Industrial Energy Efficiency in Key Sectors

Emissions Trading Scheme

Task 1: Review the background, best practices and lessons learnt from the Cap and Trade scheme and define the infrastructure requirements for this scheme.

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Introduction

As the consequences of global warming become more and more real, demonstrated by sea-level rise, melting glaciers and increased frequency of extreme weather, the need to implement an effective solution to climate change cannot be more urgent. Now that scientists overwhelmingly agree that global warming is caused chiefly by anthropogenic climate change, the answer to slowing global warming rests undoubtedly in slowing climate change. Although there will always be critics, cap and trade not only provides an environmental solution to the problem of climate change, but does so in an economical way. This report analyzes the history of cap and trade, with particular emphasis on cap and trade schemes that are currently operational. Part I offers a general background and Part II defines the infrastructure requirements of a cap and trade scheme. In Part III, lessons learned from operational cap and trade schemes are summarized. The report closes with Part IV, which describes the best practices of cap and trade schemes, in hopes that future schemes may adopt such practices.

I. Background

Although the concept of cap and trade was originated in the 1960s, when two U.S. government scientists developed a regulatory scheme that would set a limit on sulfur dioxide emissions and then allow trading of "rights to emit" beyond that limit, the practice of cap and trade started much later and is only just starting to fully develop. Arguably the first cap and trade scheme, the U.S. Acid Rain Program was incorporated into U.S. law as part of the 1990 Clean Air Act in order to curb the emissions of sulfur dioxide and nitrogen oxides, the primary causes of acid rain. It subsequently came to fruition at the beginning of Phase I of the program five years later, over three decades after the conception of the cap and trade concept. Furthermore, the European Union Emissions Trading Scheme, the world's largest cap and trade scheme aimed at reducing the emissions of greenhouse gases to combat dangerous anthropogenic climate change, launched ten years after the Acid Rain Program, in 2005. Obviously, therefore, while the cap and trade concept is old, the practice itself is relatively new. Today, many countries are seriously considering developing their own cap and trade systems. Before examining such schemes on an individual basis, a general definition of cap and trade is required.

Cap and trade is a market-based policy tool that establishes an aggregate emission cap, or maximum ceiling for emissions, on total emissions from a group of sources and creates a financial incentive to reduce emissions. The emission cap is expressed as allowances, or "rights to emit," distributed to individual emission sources that must in turn surrender the allowances necessary to cover their emissions during the compliance period. The cap and trade scheme lets the market determine the price for keeping emissions within the cap. The program provides the flexibility for sources with low-cost reductions to reduce even further and sell allowances to others with higher costs of control, resulting in achievement of the environmental goal at the lowest cost. While cap and trade can be used as an economical tool to reduce the emissions of a wide variety of gases, the gases of primary interest to most cap and trade systems are greenhouse gases, those responsible for climate change and thus global warming. Accordingly, a more

specific definition of cap and trade and how it is used in the context of climate change bears mentioning.

A cap and trade system is one of a variety of policy tools to reduce the greenhouse gas emissions responsible for climate change. A cap and trade program sets a clear limit on greenhouse gas emissions and minimizes the total costs to emitters while achieving the target. This limit is translated into tradable emission allowances (each allowance typically equivalent to one metric ton of carbon dioxide or carbon dioxide equivalent), which are auctioned or allocated to regulated emitters on a regular basis. At the end of each compliance period, each regulated emitter must surrender enough allowances to cover its actual emissions during the compliance period. To comply with their emission targets at least cost, regulated entities can either opt for internal abatement measures or acquire allowances or emission reductions in the carbon market, depending on the relative costs of these options. If an emitter has too few allowances and elects to buy allowances in the carbon market, the emitter can trade with another regulated emitter who has excess allowances. The total number of available allowances decreases over time to reduce the total amount of greenhouse gas emissions. By decreasing the cap and by creating a market, and a price, for emission reductions, the cap and trade system offers an environmentally effective and economically efficient response to climate change. However, there are other policy tools to reduce greenhouse gas emissions, the most prominent of which, after cap and trade, is carbon taxation.

Carbon pricing instruments such as carbon taxes, emissions trading schemes, and crediting mechanisms are of fundamental relevance to internalize the external cost of climate change in the broadest possible range of economic decision making and in setting economic incentives for clean development. As its name suggests, a carbon tax literally places a value on carbon, which sources would have to pay if they emit. Considering different carbon pricing approaches, a carbon tax, on the one hand, guarantees the carbon price in the economic system. An emissions trading scheme, on the other hand, provides certainty about the environmental impact, through the cap, but the price remains flexible. Cost is left uncertain in an emissions trading scheme because sudden and unexpected changes in economic parameters can be harmful, disrupting the basic functioning of the market. Nonetheless, both instruments impact economic decision making through setting a price on carbon and both instruments raise revenues. Careful use of the income stream can improve the effectiveness of the policy instrument.

