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RALI Series: Promoting Solutions for Low Emission Development

Market-Based Mechanisms to Reduce GHG Emissions in Asia

The RALI Series is a collection of papers developed by the RALI project to share examples of low emission development in practice. The series features case studies, tools, and innovative new approaches in this space, highlighting user benefits and lessons learned. To learn more about the RALI project, visit https://www.climatelinks.org/projects/rali.

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Executive Summary

Introduction

This paper provides **an overview of market-based mechanisms** (**MBMs)** for climate change policy and **case studies** of MBMs used in Asia. It illustrates the challenges faced by policymakers in the design and execution of these measures.

- MBMs are policy instruments that can be used to deploy market forces to generate action on climate change.
- The climate goal of MBMs is to incorporate the cost of greenhouse gas (GHG) emissions and/or energy production into both the market price of a product and the decision-making processes of the energy producers and/or GHG emitters.
- MBMs provide flexibility for participants to select the most cost-effective mitigation solution by using market forces rather than a top-down policy of prescribed approaches. This flexibility also encourages innovation in mitigation solutions as regulated entities strive to meet targets more efficiently.

Common Types of MBMs and their Application in Asia

- Carbon taxes, cap-and-trade programs, baseline and credit programs, renewable electricity standards, and energy efficiency resource standards are some examples of MBMs.
- In Asia, MBMs are frequently used as a tool to reduce emissions and finance low emission development.
- China's recently launched national cap-and-trade program will be the largest of its kind once fully operational; is expected to be double the size of the European Emission Trading System (ETS).

Role of MBMs in the Paris Agreement and Nationally Determined Contributions (NDCs)

- MBMs can be an effective tool to help countries meet their NDC targets. India aims to reduce its GHG emissions through MBMs such as trading programs and taxes. Bangladesh, Vietnam, Indonesia, Thailand, Laos, Cambodia, and Taiwan are each exploring MBMs as part of their NDCs.

Limitations and Elements for a Successful MBM

- For successful implementation, MBMs must be designed for the context where they will be applied. This requires explicit objectives such as desired emission reductions and the rate at which reductions are needed.
- Designing a successful MBM also requires effective stakeholder engagement, supporting legislation, and capacity building. Developing regional or pilot programs, such as the ETS pilots for regions in China, can be useful to gauge market readiness and capacity and to ensure higher compliance rates.
- Success of MBMs depends on the actions of the regulated party, which is inherently uncertain. This may not be viable when stakeholders are looking for certainty in costs and benefits.
- Effective compliance mechanisms are essential in ensuring that regulated parties are appropriately implementing and complying with MBMs.

Market-Based Mechanisms and Their Role in Low Emission Development

Introduction

In part due to country commitments to reduce greenhouse gas (GHG) emissions as part of the Paris Agreement, there has been increased demand for policies that will be environmentally beneficial without excessive costs or burdens on regulators or regulated entities. This paper discusses an especially promising type of policy—market-based mechanisms (MBMs)—that has broad benefits in terms of emissions reduction potential and economic development. These policies will be especially relevant for developing countries as they work to reconcile their growth and development with their emission reduction targets, and as they navigate various ways to meet those targets.

The sections below provide:

- Descriptions of key types of MBMs and examples of their application throughout Asia;
- The role and context of MBMs in the Paris Agreement and international climate mitigation efforts;
- MBM success stories from India, Korea, China, and Singapore; and
- Elements of a successful MBM.

What is an MBM?

MBMs are regulatory instruments that create economic incentives to manage externalities such as GHG emissions. In the climate context, MBMs function by associating a cost with GHG emissions and requiring a regulated entity (typically the GHG emitter) to reduce or pay a penalty for their emissions. Carbon taxes, cap-and-trade programs, baseline and credit programs, clean or renewable electricity standards, and energy efficiency resource standards are different types of MBMs.

*A **regulated party** or **regulated entity** is an organization that is responsible for complying with the requirements of an MBM. These organizations are held responsible for meeting requirements or paying non-compliance fees, as determined by the design of the MBM.*

Traditional command-and-control environmental regulations—such as setting emission standards and mandatory use of pollution control technologies or best available control technologies—are prescriptive and can be less likely to incentivize innovation. In comparison, MBMs are more flexible and give regulated entities the option to reduce their emissions through the approach that is most cost-effective for them. Many MBMs also allow the market to determine the price of pollutants.

Depending on the design of the MBM, regulated entities often have multiple compliance options. First, most programs encourage regulated entities to take mitigation measures or change their processes however they see fit in order to comply with the regulation. Second, if an entity cannot take the necessary measures to comply, or decides it is too costly to do so, it can instead purchase credits that count towards compliance but which are generated by another entity that exceeded its compliance target. Finally, some MBMs allow entities to pay a financial penalty to the government or regulatory body for noncompliance. Ultimately, MBMs require organizations to internalize the cost of emission into their decision-making and business processes.

A number of countries across Asia are deploying MBMs to control GHG emissions. China, for instance, has officially initiated regional cap-and-trade pilot projects, and recently developed a national-level emission trading scheme.[1] In Japan, municipal cap-and-trade systems, taxes, and renewable energy credits are used to reduce emissions. The map on the next page provides an overview of MBMs in Asia.

