pilot the sectoral market mechanisms. Japan has been implementing its joint crediting mechanism (JCM) in eleven developing countries (e.g. Mongolia, Ethiopia and Vietnam). The Chinese National Development and Reform Commission (NDRC) has also encouraged exploring bilateral and multilateral carbon trading activities in 2014–2020 (NDRC, 2014a).

2.3.5. Result-based finance (RBF) at both project and sectoral level

RBF is another way to solve the problem of demand scarcity. Many pilots actually use the RBF to simulate market operation, either at project or sectoral level. For example, a methane RBF project pilot by the World Bank focuses on exploring cost-efficient methane mitigation of the private sector. Furthermore, European Commission-supported programs in Indonesia and Latin America design concepts and methods of RBF at the sectoral level. Both RBF and bilateral crediting mechanism could be designed to ensure environmental integrity with the perspective to be converted into a centralized NMM.

3. Operational framework at the national level

The operational framework at the national level, which is one

Table 2
Different options of the operational framework at the national level.

Options	Instruments	Description and comparison
Tradable units for government	Mandatory "sticks" Voluntary "carrots"	Include general economic and fiscal policies, and standards Include targeted economic and fiscal incentives, and information instrument
Tradable units for installations with voluntary targets	Government ensures each installation that achieves the target to receive the tradable units	Low pressure of emission reductions for installation owner; A low political feasibility from the host country
	Retain a small portion of tradable units issued	Low pressure of emission reductions for installation owner; Unfair distribution of burden
Tradable units for installations with mandatory targets	Pay tax for emissions exceeding the target	High pressure of emission reductions for installation owner; Akin to the carbon tax or energy tax and thus familiar for both governments and private sectors
	Buy tradable units for excess emissions	High pressure of emission reductions for installation owner; Applies to SMM and NAMA crediting; Fluctuation of carbon price gives more freedom to installation owners to make trading decisions
	Pay a certain deposit for each ton of emissions ex-ante	High pressure of emission reductions for installation owner; Negative effect on the companies' cash flow and thus would hardly offer incentives to participate
	Domestic ETS	High pressure of emission reductions for installation owner; Applies to the SMM; Ex-ante tradable units can be the parts of initial investment
Mixed policy instrument	Both distribute tradable units to installations and introduce concrete policy measures	High dynamic and static economic efficiency; Potential policy interaction

of the six thematic areas in negotiations (SBSTA, 2013), determines whether the NMM could actually generate emission reductions. It also receives most attentions from workshops on the NMM (NEFCO and Kfw, 2013). Since there has been much experience with project-based mechanisms, this section is limited to the sectoral level. Because the private sector cannot be in charge of a whole sector, the NMM at the sectoral level is clearly different from project-based mechanisms. The host country government will have to be in the driving seat instead of the private sector. This raises a key issue: how can the government develop an appropriate operational framework at the national level to stimulate the private sector to reduce emissions in order to achieve the emission targets or PAMs? To unpack this question, we look at whether the tradable units from crediting should be disbursed to individual emitters or retained by the government. Three options are proposed: (i) tradable units for government; (ii) tradable units for installations; (iii) a mixed policy instrument. Table 2 presents these different options of the operational framework at the national level, which are developed in more detail in the remainder of this section.

3.1. Tradable units for the government

This option is based on a strong executive force of the government to implement mitigation policies across sectors or subsectors. The government could introduce a variety of PAMs and use the potential tradable unit revenues or RBF funds to support policy implementation. There are two options (Harrison et al., 2011): (i) mandatory "sticks" containing general economic and fiscal policies (e.g. energy/carbon tax and abolishment of fossil fuel subsidies), and standards (e.g. efficiency standards for electric vehicles and building codes); and (ii) voluntary "carrots" consisting of information instruments (e.g. know-how transfer and demonstration and training), and targeted economic and fiscal incentives (e.g. government procurement and feed-in tariffs). The government usually uses policy packages that include both sticks and carrots.