China's National Development and Reform Commission ("NDRC") announced its plan to develop seven official regional emissions trading scheme pilot programs (Beijing, Shanghai, Tianjin, Chongqing, Guangdong, Hubei and Shenzhen) in 2011. This plan began to deliver from 2013. By July 2014, all seven pilot schemes started trading. Carbon markets are now officially open for business in China. The total 2013 allocations of six pilots (excluding Chongqing) combined amounts to 1,115 megatons of carbon dioxide equivalent ("MtCO2e"), making China the second largest carbon market in the world, after the European Union Emissions Trading Scheme. The Guangdong emissions trading scheme, the largest of the Chinese emissions trading scheme pilots, itself covers 388 MtCO2e in 2013. Each of the pilots has unique characteristics; the way in which the regional carbon markets play out will help policy makers learn lessons that

can be applied in the national context. A quick overview will provide a helpful introduction into this latest program.

In line with China's 40–45% carbon intensity reduction target by 2020, most pilots have an absolute cap, though Shenzhen has an intensity-based cap. . Most pilots use historical intensity or emissions-based free allocation. Guangdong is the first pilot to use auctioning. Dynamic allocation is included in the emissions trading scheme Implementation Plans for Shenzhen, Tianjin, and Shanghai. Allocation for the power sector is similar across pilots, based on benchmarks of different generation technologies and installation capacities. In terms of using offsets, by April 2014, 178 China Certified Emission Reduction methodologies based on Clean Development Mechanism methodologies were published. About 200 projects have been approved by the NDRC. Furthermore, with respect to price stabilization, Shenzhen, Guangdong and Hubei have set aside reserve allowances to manage price fluctuations. Carbon prices in the pilots range from approximately CNY120/tCO2e (US$20) in Shenzhen, to CNY22/tCO2e (US$3.6) in Hubei. In terms of monitoring, reporting, and verification, greenhouse gas accounting methodologies have been released for 10 sectors. With respect to linking, there is potential to link Hubei with Guangdong, but no official progress has been made and no details have been released.

Looking ahead, the first pilot phase is planned to end in June 2016 and should provide lessons for the national emissions trading scheme. Some preparation at the national level has already started, primarily on the work released to the national registry, greenhouse gas inventory, monitoring, reporting, and verification guidelines for a number of industries and China Certified Emission Reduction methodologies. A preliminary national allocation plan will be developed in due course. There is no clarity yet on how the pilots and national emissions trading scheme will relate to each other. The national China emissions trading scheme is expected to start during the 13th Five Year Plan (2016–2020). With these provinces in China now on board and with a Chinese national emissions trading scheme looming, the significance of emissions trading cannot be overstated. Accordingly, as more countries begin to develop emissions trading schemes, it is becoming increasingly important to understand the infrastructure required to successfully implement them.

II. Infrastructure Requirements

In order to successfully implement an emissions trading scheme, certain infrastructure requirements must be met. The term "infrastructure requirements" refers both to the foundation and fundamental features of a cap and trade system; in other words, what is needed to implement an emissions trading scheme. This section describes the most important of those requirements and is sub-divided accordingly: (1) assessing the political setting for ripeness; (2) creating a regulatory body; (3) completing an emission inventory; (4) setting the cap; (5) distributing and use of allowances; (6) monitoring, reporting, and verification; and (7) enforcing the rules and imposing penalties for non-compliance. First and foremost, as with any new system, in order to provide the proper foundation, the political setting must be ripe.

1. Political Atmosphere

Cap and trade can be an effective tool to address air pollution and greenhouse gases. However, it is not appropriate in all situations or for all environmental problems. Policymakers should consider a number of important issues before deciding whether cap and trade is appropriate. Prior to developing a cap and trade program, policymakers and other experts should determine whether the nature of the environmental problem, as well as the institutional capacity and political situation, is conducive to the successful establishment of such a program. It can be stated that cap and trade is the appropriate system to use with respect to the global environmental problem of climate change because in general, the more a pollutant is uniformly dispersed over a lager geographic area, the more appropriate it is for the use of cap and trade. Nonetheless, however, policymakers must still assess whether the political atmosphere is ripe for the successful implementation of a cap and trade scheme.

For the trading component of a cap and trade program to work, a country must have some of the same governmental institutions and economic incentives in place as those required for any type of market to function. These include: (1) a developed system of private contracts and property rights; (2) a private sector that makes business decisions based on the desire to lower costs and improve results; and (3) a government approach that will allow private businesses to make decisions about "how" to achieve objectives with a prudent level of intervention.

As with all environmental programs, a cap and trade program requires adequate enforcement to ensure that emission objectives are met. In addition, for an allowance market to develop, market participants must be confident that sources will measure and report emissions correctly, the regulating authority will verify compliance, and, if there is non-compliance, the regulating authority will assess sufficient financial penalties. Thus, cap and trade programs will have greatest success in countries where rule of law is respected and enforcement is consistent, impartial, transparent, and independent. In addition, once regulations are implemented, they should be changed only through transparent and fair procedures. Participants should clearly understand from the beginning how the program works and how regulating authorities will measure and enforce compliance. Interest in a trading program will diminish significantly if firms believe that rules are unfair, arbitrary, or unpredictable.