*An **externality** is an unintended side effect of an activity that affects stakeholders who did not choose to incur the associated costs or enjoy the benefits. The cost or benefit of an externality is often not reflected in the cost of producing goods or services. For example, electricity generation results in air pollution and GHG emissions that negatively impact human health and the environment. The cost of these negative impacts are not incurred by the power generator, but are instead incurred by the public or other entities (e.g., hospitals).*

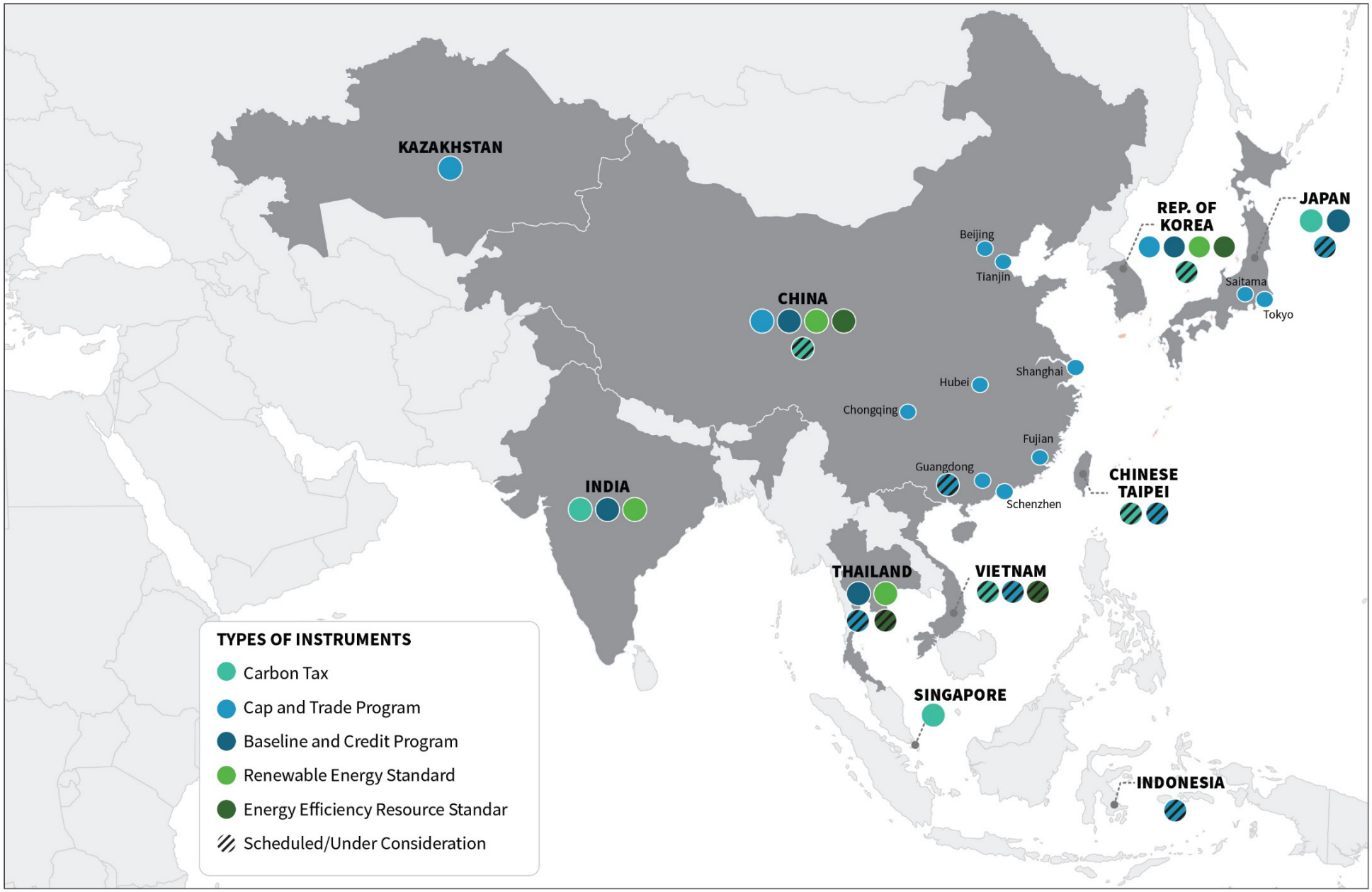
While MBMs primarily serve as a tool to stimulate emissions reductions, they can also be used to satisfy broader social, environmental, and economic objectives. For example, many of China's pilot cap-and-trade programs mention the optimization of industrial processes as a complementary objective, which has positive impacts on the economy. MBMs in China, Republic of Korea, and Singapore also mention low-carbon innovation as an additional objective.[2] In general, MBMs have an impact on the economy by shifting the financial burden of climate change mitigation to the regulated entity or polluter instead of the government or communities who bear the burden of the pollution in the absence of regulation. Taxes, cap-and-trade programs, and other MBMs can be designed so that the revenue earned from these programs promotes equity for groups that suffer the greatest burden from pollution, such as disadvantaged people, communities, or industries. For example, Beijing's cap-and-trade program was designed to address climate change as well as to improve air quality in Beijing.[3] This type of policy can be implemented through burden-shifting of taxes, direct distribution of revenues to all residents of an area, or funding of programs to assist certain groups. The focus on equity and economic benefits from MBMs allows these policies to be progressive rather than regressive.

[1] Timperley (2018). The initial national ETS system covers emitters from the power sector alone.

[2] World Bank Group (2018).

[3] World Bank Group (2018).

Market-Based-Mechanisms in Asia*



*As of June 2019

The table below shows the various MBMs in Asia and their status.

Table 1: MBMs currently active, scheduled, or under consideration in Asia, by country

	Cabon Tax	Cap and Trade	Baseline and Credit	Renewable Energy Standard	Energy Efficiency Resource Standard
China	○	✓	✓	✓	✓
Chinese Taipei	○	○			
India	✓		✓	✓	
Indonesia		○			
Japan	✓	○	✓		
Kazakhstan		✓			
Rep. of Korea	○	✓	✓	✓	✓
Singapore	○				
Thailand		○	✓	✓	○
Vietnam	○	○		○	

Key: ✓ = Active; ○ = Scheduled/Under Consideration

Common Types of Market-Based Mechanisms

This section describes five types of MBMs used in practice:

1. Carbon Tax
2. Cap-and-Trade Program
3. Baseline and Credit Program
4. Clean or Renewable Electricity Standard
5. Energy Efficiency Resource Standard

1. Carbon Tax

A carbon tax is a climate change mitigation instrument used to reduce the production or consumption of fossil fuels by imposing a fee on each unit of carbon emitted. A carbon tax can be levied at any point in the supply chain, including directly on emissions or on specific, carbon intensive products such as gasoline. A unit price (generally a price per metric ton of carbon) is established, which internalizes the pollution externality and raises the price of commodities produced using fossil fuels. The tax rate frequently will be designed to increase gradually over time. This change in price is intended to shift the market away from carbon-intensive processes. In turn, the tax revenue earned can be used for a variety of related government priorities, such as energy efficiency, renewable energy, climate change mitigation, or environmental justice efforts.