Tradable units for the government are relatively easy to implement as the accounting of emissions takes place on a sectoral scale and there is no need for installation level emission data. It is thus suitable for sectors with numerous emission sources, and for state-owned sectors in particular. There is a broad range of mitigation policies to fit into the specific sector. Besides, some policies (e.g. feed-in tariffs) have been already in place and these can be strengthened and up-scaled through the NMM. In terms of economic efficiency, this option provides high dynamic efficiency as it can foster the development of technologies which are currently commercially less attractive (e.g. carbon capture and storage), or are hard to incentivize by the current carbon price (Sterk et al., 2014). However, emission reductions from some PAMs are difficult to account or needs prohibitively high MRV costs, inducing a risk of ineligibility for crediting. Moreover, as mentioned above, the flexibility provided by PAMs for the private sector to choose mitigation measures might be small (e.g. abolishment of outdated equipment), which could have a negative effect on the cost-effectiveness of the mechanism in the long run.

3.2. Tradable units for installations

This option requires a lot of installation-level emissions data as a basis for passing the sectoral target and PAMs to installations. Each installation will be allocated its own target, using either voluntary or mandatory measures, which will be discussed below.

3.2.1. Voluntary target

A voluntary target, without penalties for non-performance, may cause some installations to achieve their targets while others do not. Therefore, a sector as a whole might not achieve the target and not get enough tradable units. This problem could be an obstacle for individual installation to actively invest in emission reductions. Two options can be used to solve this problem: (i) the government could ensure each installation that achieves the target to receive the tradable units (Dransfeld et al., 2011); or (ii) the government retains a small portion of tradable units issued as a buffer to be reinvested into buying the shortfall tradable units (IETA, 2010). If the buffer is insufficient, the government will cover the rest.

Voluntary targets put less pressure on each installation owner

to reduce emissions which may have influence on the competitiveness of installations. However, the first option exposes the government to the risk of taking on the costs from the installations that fail to achieve their target, and thus lowers the political feasibility. The second option induces unfair situations where the installations that have successfully reduced their emissions have to pay for the costs of the installations that fail to achieve their targets.

3.2.2. Mandatory target

A mandatory target with penalties would be an effective approach to solve the above mentioned problems induced by a voluntary target, but will cause more pressure on installation owners. Four options can be used to work with mandatory targets.

(i) If the target is achieved, the installation receives the tradable units. If not, the government will levy a tax on the emissions exceeding the target (Butzengeiger et al., 2012). The tax rate could be set at the recent average carbon price under SMM and NAMA crediting mechanism, or, depending on the prevailing market price, under RBF. This option is akin to the current carbon tax or energy tax in some countries.

(ii) If installations fail to achieve the target, they are obliged to buy tradable units from carbon markets for the excess emissions and hand them over to the government (Whitesell, 2009). This option only applies to SMM and NAMA crediting. Compared with the emission tax, the fluctuating carbon price gives installations more flexibility to make trading decisions.

(iii) The government charges installation owners a certain ex-ante deposit for each ton of emissions, which will be returned if the target is achieved. If not, there is no return (Michaelowa, 2012). This option has worked well in the context of waste management (Walls, 2011), but does require trusts in the government to provide the future refund. Any unclaimed deposits could be used to offset excess emissions. The deposits could be invested in government bonds and accrued interests could be paid to the owners so as to make it equivalent to an investment of owners themselves. The interests, however, may be lower than that of other investment made by owners. Moreover, ex-ante deposits will negatively impact the cash flow of the private sector and would thus offer less incentive to participate.

(iv) The government establishes a domestic emission trading system that is only applicable to the SMM (Schneider and Cames, 2009). The operation of this option is similar to the current regional emission trading system (e.g. EU ETS, California cap-and-trade Program and the upcoming China national ETS). Ex-ante tradable units would mean that trading will be conducted at the beginning and that the income from selling tradable units can be part of initial investments. Notably, the crediting mechanism would need to establish a separate national emission currency (tradable units) for this ex-ante distribution. The national emission currency could also be allowed to be exchanged against the future credits issued by COP.

The option of distributing tradable units to installations requires accounting emissions at the installation level, which would increase the administrative and technical efforts. The private sector is directly exposed to the carbon market and its price. This means that an advanced energy and emission management system should be in place, as well as sufficient carbon trading and management capacity in the private sector. The carbon price signal can effectively stimulate emission reductions in the short run, which may provide a high static efficiency. The private sector, however, would have to make investment decisions based on the price signal only. This would hinder the development of expensive technologies with bright prospects in the long run and thus may lead to a lower dynamic efficiency. The option does offer high flexibility by making the private sector select their own measures and thus provide high cost-effectiveness.