Some regions have a history of implementing environmental tax programs. In these regions environmental taxes may be easier to implement because they are already understood and accepted and much of the infrastructure may already exist. In other regions, there may be political reasons to opt for a cap and trade program. Emission sources may prefer a system in which allowances are allocated without charge rather than a system of environmental taxes in which a source has to pay for emissions. The initial allocation of allowances reflects a transfer to sources of an asset that is scarce and therefore has economic value. Recognizing this, sources are often more supportive of this market-based incentive program than they are of environmental taxes. In some circumstances, policymakers might use both policies: environmental taxes and cap and trade. A low tax can generate revenue for the regulating authority while still offering emission sources the benefits of a cap and trade program. Alternatively, the regulating authority

could generate revenue with a cap and trade program by distributing some or all allowances through an auction. No matter the case, once a country does make the affirmative decision to implement cap and trade, the country must create a regulating body to run the scheme.

2. Regulatory Body

In creating a regulatory body, an important initial question government officials must consider is whether the relevant government entity has sufficient jurisdiction over the geographic area where they would implement the cap and trade program. In many countries, regional or local authorities are responsible for implementing environmental programs. Often, they must follow national policies but are given considerable autonomy in implementation. To the extent that the region of a cap and trade program covers more than one jurisdiction, the authorities should maintain some consistency in key design elements of the program. To ensure that the allowances are consistent and fungible across jurisdictions, cap and trade programs require common design elements, including standards for determining applicability, emissions measurement and reporting, recordkeeping, enforcement, and penalties for non-compliance. Thus, program designers should answer the following questions: (1) Will provinces and municipalities be responsive to directives, such as monitoring requirements, imposed by the national government or would they cooperate to form a collective effort to develop such requirements?; and (2) Does the central government, or coalition of local governments, have the capacity to enforce compliance provisions and penalties throughout the entire trading region? Other design elements, such as allocation methodologies for assigning the initial distribution for allowances, might be left to the provinces or municipalities since the allocation methods have little environmental impact. Once the jurisdictional issues have been fully considered, policymakers must then create legal authority within a designated regulatory body.

For there to be a regulatory body, there must be legal authority to establish a cap and trade program. Although policymakers can include many components in authorizing legislation, the basic components include: (1) setting the mass-based emission cap, so that if the cap is not set directly by policymakers, the regulating authority has authority to limit the total quantity of pollution from the relevant sectors; (2) implementation dates; (3) sources covered, that is, which sectors are subject to program requirements and, within each sector, which emission sources are affected; (4) distributing tradable allowances, so that the regulating authority can allocate or auction allowances; (5) banking, which would allow sources to use allowances issued in one period for compliance in subsequent periods; (6) trading procedures, explicitly stating which regulatory authority is responsible for development and enforcement; (7) emission monitoring and reporting, so that the regulatory authority has the authority to require standardized methodologies for emission measurement, collect emissions data to determine compliance, and publicize emission and allowance date to provide transparency and promote confidence in the program; (8) compliance, so that the regulating authority may reconcile the emissions of each source with the number of allowances they hold; and (9) establishing and enforcing penalties for non-compliance, so that the regulating authority has the authority to impose and enforce sufficient penalties on emission sources that do not comply with the rules of the program.

In addition to establishing this new authority, a cap and trade program may require appropriate amendments to a country's existing legislation. For example, fundamental legal issues (e.g., existing technology standards or taxes) may hinder the development of a cap and trade program if not properly addressed. Most countries already have some regulations that are related to environmental performance. If existing regulations (or economic incentives) are simply in place to collect revenues for the government (e.g., environmental taxes set well below the marginal abatement cost), then a cap and trade program can likely be added. If there are technology standards, it may be necessary to make certain adjustments in existing legislation (e.g., replacing the technology standards with caps of equal or greater stringency, or allowing firms to opt out of them in favor of participating in the cap and trade program). Whatever the case may be, once the regulating body is fully established, it will need to begin taking emission inventory immediately.

3. Inventory

An important step in the development process for a cap and trade program is the creation of an adequate source-level emission inventory. The collection of emission data before operation of a cap and trade program is incredibly important to ensure a level-playing field on which regulated sources can trade. The types of data and appropriate level of detail for the emission inventory will depend upon the intended use of the data. Minimum data requirements for the emission inventory include: (1) individual emission source characteristics (e.g., size, location, name-plate capacity, process type, boiler type, fuel type); and (2) emission levels for individual sources based on output, fuel use, and/or emission data. Once inventory is complete, the next step in implementing a cap and trade scheme is to set the emissions cap.

4. Cap

Setting the level of the emission cap is one of the most important decisions for policymakers and the regulating authority. To come back to the definition, the cap is the overall emission limit that a group of affected sources cannot exceed under a cap and trade program. It may also be referred to as the aggregate emission quota, target, or budget. In theory, the most economically efficient level for the emission cap is where marginal abatement costs are equal to marginal benefits from the reduced emissions. However, this level is often difficult to determine due to uncertain information. More generally, the cap should be set at a level that is expected to address the environmental and health problems of concern at an acceptable cost.

In practice, policymakers will determine the cap by considering a combination of science, economics, and political feasibility. One approach that policymakers sometimes use to determine the aggregate emission cap is finding the "knee in the cost curve" (i.e., the point before costs per unit of emission reduction begins to rise rapidly). Policymakers may also want to ensure that costs are within an acceptable range. To estimate costs and benefits, policymakers may use economic modeling to depict optimal control decisions.