For example, India employs a coal cess that levies a tax on every metric ton of coal mined or imported into the country. [4] This is a type of implicit carbon tax in which upstream activities are taxed instead of emissions. As a result, coal-fired power plants are incentivized to find ways to optimize the energy produced per unit of coal, while clean energy is more able to enter the market. India has generated over USD 12 billion in revenue through this tax since 2010, 24% of which was transferred to the National Clean Energy and Environment Fund.[5]

[4] Business Dictionary (2019). A "cess" is a tax mechanism used for a specific purpose. The coal cess in India is an additional tax that is used specifically for financing renewable energy.
[5] IISD (2018).

Japan's tax for climate change mitigation taxes carbon dioxide (CO_2) emissions from the consumption of fossil fuels such as petroleum, natural gas, and coal. The tax rate is set at USD 11.74 per ton of CO_2 emissions, using a CO_2 emission factor for each of the regulated types of fossil fuels. The tax revenue is used to curb energy-related CO_2 emissions through the promotion of renewable energy and enhancement of energy conservation measures.[6]

Singapore launched a carbon tax in 2019 that will apply a fee on facilities emitting 25,000 metric tons of CO_2 equivalent ($mtCO_2e$) or more annually. These facilities account for around 80% of Singapore's emissions. The tax rate is planned to start at USD 4/$mtCO_2e$ in the first phase, with the intention to increase it to USD 8/$mtCO_2e$ and then USD 15/$mtCO_2e$ in later phases.[7]

2. Cap-and-Trade Program

Cap-and-trade programs, unlike taxes, place a limit (the cap) on the overall emissions (at the economy-wide, sector, enterprise, or facility level). The program then creates a market for companies to buy and sell allowances (the trading) that permit companies to comply in a cost-effective manner. Compliance can typically be met by: (1) lowering emissions below the allocated amount, (2) purchasing credits from companies that lowered their emissions further than needed, or (3) paying a noncompliance fee.

The total cap is generally split into allowances of one metric ton of emissions each. These are then distributed to companies either for free (using a certain benchmark of company emissions such as fuel input or value of output) or through auctions. Companies that reduce their emissions more efficiently can sell their unused allowances in the market to other companies that may not find it cost-effective to keep their emissions within their permitted carbon allowance, so that the overall emissions are reduced at a lower cost. Those who do not comply with their designated allocation cap (either by reducing their own emissions or purchasing allowances from other companies) are penalized. The emissions cap and the number of available allowances are typically reduced over time, giving regulated entities time to adapt. Regulated entities are incetivized to become more efficient in their emissions reductions and to adopt innovative new technologies if necessary. Since there are a predetermined number of allowances for trading, total emissions decrease as the cap decreases. Cap-and-trade systems also create a market for technologies that reduce emissions, such as energy efficiency improvement technologies, further driving down the cost of emission reduction.

In Asia, cap-and-trade programs are being deployed to control emissions in China, Republic of Korea, Kazakhstan, and Japan. China launched and began designing a national Emission Trading System (ETS) in December 2017, which is still under development. Once operational, this national cap-and-trade system will compile multiple existing subnational pilot programs, and it is expected to become the largest cap-and-trade program in the world, covering over 3 billion metric tons of CO_2e. Currently, the European Union Emission Trading System is the largest in the world, followed by the Korea Emission Trading System (KETS). Japan also has regional cap-and-trade programs in Tokyo Prefecture and Saitama. Other potential cap-and-trade programs for pollution abatement are being considered in Vietnam, Japan, Indonesia, Thailand, and Chinese Taipei.

3. Baseline and Credit Program

Under a baseline and credit program, credits are created by entities who reduce their emissions below a set baseline emission level. This baseline level can be set as either: (1) a projected business-as-usual (BAU) scenario based on knowledge of trends from historical emissions, or (2) a proportion of the BAU rather than the total BAU, to encourage stronger mitigation efforts. The credits earned by emitting below the baseline can then be traded by polluters that face regulatory limits on their overall emissions. Under this system, there is no fixed cap on emissions; however, emission permits are generated by individual polluters who reduce their emissions below their personal regulatory limit. They can then sell those credits to other polluters who are not compliant within their regulatory limits. Regulated entities who do not meet their regulatory limits can choose to either purchase credits to make up for any amount of pollution over their limit or pay a noncompliance fine. Due to this structure, baseline and credit programs are very similar in design and implementation to cap-and-trade programs. Despite these similarities, baseline and credit programs can be harder to implement than cap-and-trade programs, due to the need for an accurate estimate of baseline emissions that would have occurred in the absence of the policy.

India's Perform Achieve Trade (PAT) is one of the largest baseline and credit schemes in Asia. Korea's Voluntary Emission Reduction program (KVERs) is another voluntary baseline and credit market for GHG reduction certificates.

[6] Environmental Taxation Team (2012).
[7] National Climate Change Secretariat (2018).

4. Clean or Renewable Electricity Standards

A clean or renewable electricity standard (also called a renewable portfolio standard [RPS], renewable purchase obligation [RPO], or renewable obligation) is a form of regulation that mandates increased production of electricity through renewable energy sources by requiring electricity suppliers to produce a portion of their electricity from clean energy sources. Renewable electricity generators earn certificates, called renewable energy credits or certificates (RECs), for every unit of renewable electricity produced. These RECs can be traded or sold, giving the owner of a REC the ability to demonstrate compliance with their renewable obligations. The price of RECs varies based on the location of the facility, supply and demand, and the year of generation.

RECs can be traded in voluntary markets or to comply with non-voluntary regulations. For example, electricity service providers regulated by policies such as a renewable electricity standard must comply with their obligations either by generating RECs themselves or purchasing RECs from other electricity providers who do generate RECs. On the other hand, voluntary markets have developed to meet increased consumer demand for green electricity. Companies are increasingly purchasing RECs to meet their voluntary renewable energy goals, a key sustainability strategy for many companies. This is particularly attractive in locations or industries where sustainability performance is valued by customers and purchasing voluntary RECs is seen as a commitment to green electricity.