3.3. Mixed policy instrument

A mixed-policy instrument combines the above two options, both distributing tradable units to installations and introducing concrete policy measures (Ecorys, 2012; Harrison et al., 2011). This combination could provide both high dynamic and static economic efficiency. The example is the EU which implements an ETS while also having various sector and technology policies in place. This design, however, faces the challenge of policy interaction that potentially causes confusion and reduces effectiveness. According to De Perthuis and Trotignon (2014), undesirable overlap with other public policies is one of the most important factors undermining the EU ETS. Flues et al. (2014) also study the interaction between renewable energy policies in EU and its ETS under the different scenarios of electricity demand. Their results show that the renewable energy support policies make the price of tradable units of the EU ETS more sensitive to changes in economic activities, and that these consequences of policy interactions become more serious when the electricity demand is lower. Table 3 presents the summary assessment of the above three options.

4. New market mechanisms in China

Some developing and emerging countries present a cautious

Table 3
Summary assessment of the above three options.

Options	Pros	Cons
Tradable units for government	Relatively easy to implement; Suitable for sectors with numerous emission sources, particularly for state-owned sectors; A broad range of mitigation policies to fit into the specific sector; Some policies have been already in place; High dynamic efficiency.	Emission reductions are difficult to measure or costs of MRV are prohibitively high; Flexibility for the private sector might be small; Low static efficiency; Negative effect on the cost-effectiveness of the mechanism in the long run.
Tradable units for installations	High static efficiency; High flexibility for the private sector; Promotes the private sector to establish an advanced energy and emission management system and to increase carbon trading and management capacity.	Requires accounting of emissions at the installation level; Higher administrative and technical efforts; Low dynamic efficiency.
Mixed policy instrument	Both high dynamic and static economic efficiency	Potential policy interaction

attitude towards the NMM as they fear it might become a major obstacle for its development. It is therefore important to analyze whether and what kind of benefits the NMM will bring and how the NMM is to be implemented at different stages of a country's development. As the biggest emerging economy and largest greenhouse gas emitter, the position of China towards the NMM could have a major effect on the future of the NMM in negotiations. Moreover, China has been expressing some interest in the NMM, for example through its ongoing policy experiments with carbon markets on provincial and municipal level and its plan to implement a national ETS in 2017. It is therefore timely to analyze the development of the NMM in China. Notwithstanding, the insights of this article are also relevant for other developing and emerging countries investigating the feasibility of the NMM, such as Mexico and Peru. This section first explores potential contributions of the NMM in China. Subsequently it discusses how to choose the appropriate options of the NMM and design the operational framework at the national level. Finally, some of the main implementation challenges are laid out.

4.1. Contributions of the NMM in China

4.1.1. Provide climate finance and further emission reductions

The recent target for CO_2 emissions to peak around 2030 in China requires substantial climate finance and emission reductions. Although China has spent $87.6 billion each year during 2008–2012, there will be $370 billion shortfall in 2030 in order to achieve the low carbon transformation (Amin et al., 2014). To cover this huge funding gap the key issue is to leverage more private investment through public funds and carbon markets, which could be attained through an NMM. Given the current uncertainty about carbon markets, RBF and bilateral crediting mechanism with predictable payments could be good choices. The potential of RBF for climate finance has been explored since the Warsaw COP 19, where the Green Climate Fund was set up to collectively channel adequate and predictable results-based climate finance (UNFCCC, 2013). The World Bank is also developing a piloting fund that supports up-scaled crediting programs in developing countries through offering payments for carbon credits (World Bank, 2015). The Chinese government also has expressed interest to establish bilateral and multiple carbon trading activities during the period of 2014–2020 (NDRC, 2014a).