The decision of when to implement the cap is integral to the decision on the level of the cap. Policymakers may need to weigh the pros and cons of opting for a tighter cap with a later

implementation date versus a less aggressive cap with an earlier implementation date. For example, it may not be feasible to set the cap at the optimal level for the initial stage of implementation. However, rather than delay implementation until a later date when the optimal level may be more achievable, it may be advantageous to begin the program as soon as possible to encourage advances in control technology and influence investment decisions. Under such a scenario, policymakers may establish a cap that declines over time to ultimately achieve the environmental goal. This is one of the advantages of allowing emission sources to bank excess allowances. It encourages early reductions, advances control technologies, and reduces the economic effect of the declining cap. For predictability, it is important that policymakers or the regulating authority define the decline in allowances in advance to provide sources sufficient time to adjust to new cap levels.

The level of the cap will also depend on applicability decisions about which sources and sectors to include in the program. In the case where policymakers establish a national emission goal and develop a cap and trade program in conjunction with other regulatory tools, they must determine what portion of the goal should come from sources in the cap and trade program (the cap) and what portion from other sectors and sources. Ideally, a cap and trade program should include as many sectors as possible to maximize the cost savings from trading between sources with different marginal abatement costs. If it is not possible to include certain sectors under the cap and trade program, then alternative policy instruments may be used to reduce emissions in sectors outside the cap. As the level of the cap is being determined, details regarding the distribution and use of allowances must also be considered.

5. Allowances

Recalling the definition, an allowance is an authorization to emit a specific amount of a pollutant under a cap and trade scheme. Allowances are used for compliance and can be traded among participating sources. The distribution of allowances may be one of the most difficult issues for policymakers when developing a cap and trade program. Distribution decisions have economic, fairness, and political ramifications. Cap and trade programs create a valuable asset for those who own or control the authorizations to emit. If emission sources receive allowances through a no-cost allocation, they capture the gains from these valuable assets. Under an auction, the government captures the value of these assets in the form of increased revenues. Some analysts have argued that the revenues from allowance auctions can have economy-wide efficiency or equity benefits if they are distributed in certain ways (e.g., used to reduce distortionary taxes or distributed in lump sums to households or other groups). Different types of allocation formulas can create "winners" and "losers" among sources participating in a cap and trade program. It is important to note, however, that the method for distributing allowances will not affect the environmental integrity of the program if the program is properly enforced.

The first major step in the allowance distribution process is to decide whether the allowances will be allocated at no cost to the emission sources (usually based on some form of operating data), sold by the regulating authority through an auction or a direct sale, or distributed by some combination of these systems. To date, most existing cap and trade started as programs that have

allocated some allowances at no cost to sources. Whatever allowance distribution method is selected, policymakers can include set-asides or pools of allowances from within the cap. Existing cap and trade programs utilize set-asides to provide allowances for new sources or to provide an incentive or compensation for certain types of behavior (e.g., early reductions, energy efficiency measures, or renewable energy generation). Set-asides can be used as reserve to manage oversupply issue as well as market stability concerns.

Auctions are an alternative approach to distributing allowances. Under this approach, sources are required to bid for the number of allowances they would like to purchase (i.e., as opposed to receiving an initial amount of allowances free of charge via allocations). Supporters of auctions argue that auctions: (1) create a source of revenue that can be used to offset administrative expenses or distributed to affected groups and, if the revenue is used to replace existing distortionary taxes it can create additional economic benefits; (2) collect "windfall" profits that might otherwise accrue to emission sources if allowances are allocated at no charge; (3) avoid politically contentious issues regarding allocation methodology and lead to an efficient distribution of allowances; (4) provide an immediate price signal in the allowance market; and (5) create an equal opportunity for new entrants into the allowance market.

In establishing the design of an auction, the regulating authority will need to consider the following issues: (1) frequency of auction; (2) "spot" and "advance" auctions, where spot auctions refer to allowances that are sold for current use and advance auctions refer to allowances for a future compliance period that are auctioned in the current year, even though they cannot be used for compliance until the future compliance period; and (3) bidding procedures. Auctions may also be used to distribute only a portion of allowances with the remainder distributed by an allocation method.

Auctioning details are incredibly important because they have significant weight with respect to the balance of supply and demand in the carbon market. Recently, European Union policymakers have been forced to consider and allow "backloading" as a way to stabilize markets amid unforeseen economic crises. "Backloading" refers to the intentional delaying of auctions that is meant to decrease the supply of allowances. For example, to rebalance supply and demand of emission allowances in the European Union Emissions Trading Scheme in the short term, the European Commission proposed to temporarily postpone the auctioning of 900 million allowances from the beginning to the end of Phase III. This measure will affect the distribution of auctions over the period but it would not reduce the overall number of allowances to be auctioned during Phase III. After several months of reiterations and uncertainties, the backloading proposal was put into legislation in February 2014.

Policymakers or the regulating authority must create rules governing the use and trading of allowances. These rules should be neutral (i.e., favoring no particular individuals or groups of market participants) and provide for low-cost exchange among participants. Accounting for allowances works like a banking system. Each affected emission source should have an allowance account for holding and retiring their allowances. Transfers of allowances between

these accounts should be made as simple as possible, with few limits or restrictions to impede the market. There are, however, restrictions on allowance trades that may be considered.