In Asia, renewable electricity standards are used to promote renewables in China, India, Japan, and Thailand.

5. Energy Efficiency Resource Standards

Energy efficiency resource standards (EERS) set energy savings targets that power producers must achieve through customer energy efficiency programs. Like the RPS, which mandates that utilities include a certain percentage of renewables in their energy mix, an EERS requires power producers to achieve a reduction in energy consumption through energy efficiency programs, and any surplus in reducing their customers' energy consumption can be traded as credits in the market.[8] The majority of these programs include some form of cost recovery to counteract the financial disincentive that utilities face to reduce their customers' energy use..[9] In Asia, China and South Korea currently deploy EERS. In addition, an EERS program is under development in Thailand.

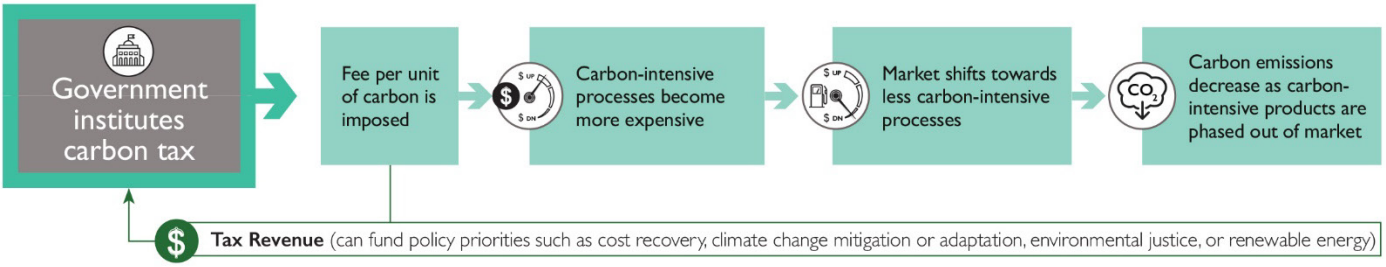
The infographic on the next page summarizes the MBMs described above and highlights the process of implementation.

[8] ACEEE (2016).
[9] ACEEE (2014).

TAXES

Carbon Tax

Internalizes the cost of carbon in order to shift the market towards less carbon-intensive alternatives



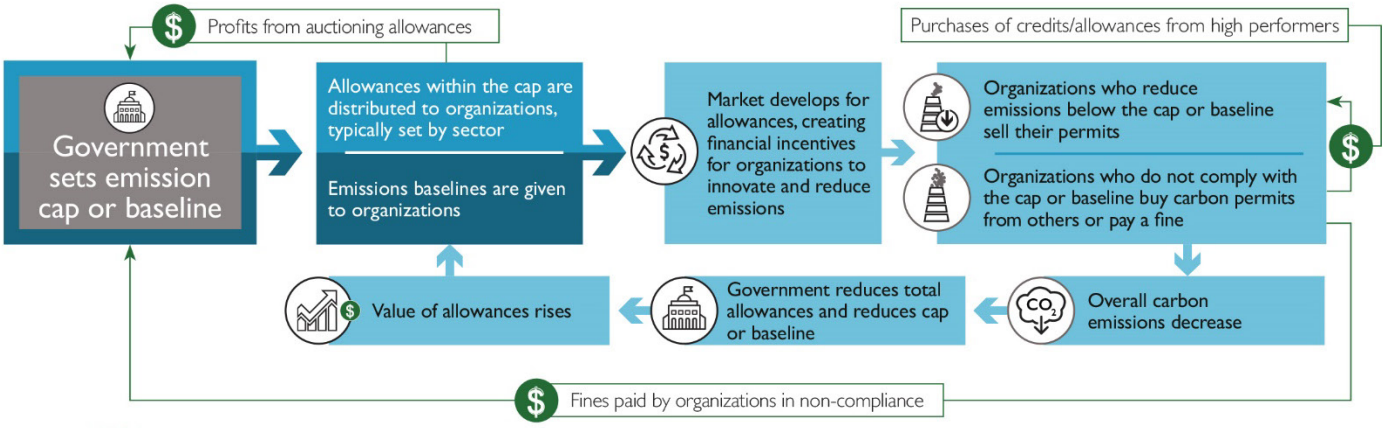
TRADING SCHEMES

Cap and Trade

Sets a cap (limit) on the total emissions for a system and distributes (or auctions) emission allowances to entities based on that total

Baseline and Credit

Credits are issued on a projected baseline (business-as-usual) scenario. Credits are generated by individual polluters based on their performance relative to their baseline



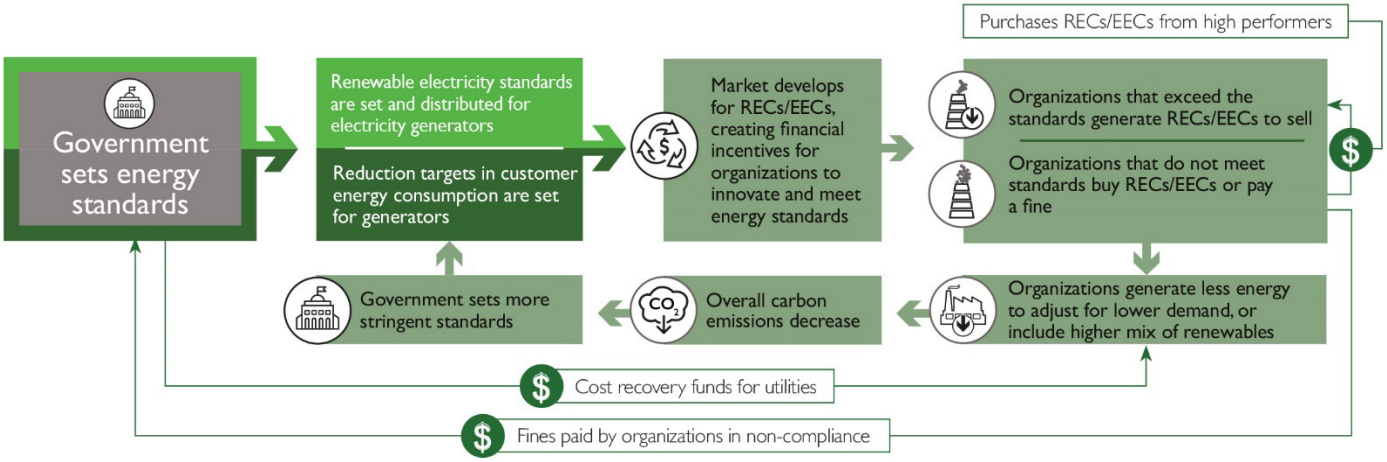
ENERGY STANDARDS

Clean or Renewable Electricity Standard

Government requires electricity generators to produce a set percentage of power from renewables. Renewable generation creates credits, called RECs, which are traded to meet government obligations