Deepening and broadening mitigation actions is required in view of ambitious climate change mitigation target in China. China is planning to establish a national ETS in 2017, which caps the emissions of the power and energy intensive industries. Although non-ETS sectors, such as the transport and building sectors, currently represent a relatively small share of emissions, they could be major contributors of future emission growth. Controlling emissions of the transport and building sector will also be one of the major measures to achieve the INDC of China (NDRC, 2015a). The NMM at sectoral level could, if properly designed, play a significant role. In the road transport sector, one of the principle abatement options is the development of electric vehicles (EV) (McKinsey, 2009), although the ambition to establish a large EV industry is not realized as fast as the government expected. One of the reasons is that most battery companies adopt a 'wait and see' attitude, because of market uncertainty and difficulties to access government subsidies (Wan et al., 2015). There is also a serious lack of financial incentives to stimulate new energy efficient technology and product investment in the building sector (Zhang and Wang, 2013). If the government could use the NMM to provide more subsidies and provide specific policy signals, investments of the private sector would be stimulated and more emission reductions could be achieved. In addition, there is a wide range of low-cost methane abatement opportunities in the oil and gas sector, solid waste management, wastewater treatment, and the livestock waste sector. These could be encouraged through incremental funds, such as the RBF (World Bank, 2013). The NMM could therefore overcome some of these financial constraints in these sectors and stimulate further emission reductions.

4.1.2. Create readiness for other climate policies

Given that there is much uncertainty about whether NMM materializes as expected in negotiations, it is important to discuss the relevance of the NMM in relation to other climate policies. As mentioned, the Chinese government is planning a national ETS in 2017 and has expressed its interests to introduce a carbon tax in the future. The national ETS would cap emissions from power, metallurgy and building materials sector and gradually expand to other sectors (NDRC, 2015b). Therefore, if NMM activities in current non-ETS sectors could create readiness for an easy transition into the national ETS and even into a carbon tax in the future, they would not go to waste. The World Bank (2015) has already identified the relevance of crediting-related activities to the other policies. Based on these points, we consider four NMM activities that are relevant to the development of a national ETS and carbon tax in China.

(i) Data management and MRV system: This activity is necessary for almost all climate policies, but its transferability depends on specific operational frameworks at the national level. If no targets are issued to installations, emissions would be accounted at the aggregate sectoral level based on statistical data (e.g. fuel statistics), which is less likely to be used in the ETS or carbon tax systems. If each installation gets a target, installation level data is needed, which is highly transferrable into the ETS and carbon tax systems. In fact, this activity has already taken place in China to prepare for the national ETS (NDRC, 2014b).

(ii) Quantification approaches: This activity refers to methodologies that are used to set a target and quantify emissions. The development of a target for non-ETS sectors in China under the NMM would increase the understanding of mitigation potential and cost while supporting cap-setting in the context of the national ETS. However, the contribution of this activity to the ETS depends upon different options within the NMM. For example, under a NAMA crediting mechanism, the target takes the form of successful achievement of a specific policy (such as an energy efficiency standard). This kind of target has little applicability for caps-setting under the ETS. However, under a sectoral crediting mechanism, the target takes the form of an emission target at the sectoral level, which could easily be used in the ETS.

(iii) Registry system: This activity is essential for an ETS and its function under the NMM could be adapted to manage different tradable units. Seven emission trading pilots in China are developing their registry systems currently, collecting important experiences and lessons to overcome some of the main challenges. Other regions could also establish such a system within the context of the NMM to provide valuable inputs into the national ETS.

(iv) Stakeholder engagement: This activity includes training, workshops and outreach for relevant stakeholders, such as the private sector, certain government departments and verifiers, which could strengthen their awareness and capacity of participation in market-based instruments. Therefore, the relevant skills would be used to set the stage for the national ETS and carbon tax systems in China.

4.1.3. First-mover advantages

In addition to fitting into the national development needs, piloting the NMM would provide China with first-mover advantages

in the climate change negotiations. The international discussion on this mechanism are still pending and national pilots could feed into international negotiations processes. Examples from the past have shown that early actions have a positive effect on the development of market-based mechanism and have the priority to set standards (Warnecke and Fekete, 2013; Höhne et al., 2015). This is part of the reason why many developing and emerging countries are entering into a pilot phase (e.g. Mexico, Peru and Tunisia). The Chinese government would also be wise to explore NMM pilots that are suitable for its national priorities, to add their own views to the discussion, and to take a leading role in setting modalities and procedures of the NMM.