Allowances are typically allocated for use in a specific compliance period. Policymakers might consider whether current allowances can also be used for compliance in future periods, referred to as "banking." Allowing banking in a cap and trade program creates additional flexibility for sources, encourages early emission reductions, can reduce compliance costs, and, partly for these reasons, can increase economic and political support for the program. "Borrowing" is another form of temporal flexibility. With borrowing, allowances from a future compliance period are brought forward to meet a compliance obligation in an earlier period. As with banking, borrowing provides compliance flexibility and can be helpful in smoothing out spikes in allowance prices. Once policymakers decide how allowances will be distributed and used in the market, they must next consider how allowances will be monitored, reported, and verified to avoid potential fraud.

6. Monitoring, Reporting, and Verification

One of the most important features of a cap and trade program is that sources measure total mass emissions, called an "aggregate cap", as accurately and consistently as possible. Because the emission measurements are the "gold standard" underlying the traded allowances, it is important that a ton of emissions at one source is equal to a ton of emissions at any other source. This creates a level playing field for participants in the program and a strong foundation upon which a market can operate. In considering potential emission measurement regimes for a cap and trade program, consistency and accuracy are most important. Ultimately, it is most important to avoid systematic underestimation of emissions.

However, simply requiring the most consistent and accurate emission measurement methodology will not ensure an effective trading system. Effective implementation is critical. It is essential that the measurement techniques are standardized, commonly applied to program participants, implemented properly, and validated for individual applications. In addition, regardless of what measurement systems are used to quantify emissions, it is imperative that any system be subject to a well-defined and continuous quality assurance and quality control program. These quality assurance and quality control programs should be based on national or international standards (e.g., International Standards Organization) and must be documented with records that can be audited and verified.

Auditing and verification of emission data can take several forms. If data submitted by sources are required in a standard electronic format, regulating authorities can use software to audit the data and identify potential discrepancies or issues to investigate. The regulating authority can use these electronic "desk" audits to target more in-depth audits. If sources submit emission data using paper forms, the audit and verification will be more resource intensive. When sources use measurement devices, the regulating authority should review data collected from measurement devices for reasonableness. In addition, the audit should review results of any quality assurance and quality control tests performed on the measurement equipment to ensure that the equipment

is operating properly. Once monitoring, reporting, and verification details have been fully considered, policymakers must then discuss the consequences of non-compliance.

7. Non-compliance

The compliance determination process for a cap and trade program should be simple and straightforward. Prior to implementation, the rules should clearly specify the deadlines for reporting and for holding sufficient allowances to cover emissions. At the end of the compliance period, the emission sources should be given enough time to verify emission data for the period and to submit them for compliance. This verification period should not be so short as to cause the emission sources to submit data that has not been properly quality assured, but not so long as to unreasonably delay compliance assessment. It should also allow enough time for the regulating authority, once it receives the data, to finish conducting the compliance determination well before the end of the subsequent compliance period, when the process will begin again. Stringent penalties for noncompliance are an integral feature of a well-functioning cap and trade program. These should be applied automatically in cases where a source does not have sufficient allowances to cover mass emissions during the compliance period. In cases where there is noncompliance with requirements of the cap and trade program (e.g., measuring emissions, reporting, and other requirements), the penalties should be determined based on the nature and severity of the violation. The penalties should be sufficiently high to provide the appropriate incentives for compliance and to deter noncompliance.

In cases where a source does not have sufficient allowances to cover its emissions, an allowance restoration rate of at least one-to-one should be applied to maintain the environmental integrity of the program. Under a one-to-one rate, one allowance from the next compliance period would be retired for every unit of excess emissions in the current compliance period if borrowing is permitted. Alternatively, the shortage of allowances can be purchased from the allowance market. Aside from the one-to-one allowance restoration rate to maintain environmental integrity, the regulating authority should apply penalties for noncompliance if the goal is to deter such behavior. The existence of a one-to-one restoration rate without other accompanying punitive measures for noncompliance implies that sources can, in effect, use allowances from future compliance periods to attain their emissions reduction target. This can result in a scenario in which the emission cap is never attained. Hence, it is very important to impose penalties to deter noncompliance. Penalties can take the form of allowance, financial, and/or criminal penalties.

Policymakers or the regulating authority should set the level of the financial penalties significantly higher than the expected marginal abatement cost—the expected market price of allowances—to create an effective deterrent for noncompliance. The regulating authority might also impose criminal penalties on individuals who knowingly violate any requirements, with maximum sentences for first-time and repeat offenders. Criminal penalties provide direct incentives for the legally responsible individuals ("designated representatives" or owners and operators) at the affected sources to behave responsibly.

From the first step to the last, developing a plan to implement a cap and trade program can be quite lengthy and complex. However, even with all the above infrastructure requirements, through the process of trial and error, many valuable lessons have been learned from existing cap and trade schemes.