Energy Efficiency Resource Standard

Government requires reductions in end use consumer energy consumption from energy generators themselves. Excess reduction in consumption can be sold as Energy Efficiency Credits (EECs)



Monitoring, Reporting, and Verification (MRV) and Compliance Mechanisms

Monitoring, reporting, and verification (MRV) frameworks for GHG emissions or energy production are central to effectively implementing market based mechanisms. MRV is critical in setting appropriate caps, baselines, and taxes, determining market readiness to adjust to MBMs, and enforcing compliance mechanisms. In addition, a robust MRV plan helps promote transparency and build integrity of the program and boosts market confidence and stability, ultimately resulting in an improved regulatory environment to achieve progress toward climate goals.

The implementation of an MRV framework generally comes before establishing the market mechanism. For example, before establishing a cap and trade system, it is important to understand the characterization of emissions in order to set emissions caps. In case of RECs, having a monitoring and verification protocol in place before credits are traded is critical in establishing authenticity of the market system. MRV is also important in building institutional capacity to respond to MBMs. Without the ability for regulated entities to measure and report their GHG emissions, there is likely a higher chance of non-compliance that could put emission reduction goals at risk.

In addition, failure to effectively determine an appropriate cap or baselines can increase the risks associated with the inherent uncertainty of MBMs. These risks can range from non-compliance, reliability and credibility of the market system, to potential market failure due to lack of trading volume. Using MRV systems to determine realistic caps and baselines can help to mitigate some of these implementation risks.

Prior to the implementation of a MBM, outlining a detailed reporting and verification plan as well as effective compliance mechanisms for ensuring that regulated entities comply with both the MBM and the MRV protocol are essential. As part of the MBM policy development, the government or regulator must determine requirements for monitoring and reporting such as frequency of required emissions reporting, scope that emissions estimates must cover and guidelines and methodology regarding estimating emissions. Best practices in MRV include mandating annual reporting through a prescribed methodology, defining a reporting template and verification through external and independent third parties.

Finally, in addition to effective MRV protocols, MBM compliance mechanisms can engage regulatory systems to incorporate thorough oversight into individual compliance as well as overall markets. For individual regulated entities, this can include compliance options such as requiring entities to register with an online system to track their allowances, RECs, or other relevant information to the MBM and requiring regular updates to the system to remain in compliance. An online system can track detailed information on all compliance options, including buying or selling in the market and paying fees. Oversight to ensure compliance in the market can also include surveillance by independent market monitors to minimize risks of unfair auctions, lack of participation in the market, design flaws in the MBM, and market manipulation or fraud. Effective compliance mechanisms, ranging from facilitative systems to compulsory techniques depending on the MBM design, are necessary to meet the goals of an MBM and must be prioritized in program design and implementation phases.

Enabling Technology

Current technology solutions for MBM markets do not necessarily address challenges such as lack of transaction transparency and limited participation from individuals and small businesses. Emerging technologies, such as blockchain, are crucial in ensuring the development and success of carbon markets.

Blockchain *is open, distributed digital ledger that uses decentralized data storage to track and store asset transactions securely. Carbon markets could use cryptographic tokens with a tradeable value to optimize existing market platforms for carbon and create new opportunities for carbon credit transactions.*

Blockchain has been heralded as a key tool in the development, monitoring, verification, and reporting of carbon markets by many organizations including UNFCCC, the World Economic Forum (WEF), and International Institute for Sustainable Development (IISD).

The potential opportunities for blockchain to transform carbon markets are twofold. Firstly, blockchain has transactions that are secure and traceable, making it easy to track credits, avoid double counting, and maintain the credibility of the market. Secondly, the decentralized nature of such a system would eliminate the need for third-party intermediaries and create opportunities for individuals and small businesses to participate in carbon markets that otherwise can be excluded on existing highly centralized platforms.

There are many organizations focusing on developing blockchain for use in carbon markets. If successful, these systems can be scaled to support carbon markets around the world by tracking carbon credits transparently and reliably. While blockchain is a promising emerging technology, it may also require significant resources and capacity to implement an effective blockchain solution.

Other technology solutions that may have lower startup costs include software as a service; build-to-suite; and open source platforms. In addition, open source platforms, which allow any organizations around the world to borrow from and contribute to the building of an effective tool, could provide a significant opportunity for knowledge sharing and capacity building for MBM compliance and market implementation across countries and regions.

Role and Context of MBMs in the Paris Agreement and NDCs

MBMs can be an effective tool to drive GHG reductions, which in turn can help countries meet their own national climate goals. In particular, MBMs are useful under the Paris Agreement for incentivizing mitigation activities and enabling countries to use flexible frameworks to meet their mitigation goals.[10]

Prior to the Paris Agreement, developed countries that ratified the Kyoto Protocol were required to adhere to specific GHG emission reduction targets.[11] All countries used the same type of target and cooperated with top-down monitoring to ensure they met the legally binding targets. Under the framework of the Kyoto Protocol, developed countries could use three options to make progress toward their targets: emission trading, the clean development mechanism (CDM), and joint implementation.[12] These options use the quantification of GHG mitigation through either certified emission reduction (CER) credits for the CDM or emission reduction units (ERUs) for joint implementation. All of these options gave developed countries the opportunity to benefit from a global market of emission reduction activities and to meet their national targets by investing in mitigation efforts in more than just their own country.