4.1.4. Overcome non-price barriers

While large financially viable abatement potential exists, this has not been fully developed in some sectors of China. The existence of economically profitable abatement potential suggests that there are some non-price barriers or hidden costs. For example, technologies of Electric arc furnace in China's iron and steel sector are almost all cost-effective while its share in China is only 10% (less than most developed countries) because of the shortage of scrap and electricity (Li and Zhu, 2014). Similarly, at least 11 emission reduction technologies in China's cement sector are cost-effective, yet most of them have a low rate of adoption (Gu et al., 2012). One reason is the shortage of alternative fuel and limited transportation network for recycling alternative fuel. In addition, the dominance of state-owned companies in China may limit the ability of companies to make commercial choices and react to the market incentives. The NMM, as a price-based mechanism, could help to overcome such non-price barriers by providing financial benefits (Sterk et al., 2014). However, only financial benefits from the NMM might not be enough to effectively address these barriers. However, only financial benefits from the NMM might not be enough to effectively address these barriers. The government also needs to implement dedicated policy instruments (Gupta et al.,2007). Therefore, the revenue of tradable units under the NMM would offer the financial support for developing such policies. Among the major options of the NMM, the sectoral trading mechanism might be the most useful one for China since the tradable units are issued ex-ante, which could help to fund the removal of non-price barriers beforehand.

4.2. Challenges of the NMM in China

4.2.1. Data reliability

The reliability and consistency of data from installations determines whether the NMM could be implemented successfully. At the current stage, the quality and quantity of emission data in China tend to be poor (Munnings et al., 2016). For example, there is a 1.4-gigaton gap between the national and provincial statistics in 2010 (Guan et al., 2012) and similar discrepancies between bottom-up and top-down datasets (Liu and Nan, 2012). One reason is that the government lacks experience in collecting emission data (Wang, 2013a). Another reason is the light punishment for obstruction of inspection and falsification of data (Wang, 2013b). In addition, the methods for accounting emissions among emission trading pilots are different, which makes it difficult to obtain consistent emission data for specific sectors. Therefore, an effective monitoring, reporting, and verification (MRV) system is needed, including strengthening stakeholder engagement in MRV design, as well as trainings for personnel from the companies and verifiers (World Bank, 2014a). Besides, it is also necessary to carry out targeted and detailed sector-specific studies before NMM implementation. The Chinese government is making steps to improve the MRV system and improve the quality of emission data. For example, the greenhouse gas emission accounting guidance for 14 sectors has been released, and a national accounting system will be established (NDRC, 2014b).

4.2.2. Policy interaction

Currently, there are many regulations to manage energy use in China, some of which include detailed targets at national and provincial level and impose specific requirements on local governments and companies. In addition, there is a wide range of sectoral measures on energy efficiency and low carbon technologies, as well as the upcoming national ETS and carbon tax. All these policies would interact with the NMM. This interaction would make the measurement and projection of emissions particularly difficult in China (Munnings et al., 2016). As a result, some overlapping climate policies may achieve the emission reductions that an ETS should achieve (Zhang et al., 2013). In addition, these energy and climate policies are developed by different ministries and agencies, which results in overlap, inconsistency and confusion and thus reduce the effectiveness (Zhang et al., 2014). In this context, how to coordinate the NMM with these existing and upcoming policies is critical for implementing a well-functioning NMM in China. Therefore, the government has to address its compatibility with other polices and to coordinate these policies across multiple agencies.

4.2.3. Legal barriers

For the NMM to succeed in generating emission reductions, the host country government needs to develop an appropriate operational framework at the national level that can incentivize the private sector to reduce emissions. As mentioned in Section 3.2, the government may set mandatory targets for installations. In order to ensure compliance, a legal framework needs to be established, allowing the government to impose a noncompliance fee. In most emission trading systems, the noncompliance fee equals a multiple of the tradable unit price for each ton of CO_2, with no limit on the total fee amount. However, the legal framework for noncompliance is still weak in China. Only two environmental laws at the national level refer to noncompliance fees and were set many years ago. One is a one-time fee for noncompliance with environmental laws in the China's Environmental Protection Law (NPC, 1989). Another one is the Law of the People's Republic of China limiting any noncompliance fee to roughly 100,000 yuan. Moreover, this law does not include CO_2 as a pollutant (NPC, 2000). Even though such noncompliance fees could be applied to the CO_2, the limited penalty level would not provide a strong deterrent against noncompliance (Zhang et al., 2014). While the upper limit of noncompliance fees has been removed under the recently amended law (NPC, 2014), it is still unclear whether the new law extends to CO_2. Therefore, a clear and integrated law framework at the national level is required for the successful implementation of the NMM in China.