III. Lessons Learned

Since the implementation of cap and trade started in 1995 with the launch of the U.S. Acid Rain Program and in 2005 with European Union Emissions Trading Scheme, many lessons have been learned through trial and error. As more cap and trade programs appear around the world, it is becoming increasingly beneficial to gather information regarding the pros and cons of existing systems to assess what has worked well and what has not. Although each emissions trading scheme is different and unique in its own right, certain features remain consistent and reflect the best way to practice cap and trade. For example, perhaps one of the most important lessons learned from existing cap and trade programs is the need for comprehensive, accurate, transparent, and timely information about emissions and allowances. The regulating authority that operates the program must collect, verify, maintain, and disseminate the data if the program is to operate with environmental integrity, economic efficiency, and public credibility. As such, computerized information systems are the most effective method available today to process and disseminate these data. In this section, three major emissions trading schemes are analyzed – the European Union Emissions Trading Scheme, the California Cap and Trade Program, and the Regional Greenhouse Gas Initiative – and, in the next section, their best practices, as well as those from other programs, are summarized. Without doubt, any discussion of emissions trading must begin with the world's largest cap and trade scheme aimed at reducing greenhouse gas emissions, the European Union Emissions Trading Scheme.

1. European Union Emissions Trading Scheme

a. Background

First and foremost, as the first carbon emissions trading program, the European Union Emissions Trading System ("EU ETS") has shown that cap and trade can be used for carbon and can be done so in an agreed-upon manner across many countries, and in doing so creates a price on carbon that drives emissions reductions. Emissions trading systems are now among the most cost-effective tools for cutting greenhouse gas emissions. The EU ETS is Europe's mandatory cap and trade scheme and it covers all 28 EU member states plus Iceland, Norway and Liechtenstein. The European Union launched the EU ETS in 2005 as the cornerstone of its strategy for cutting emissions of carbon dioxide and other greenhouse gases at least cost. In contrast to traditional "command and control" regulation, emissions trading harnesses market forces to find the cheapest ways of reducing emissions. The EU ETS is the world's first major carbon market and remains by far the biggest today. As of 2013, it covered more than 11,000 installations.

While the regulatory framework of the EU ETS was largely unchanged for the first two compliance periods of its operation, the beginning of the third trading period brought major reform based on common rules that were meant to strengthen the system. Phase III of the scheme started in 2013. This was a year with many uncertainties for the participants and important decisions on the future functioning of the scheme, including a formal endorsement of "backloading," which was discussed above and is further analyzed within the context of the EU ETS below. The scope of the scheme also expanded from Phase III to include Croatia and new sectors and gases. In 2013, the new cap for stationary installations in the EU ETS was 2,084 million allowances, compared to the previous 1,977 million allowances in 2012. For aviation, the "Stop the Clock" amendment was extended until 2016, following a plenary vote in favor by the European Parliament in March 2014 and endorsement by the European Council in April 2014. This will result in only flights within the European Economic Area being covered and therefore a lower aviation cap than the provisional 210 million allowances.

Greenhouse gases and sectors covered in the EU ETS are as follows: (1) carbon dioxide from power and heat generation, energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminum, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals, and civil aviation; (2) nitrous oxide from production of nitric, adipic, glyoxal and glyoxlic acids; and (3) perfluorocarbons from aluminum production. Altogether the EU ETS covers around 45% of total greenhouse gas emissions from the 28 EU countries. The caps for 2020 represents a 21% reduction in greenhouse gases compared to 2005 (with a 1.74% reduction per year starting in 2013).

Whereas the vast majority of emission allowances was previously given away for free by governments, from 2013, auctioning is the main method of allocating allowances. This means that businesses have to buy an increasing proportion of their allowances at auction. The EU legislation sets the goal of phasing out free allocation completely by 2027. Auctioning is the most transparent method of allocating allowances and puts into practice the principle that the polluter should pay. Under the relevant EU legislation at least half of auctioning revenues, and all of the revenues from auctioning allowances to the aviation sector, should be used to combat climate change in Europe or other countries. Member states are obliged to inform the European Commission of how they use the revenues. Germany, for instance, is spending a large part of its auctioning revenues on climate change projects in developing countries and emerging economies.

From 2013, power generators must also buy all their allowances: experience shows that they have been able to pass on the notional cost of allowances to customers even when they received them for free. However, eight of the member states which have joined the EU since 2004 – Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Poland and Romania – have made use of a provision allowing them to continue granting limited numbers of free allowances to existing power plants until 2019. In return they will invest at least as much as the value of the free allowances in modernizing their power sector. In sectors other than power generation, the transition to auctioning is taking place progressively. The manufacturing industry was allowed to receive 80% of its allowances free of charge in 2013 but this will decrease annually to 30% in

2020. Allowances not allocated for free will be auctioned. In the aviation sector, however, only 15% of allowances will be auctioned over the whole 2013-2020 period.