In place of the CDM and joint implementation, the Paris Agreement enables countries to use internationally transferred mitigation options (ITMOs). International cooperation and mitigation trading are discussed in Article 6 of the Paris Agreement, which outlines coordination between nations to meet their NDC targets. The Paris Agreement differs from the Kyoto Protocol in that every country that ratifies the agreement is required to submit an NDC with a self-determined GHG emission reduction target. The framework of ITMOs under the Paris Agreement will allow for MBMs to contribute toward countries' achievement of meeting their NDC targets. It is also expected that under Article 6 of the Paris Agreement, the project-based framework of the CDM and joint implementation under the Kyoto Protocol could be expanded to include policy and regulatory mechanisms that would contribute to ITMOs, making it easier to benefit from a range of MBMs.[13]

Inclusion of MBMs in NDCs for Asian Countries

Many emerging economies in Asia identify MBMs as playing a critical role in helping them to successfully meet their NDC targets. China's NDC outlines a commitment to reduce CO_2 emissions by 40-45% per unit of gross domestic product (GDP) by 2020 compared to 2005 levels. Promoting a national carbon emission trading market is a critical element of China's NDC plan to reduce their emissions. Korea has committed to using carbon credits from international market mechanisms to achieve its 2030 emission reduction target, and Japan intends to reduce emissions by between 50-100 $mtCO_2e$ per year through the Japanese Crediting Mechanism (JCM). Similarly, India outlines in its NDC a goal to reduce its emissions by 30-33% by 2030 through the promotion of fiscal and market instruments such as trading programs, taxes, and subsidies. Smaller countries such as Bhutan intend to pursue clean power development to reduce emissions through the support of market mechanisms. Finally, Bangladesh, Cambodia, Indonesia, Laos, Thailand, Singapore, and Vietnam have stated their intent to study the potential of market mechanisms.

Case Studies

Many of the notable MBMs from Asia have already been mentioned as examples of various types of taxes, credits, and programs. Detailed case studies of three specific MBMs currently used in Asia are presented in the following section.

[10] United Nations Treaty Collection (2015). The Paris Agreement entered into force on November 4, 2016, thirty days after at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global

[11] UNFCCC (n.d b). GHG emissions ratified the Agreement. As of the time of publication, 195 of the 197 Parties to the UNFCCC had signed the Paris Agreement.

[12] UNFCCC (n.d. a). The CDM and joint implementation both allow nations to implement emission reduction projects in other countries to earn emission reduction credits to count toward Kyoto Protocol targets. The CDM allows Annex I countries to earn credit for projects in non-Annex I countries, while joint implementation allows Annex I countries to earn credits for projects in other Annex I countries.

[13] IEA (2016).

Baseline and Credit: Perform Achieve Trade (PAT) India[14]

The PAT program is a baseline and credit MBM aimed at improving energy efficiency of large, energy-intensive industries. Energy savings certificates (EsCerts) are issued to overperformers who achieve greater energy efficiency savings than their baseline target, and these EsCerts can be purchased by those struggling to meet their targets. The EsCerts that are issued to facilities are worth one metric ton of oil equivalent of energy savings. The PAT program uses a trading platform that allows for bilateral trades between facilities as well as banking of EsCerts for future use by a single facility. The overall reduction target is set at 5% on a facility level over three years.

The PAT scheme was introduced under the National Mission on Enhanced Energy Efficiency in the National Action Plan on Climate Change. The facilities cumulatively account for about 165 million metric tons of oil equivalent, about 60% of India's total primary energy consumption. Sector-wide energy consumption targets were identified based on data reported between 2005 and 2009.

By the end Phase 1 of the program, India achieved savings of about 8.67 million metric tons of oil equivalent, mitigating 21 million $mtCO_2e$. Phase 2 widened and deepened the program, including more units from the existing sectors and adding three new industrial sectors (refineries, railways, and electricity distribution companies). At the end of the first phase, key issues faced by obligated entities included lack of technical knowledge about both the PAT scheme and energy efficiency, lack of financing, the possibility of low ESCert prices, long payback periods for energy efficiency technologies, and lack of knowledge needed to calculate energy inputs. However, the program plans to establish a domestic MRV system, which paves the way for the formulation of an ETS and the streamlining of emission data collection processes in the country.

In addition to the PAT scheme, India also issues RECs to enable cost-effective energy reductions for states to meet renewable purchase obligations (RPOs). Renewable energy generators can choose to either sell their electricity at a subsidized rate or sell a renewable energy credit for every 1 MWh of renewable electricity that they generate. Both solar and non-solar RECs have floor and ceiling prices determined by the energy board. RECs are traded in the same exchanges as PAT and are expected to be interchangeable with EsCerts.

Established:	April 2012; second three-year phase running through 2019
Compliance Period:	Phase 1, 2012-2015 (successfully completed); Phase 2, 2016-2019 (in progress)
Scope:	National; mandatory
Coverage:	621 facilities across the following 11 energy-intensive sectors: aluminum, cement, chlor-alkali, electricity distribution utilities (referred to as DISCOMS), fertilizer, iron and steel, pulp and paper, railway, refinery, textiles, and thermal power plants (2016)
Baseline:	10 metric tons of oil equivalent per unit of production
Baseline Production:	10,000 units
Target:	5% reduction per facility
Penalty:	Base rate of USD 20,000, plus amount equivalent to units short of target

[14] IEA (2016).

Cap-and-Trade: Korean Emission Trading Scheme[15,16]

The Korean Emission Trading Scheme (KETS) was introduced in 2015, making South Korea the second nation in Asia to introduce a national cap-and-trade market and the first to launch an economy-wide market. KETS covers roughly two-thirds of the country's overall GHG emissions (nearly 600 businesses and 283 facilities). The KETS was deployed as the Korean governments' main policy instrument to meet their NDC target of reducing GHGs by 30% by 2030 from a 2020 baseline.