4.2.4. State-owned companies

The existence of state-owned companies in China poses both opportunities and challenges for emission trading systems such as the NMM. In the current emission trading pilots, most state-owned companies perform well (Zhang, 2014). These state-owned companies usually have strong sources of funding and a high capacity to implement emission reduction projects, thus providing good opportunities for the NMM. The challenge lies in China's unique political economy. Although the government no longer directly operates the state-owned companies, it still continues to appoint and evaluate top managers. Most of state-owned companies are large and thus have significant market power, which could result in inefficient market outcomes, as these companies can hold a large number of tradable units to manipulate the price (Qi et al., 2014). This situation is likely to occur when the government

chooses a domestic ETS as the operational framework at the national level. Thus, the government needs to anticipate this situation and take action to avoid it, for example by limiting the amount of tradable units a company can hold.

4.3. Implementation of the new market mechanism in Chin

A key issue for the NMM in China will be its implementation at different stages of development. At the current stage, as noted above, strengthening existing and successful policies in non-ETS sectors would be considered an effective way and a good starting point. For example, the government requires the full implementation of 50% reduction in heating energy for buildings without proper insulation by 2020, which will save 31.5 million t-CO_2 in 2020 (MOHURD, 2011). If this strategy would include all the new buildings to aim for a standard of 65% reduction, up to 64.0 million t-CO_2 would be realized by 2030 (Xiao et al., 2014). In view of the current supply and demand imbalance of tradable units in the international carbon market, a sectoral RBF and bilateral crediting mechanism would be most appropriate. Because of the lack of installation level data at present, the government could retain the tradable units and use their revenues to co-fund the costs related to the policies outlined above.

The NDRC has already ordered the 20,000 biggest companies to report their annual greenhouse gas emissions, aiming to establish a national accounting system (NDRC, 2014b). Some of the provinces and cities (e.g. Shanghai and Anhui) have already started reporting their greenhouse gas emissions. Therefore, more installation level data will be available in the next few years and setting an emission target for an entire sector or even for individual installations would thus become feasible. A mandatory target for installations could be an effective way to create a fair system, as mentioned above. Such mandatory targets are already common for the government to reduce emissions in China, for instance in the top-1000 energy-consuming enterprises program (NDRC, 2006).

With the development of the NMM in non-ETS sectors, the possible relationship with national ETS should be explored. There are two conceivable pathways. The NMM in non-ETS sectors could serve as a stepping stone to a future national ETS by creating readiness in these sectors for a gradual transition into the national ETS. On the other hand, not all sectors will be involved in the national ETS and the NMM in those sectors could be considered as an independent and complementary mitigation tool to the national ETS.

Once there is enough demand for tradable units, the sectoral market mechanism including sectoral crediting or even sectoral trading would become major options of the NMM. In this case, tradable units directly from UNFCCC could be used for compliance or traded without any approval process at the international level. One of the possible pathways is thus that national ETS becomes integrated into the sectoral market mechanism as an option for the operational framework at the national level. Alternatively, the sectoral market mechanism could remain independent from the national ETS. Fig. 2 shows the possible process of implementing the NMM in China.

5. Conclusion and policy implications

In this paper, we established a framework to shed light on the ambiguity of the NMM concept, which needs to be specified at the international level. We also presented different options of the national-level operational framework of the NMM and assessed them with respect to effectiveness and efficiency. Finally, China was analyzed as a case to explore the contributions and challenges that the NMM could bring and how the NMM could be implemented at different stages of a country's development. This shows that the NMM could be a useful mitigation instrument for developing and emerging countries if designed properly.

In order to exploit the benefits of the NMM in these countries, it is important to take national capacities, priority sectors and the future climate change mitigation policy and strategy into account. First, countries could choose the sector which accounts for a considerable and increasing share of national emissions, has the relevant experience on market instruments (e.g. CDM), and is able to contribute to future mitigation policy development. For example, China could explore the NMM in the transport and building sectors which are considered as priority areas to achieve the INDC of China. Vietnam has set a target in the solid waste sector for NAMA crediting because this sector has experience with the CDM and relevant data is available (NRES and MPI, 2012).