A business is penalized if it does not surrender enough allowances to cover its emissions. It has to buy allowances to make up the shortfall, is "named and shamed" by having its name published, and must pay a dissuasive fine for each excess ton of greenhouse gas emitted. The fine in 2013 was €100 per ton of carbon dioxide or equivalent. The penalty rises annually in line with the annual rate of inflation in the Eurozone (the group of EU countries using the euro as their currency). The accurate accounting of all allowances issued is assured by a single EU registry with strong security measures. The registry keeps track of the ownership of allowances held in electronic accounts, in the same way as a bank holds a record of its customers and their money. Anyone with an account in the EU registry can buy or sell allowances, whether they are a company covered by the EU ETS or not. Trading can be done directly between buyers and sellers, through several organized exchanges or through the many intermediaries active in the carbon market. The price of allowances is determined by supply and demand. As many as 40 million allowances have been traded per day. In 2012, 7.9 billion allowances were traded with a total value of €56 billion.

While allowances are the main currency of the EU ETS, companies can also use credits generated by certain types of emission-saving projects around the world to cover a proportion of their emissions. This is called "offsetting." These projects must be recognized under the Kyoto Protocol's Clean Development Mechanism or Joint Implementation mechanism as bringing real and genuinely additional emission reductions. When credits are generated through the Clean Development Mechanism, they are called Certified Emission Reductions ("CERs"); when credits are generated through Joint Implementation, they are called Emission Reduction Units ("ERUs"). See Table 1 below. By allowing companies to buy international credits, the EU ETS is channeling substantial amounts of investment and clean technologies to promote low-carbon development in developing countries and economies in transition. Credits are accepted from all types of projects except nuclear energy projects, afforestation or reforestation activities and projects involving the destruction of industrial gases.

Table 1: Carbon Credit Names

	Name	**Authority**
EUAs	European Union Allowances	EU ETS
CERs	Certified Emission Reduction	Kyoto Protocol – Clean Development Mechanism
ERUs	Emission Reduction Unit	Kyoto Protocol – Joint Implementation

The European Commission sees the EU ETS as an important building block for developing an international network of emission trading systems. The international carbon market is expected

to develop through the bottom-up linking of compatible domestic cap-and-trade systems. Linking the EU ETS with other robust emissions trading systems provides several potential benefits including reducing the cost of cutting emissions, increasing market liquidity, stabilizing the carbon price, leveling the international playing field and supporting global cooperation on climate change. In a major step towards the first full inter-continental linking of emission trading systems, the European Commission and Australia agreed that the EU ETS and the Australian emissions trading scheme should be fully linked by mid-2018, with an interim link from July 1st 2015. This would mean that Australian businesses would be able to use EU allowances to help cover their emissions under the Australian scheme. However, progress on linking with the Australian Carbon Pricing Mechanism is currently on hold due to uncertainties about the future of the Australian scheme. Negotiations are still under way with Switzerland on linking the EU ETS with the Swiss ETS.

However, the EU ETS also faces a challenge in the form of a growing surplus of allowances, largely because of a greater than anticipated reduction in emissions since 2008 due to the economic crisis. As experience with carbon pricing grows, scheme design is gaining in maturity and sophistication, introducing innovative features to tackle key challenges. The economic downturn, amongst others, has led to a significant surplus of allowances in the EU ETS, reducing scarcity and depressing prices. In the short term this surplus risks undermining the orderly functioning of the carbon market; in the longer term it could affect the ability of the EU ETS to meet more demanding emission reduction targets cost-effectively. Realizing there is slim chance of future recovery under existing conditions, EU stakeholders, led by the European Commission, have designed a plan to shore up the EU ETS.

This "backloading," as the plan is called and as previously discussed above, involves shifting the planned auctioning of 900 million EUAs from the originally planned auctions from 2014 onwards, to the end of Phase III (i.e., 2019 and 2020) as an initial step to redress the current supply-demand imbalance. The postponement of the auctioning of some allowances in the short term, and the proposed market stability reserve in the long term, introduce some flexibility into the cap of this established system. This plan should enable the EU ETS to better contend with envisaged changes in economic circumstances. Looking ahead, the European framework on climate and energy to 2030 was published in January 2014. Proposals include: (1) a 40% greenhouse gas reduction target for the EU as a whole below 1990 levels; (2) an increase in the linear annual reduction of the EU ETS cap; (3) a requirement that all emission reductions from 2020 onwards be met within the EU; and (4) a market stability reserve to be introduced under the EU ETS from Phase IV onwards.

b. Guiding Principles

With the EU ETS several years on, it is possible to compare expected outcomes with the results in relation to (1) the fundamental determinants of carbon price, (2) the use and role of Kyoto offset credits, and (3) the way in which the market itself operated, as well as note (4) the way cap and trade schemes can be designed to be more cost effective and flexible. Each of these guiding principles will be discussed in turn.

First, in terms of the carbon price and its determinants, the European Commission's expectation in 2008 – at the start of Phase II of the scheme – was that it would allow international credits "up to a level which would ensure that the carbon price in the EU is not higher than €30 per ton of carbon dioxide equivalent ("tCO2e"). Other scenarios showed prices mostly in the range of €30 to €40/tCO2e. A carbon price of €4/tCO2e was mentioned in the European Commission's original modeling scenario with unlimited access to international credits. While the impact of a renewables target and the use of international credits were both assessed, the economic crisis was not anticipated in any of the models.