Under the scheme, caps are set on a facility- or company-level, and credits generated from emission reduction projects outside the boundaries of the ETS may be used for compliance. Companies are allowed to use domestic or international CDM credits or any other international offset credits to meet up to 10% of their emissions reduction obligations. KETS has a national cap for emissions, and emissions allowances are allocated based on phase, industry, and sector. One hundred percent of allowances were freely allocated in the first phase, 97% were freely allocated in Phase II, and by Phase III only 90% will be allocated for free. Consequently, 3% of allowances in Phase II were auctioned and 10% of allowances in Phase III will be auctioned. Companies in energy-intensive and trade-exposed sectors received 100% of their allowances at no cost.

Prior to KETS, Korea had the Target Management System under which covered entities were obligated to submit periodic reports on GHG emission levels. If the amount of emissions exceeded the target level, the entity was charged a fine. This paved the way for the design and implementation of the KETS by providing training to business entities and controllers on emissions MRV. Like the Target Management System, KETS originally included both direct and indirect emissions, but it faced controversy regarding the double counting of emissions. Eventually, the government reduced the cap for indirect emissions and drafted exclusion criteria for indirect emissions in the ETS. Additionally, the number of allowances for free allocation was questioned. After the ETS was launched, there was an insufficient supply of tradable carbon credits, causing emission trading to cease since the number of buyers exceeded the number of sellers and prices of carbon credits were driven up. Under the ETS, the Ministry of Environment has the ability to take cost containment measures such as setting minimum and maximum emissions permit possession limits and setting price ceilings and floors. Due to the lack of supply in credits, the government implemented some of these measures to stabilize the market, dropping the price of credits. The KETS demonstrates that accurate scoping, MRV, and stakeholder engagement in decision-making is critical for a MBM to be successful. Laying out supporting legislation and building capacity of regulated entities is also critical to the successful implementation of a cap-and-trade program.

Established:	January 2015
Compliance Period:	One year
Scope:	National; mandatory with voluntary opt-in for entities outside the scope
GHGs Covered:	CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride
Emissions Covered:	70%
Coverage:	610 companies across 23 subsectors including steel, cement, chemicals and petrochemicals, refinery, power, buildings, waste, and aviation sectors
Inclusion Threshold:	Companies are included in KETS if they have emissions greater than 125,000 $mtCO_2e$, and facilities are included in KETS if they have emissions greater than 25,000 $mtCO_2e$
Cap:	538.5 million $mtCO_2e$ (2018)
Average Carbon Price:	USD 20.62 (average market price in 2018)
Penalty:	Not more than threefold the market price of allowances in the compliance year

[15] ICAP (2019).
[16] EDF (2013).

Cap-and-Trade: Emission Trading Scheme (China)[17,18]

In June 2013, China announced its first ETS pilot program. Since then, eight programs have been established in three different provinces and five cities. Fujian Province was the latest province to establish a carbon trading market. Since trading began, 177 million metric tons of emission allowances worth USD 554 million have been traded under these pilots at an average price of USD 3.13 per metric ton of allowance. The sites selected—Beijing, Tianjin, Shanghai, Hubei, Chongqing, Guangdong, Fujian and Shenzhen—produce approximately 30% of China's GDP and release 20% of the country's CO_2 emissions. Each pilot program covers sectors relevant to the region, and carbon prices and emission cap levels vary as well. China approved its National ETS in December 2017, and work has been underway since to prepare for its implementation. Once operational, the program will regulate 1,700 companies from the power sector, which emit 30% of national emissions (equivalent to 3 billion $mtCO_2e$ per year).

One of the largest challenges identified in establishing a successful ETS in China was the lack of a comprehensive data collection system. Historical data on baseline emission levels is critical in setting caps and targets, as well as for allocating credits. In addition, giving industries time to adjust to incoming regulation is vital. In the case of the European Union ETS, policy for implementation was drafted several years prior to the enactment of the regulation. Under the Kyoto Protocol, China spent several years participating in the CDM program, which also served as a basis for establishing the ETS in China. State-owned companies from the petrochemical, cement, and power sectors were actively trading CER credits with European and other CDM project partners from the Organisation for Economic Co-operation and Development, which helped to allow for the successful implementation of the Chinese pilot ETS.

Established:	December 2017
Compliance Period:	One year
Scope:	National; mandatory with voluntary opt-in
GHGs Covered:	CO_2
Emissions Covered:	30%
Coverage:	1,700 liable entities from the power sector; the scope is expected to expand to eight other sectors
Inclusion Threshold:	Emissions more than 26,000 metric tons GHG or more than 10,000 metric tons of standard coal equivalent
Cap:	3,300 million $mtCO_2e$
Average Carbon Price:	To be determined for the National ETS
Penalty:	To be determined

Note : Data is presented for the National ETS.

[17] ICAP (2019).
[18] PMR (2017b).

Carbon Tax (Singapore)[19,20, 21,22]

In March 2018, the Minister for Finance annouced Singapore's plan to introduce a carbon tax. Starting in 2019, the tax levies a USD 4/mtCO_2e fee on facilities that emit more than 25,000 mtCO_2e annually, without any sectorial exemptions. The carbon tax takes the form of a fixed price credit based mechanism. Taxes are paid in the form of carbon credit purchases by the taxable regulated entity. The National Environment Agency (NEA) sells carbon credits to liable facilities from a registry account. Credits in the Singapore carbon tax system are non-transferrable between businesses, and at the end of the year, credits equivalent to verifiable emissions must be surrendered to the NEA. Use of international carbon credits to meet tax liability is not permitted.

The tax starts at USD 4/mtCO_2e in the first phase (2019-2023). In 2023, the Government plans to review and increase the tax rate to between USD 8/mtCO_2e and USD 11/mtCO_2e by 2030. By keeping the carbon tax low in the first phase and expressing the intent to increase prices over time, affected businesses are able to channel investment into mitigation measures over time throughout the initial phases. In addition, businesses are able to plan for the likely incremental increase in tax and to take into account potential impacts of climate change regulation that may occur in the medium and long term in their business planning process.