Second, if the primary target of a developing country is to get more climate finance and leverage more low-carbon investment of the private sector, strengthening existing mitigation policies could be a good choice. Because of political feasibility and the absence of need for reliable data on emissions from installations, this could prompt a quick start. If a developing country also plans to use the

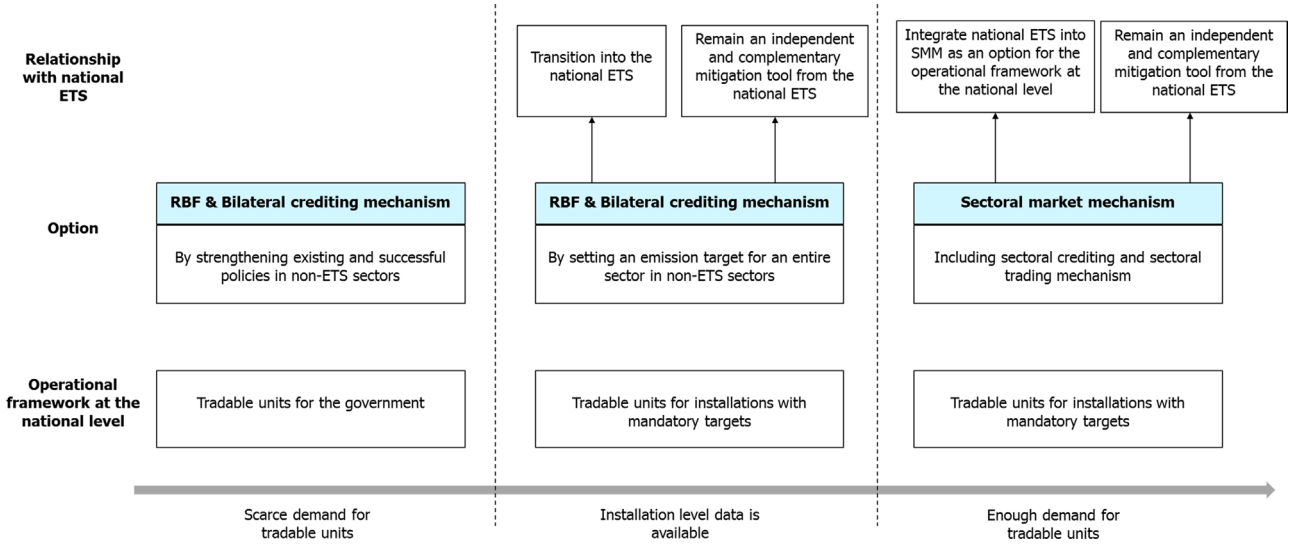

Fig. 2. Possible process of implementing the NMM in China.

NMM to contribute to other climate policies, especially through an ETS or carbon tax system, it could set an emission target for a specific sector and forward the sectoral target to installations. This could help to build a reliable emission database, increase the understanding of mitigation potential and cost, and establish relevant institutions. For example, China could use the NMM in non-ETS sectors to create readiness and gradually transition into a national ETS, as noted above. Thailand and Peru are exploring the NMM, and the market institutions and capacities built in the NMM could serve as a stepping stone to establish a domestic ETS there too (World Bank, 2015). Similarly, this pathway could apply to other countries that are considering to launch an ETS or carbon tax system, such as Chile and Brazil (World Bank, 2014b).

Third, given the current demand scarcity for tradable units, bilateral crediting mechanisms or RBF could be good choices, which could evolve into a NAMA crediting or a sectoral market mechanism once there is adequate demand for tradable units. Finally, in addition to satisfy the national development needs, it is worth noting that early action on the NMM would give developing and emerging countries the opportunity to set standards on the NMM in negotiations, which are currently dominated by developed countries.

However, challenges and difficulties in establishing the NMM remain and need to be solved, including data reliability, policy interaction, legal barriers, and how to deal with state-owned companies. A reliable and consistent MRV, targeted and detailed sector-specific analysis, a clear and integrated law framework at the national level, and an effective mechanism to coordinate the NMM with the existing and upcoming policies are required before the NMM can be implemented. In addition, Chinese government needs to pay attention to the possible market distortions caused by the large state-owned companies.

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