A robust MRV system is integral for any MBM to be effective, including taxes. To this end, Singapore published its MRV requirements for two categories of facilities – *reportable facilities* and *taxable facilities*. These requirements reference international standards and practices. All companies are required to compile and submit an annual emissions report for any of their facilities that are subject to the tax. *Reportable facilities* emit between 2,000 and 25,000 mtCO_2e per year and are not liable to pay the carbon tax. However, this group of facilities must develop a monitoring plan and submit an emissions report every year. *Taxable facilities*, which are facilities emitting more than 25,000 mtCO_2e per year, must have emissions reports verified by a Government accredited third party prior to submission. The emissions reports for all facilities must contain information on activity data, direct GHG emissions (for each gas), and a total direct GHG emissions estimate. The monitoring plan must describe the facility's GHG emission sources and streams, quantification methods and quality assurance procedures. The monitoring plan is required to be submitted and approved by NEA before the start of the first reporting period. To assist regulated entities in complying with Singapore's carbon tax, the government has published a series of guidelines detailing all MRV requirements and approaches for quantification of emissions.

Established:	March 2018
Compliance Period:	One year
Scope:	National; mandatory with voluntary opt-in
GHGs Covered:	CO_2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride
Emissions Covered:	~80%
Coverage:	~30-40 liable entities
Inclusion Threshold:	Facilities with emissions of more than 25,000 mtCO_2e
Cap:	N/A
Average Carbon Price:	USD 4/mtCO_2e

[19] World Bank (2018)
[20] NEA(2019)
[21] NCCS (2018)
[22] Reach (2017)

Limitations and Barriers to Implementation

While there are numerous benefits to a well-established MBM, there are also conditions under which an MBM may not be the best policy choice. For example, under an MBM, the costs of control are uncertain as they depend on the actions of the regulated parties. While this is often preferred because it allows each affected entity the flexibility to determine their own costs for compliance, it also has the potential to raise concern if stakeholders or investors are looking for certainty in costs and benefits. MBMs also run the risk of market manipulation and may not be the best choice if there is not enough trust in the relevant markets. Public perception can be a concern, especially in a tense political climate where a particular group or party may dismiss certain policies and/or the public believes that an MBM may be harmful to their wellbeing.[23] In particular, the public could be convinced that MBMs may raise prices for consumers, which would disproportionately harm marginalized and low-income communities. However, some of these concerns can be mitigated if tactics are used in program design to outweigh the economic disparities of the impacts of an MBM on a community or group.

Another key challenge for the success of MBMs will be the implementation of Article 6 of the Paris Agreement (which outlines coordination between nations to meet their targets). The use of Article 6 will require coordination and harmonization between mitigation and carbon trading programs, teams tracking progress towards NDC targets, and any other policy intended to have an impact on climate mitigation. While mitigation activities are a positive result of the Paris Agreement, the functioning of an MBM and the use of Article 6 can be very sensitive to other policy mechanisms. A systematic assessment of all relevant policies (existing or potentially upcoming) to ensure that the basis of the MBM includes the expected results of other policies is critical to the success of an MBM.[24]

Implementers must also consider the limitations of implementing MRV for MBMs. Successful MRV systems can be complex in design and challenging to manage. They require input from stakeholders, including industry representatives, who are key proponents in ensuring the MBM runs effectively. MRV also comes with the added cost of ensuring that entities report data accurately and efficiently, though this is critical to the integrity of MBMs. Policy designers and MRV stakeholders must determine the practical aspects of GHG accounting for MBMs, such as methodology, emission factors, reporting on indirect emissions, and development of audit protocols. Determining appropriate technological systems for MRV can also be challenging, especially if new IT systems must be developed or designed to integrate legacy data systems. Lastly, MBMs are often regulated by a number of government agencies, and the turnover in political figures and agency staff can hinder countries from optimizing new policies.[25]

Elements for a Successful MBM

A strong MBM is built on explicitly defined objectives, such as the desired resulting emissions reductions, the rate at which those reductions are needed, how costs will be distributed across the economy, what level of cost is acceptable to all stakeholders, and how the MBM will fit into broader policy goals. To ensure the MBM is appropriate for the local context, its design must take into consideration relevant aspects of the locality or region in question, the regulatory environment, the strength of the economy, and any other policies that could affect the MBM's implementation. Other elements for a successful MBM include:

- **Stakeholder engagement and capacity building**. Stakeholder engagement is critical in the design and implementation of an MBM as it provides information on the readiness and capacity of industry to participate in an MBM, reduces the likelihood of opposition, and helps with managing unanticipated issues.
- **Supporting legislation.** Legislation to support the creation of an MBM must be instated early on in the design stage.
- **Defined quantitative reporting methods.** A method for quantifying historical and future emissions is important in setting caps, distributing allowances, and managing targets, and thus a robust MRV system is critical to the successful implementation of MBMs.
- **Regional schemes.** For larger countries, developing regional schemes is a useful approach. It can help to prepare industry through the piloting of policies at the regional level before expanding to the national level and allows for identification of problems and capacities early on.
- **Cost Containment.** Providing price certainty to regulated entities is important to avoid non-compliance due to unanticipated market changes. To allow flexibility with compliance by regulated entities, the government can modify compliance periods, establish floor or ceiling prices, allow the use of carbon offsets, or allow borrowing to manage compliance costs.

[23] Stavins (2010).
[24] PMR and ICAP (2016).
[25] Brookings Institute (2015).

- **Combining of policies.** Multiple MBMs can be combined to increase overall effectiveness. For example, MBMs focused on energy efficiency and renewable energy can be combined to help meet overall goals, or subsidies can be combined with cap-and-trade programs to aid innovation and drive costs down for low-carbon technology.
- **Compliance mechanisms.** Effective compliance mechanisms are essential in ensuring that regulated parties are appropriately implementing and complying with MBMs. These can include online systems that take advantage of emerging technologies, third party verification methods, and MRV protocols.

MBMs provide a proven approach to reducing emissions on a regional, national, and international scale. While program design and implementation can be challenging, well-developed MBMs can have numerous environmental and economic benefits and can help countries meet new national-level GHG targets. As countries continue to navigate policy options to mitigate their GHG emissions, MBMs stand out as an effective GHG reduction strategy that should be expanded at subnational, national, and international scales.

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Contact

USAID
Amanda Valenta
Climate and Energy Specialist
avalenta@usaid.gov

ICF
Marian Van Pelt
Project Director
marian.vanpelt@icf.com

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