In reality the carbon price has been well below €30/tCO2e since 2009, dropping to €4/tCO2e in 2013. Significant reductions in the emissions within the EU ETS scope have led to a higher supply of allowances than predicted and therefore a lower price than originally foreseen. The European Commission cites the international economic crisis as the main cause of the emission reductions achieved in the EU ETS. According to some analysts though, the low carbon price is caused primarily by the large uptake of renewables: compared to business as usual, renewables contribute to around 60% of the emission reductions, while the recession accounts for only around 30%. On the contrary, others note that the recent and projected growth path for renewables matches quite well with the assumptions used to set the EU ETS cap. They therefore conclude, in line with the European Commission, that the recession is the primary cause of the supply-demand imbalance.

Second, with respect to the use of Kyoto offset credits, installations in the EU ETS are allowed to surrender up to around 1,600 to 1,700 million Kyoto credits (CERs and ERUs) in addition to EUAs in the period 2008–2020. The European Commission's 2008 impact assessment anticipated that access to international credits in Phases II and III of the EU ETS would decrease direct costs at the EU level from 0.61% to 0.45% of EU Growth Domestic Product in 2020, equal to a cost advantage of around €25 billion. In turn, the carbon price was expected to be reduced from €43/tCO2e to €30/tCO2e in the scenario with the use of international credits. A lower carbon price leads to reduced revenues from auctions for member states and therefore increased support necessary to meet the renewable energy targets, although no quantitative impact is estimated. With the use of international credits, domestic carbon dioxide reductions are estimated to decrease from a 20% saving to a 14% saving by 2020 compared to 1990.

Third, in terms of the way in which the market operates, although the above outlines the fundamental policy issues that determine the carbon price, day to day prices are determined by actors in the market. The EUA market quickly developed a very high level of sophistication, something that was not explicitly anticipated at the outset. Private sector market players were swift to react to stimuli and put in place complex financial infrastructures. In 2009, during the economic downturn, cash-strapped industrial participants in the EU ETS were selling carbon assets at a very low price to raise cash at a time of limited access to credit. At the same time, with the end of Phase II of the EU ETS in sight, many entities, in particular utilities, sought to buy EU vintages under the assumption that they would no longer receive free allocations after 2012, and that they would therefore need to hedge their exposure to Phase III. As a result, the

EUA price curve steepened significantly in a contango shape, contrary to the Clean Development Mechanism price curve that skewed towards a backwardation curve. The curve began to flatten out only during the second half of 2009, when liquidity increased and the cost of funding declined.

Fourth, in considering any emissions trading scheme, an important guiding principle is that cap and trade instruments can be designed to be more cost-effective and flexible. In terms of cost-effectiveness, lower implementation costs could have helped maximize the cost-effectiveness of each instrument. In terms of enhanced flexibility, as discussed, the instruments with market elements were not designed to adapt to changes in macro-economic conditions. This led to an oversupply of carbon allowances and credits under a scenario of low demand. The EU ETS suffers from a surplus now because of this initial inflexibility which has consequently impacted the Clean Development Mechanism market as well. Increasingly, as in the EU ETS, more rules are being added to carbon pricing instruments to create stability and certainty. The design of these rules needs to be carefully tuned to avoid being too complex, whilst providing sufficient predictability in the schemes.

In order to run effectively, markets rely on an unimpeded flow of information, clear rules and rigorous oversight. The EU ETS is under fire from some environmentalists because of its relatively lax targets and low carbon prices, along with its vulnerability to fraud and abuse. In 2005 EU embarked on the pilot phase of its emissions trading scheme and the lack of emissions data allowed companies to game the system. EU governments asked companies to provide their own, unverified historical emissions data, and many inflated their numbers so as to claim more free allowances from government. This practice created an overhang of surplus permits that led to a price collapse in 2007. Nonetheless, however, generous allocations of allowances are probably inevitable as the price paid for industry acceptance.

2. California Cap and Trade Program

California recently launched the California Cap and Trade Program which is the largest program in the United States both in size and market value. In addition to driving emission cuts in the ninth largest economy in the world, the program will provide critical experience in how an economy-wide cap-and-trade system can function in the United States. California's emissions trading system will reduce greenhouse gas emissions from regulated entities by more than 16% between 2013 and 2020. It is a central component of the state's broader strategy to reduce total greenhouse gas emissions to 1990 levels by 2020. California's program represents the first multi-sector cap-and-trade program in North America. Building on lessons from the northeast Regional Greenhouse Gas Initiative and the EU ETS, the California program blends proven market elements with its own policy innovations.

California adopted the cap-and-trade rule on October 20, 2011. The Association of Irritated Residents sued the state, claiming cap and trade was not fully justified as a policy decision relative to a carbon tax or direct emission limits. After adding justification to the regulatory record, the court approved state's approach. The cap-and-trade rules came into effect on January

1, 2013 and apply to large electric power plants and large industrial plants. These plants emit 25,000 metric tons of carbon dioxide equivalent per year or more. In 2015, the rules will extend to fuel distributors (including distributors of heating and transportation fuels) that meet the 25,000 metric ton threshold. At that stage, the program will encompass around 360 businesses and around 600 facilities throughout California and nearly 85% of the state's total greenhouse gas emissions. The program imposes a greenhouse gas emission limit that will decrease by 2% each year through 2015, and by 3% annually from 2016 through 2020. The gases covered by the California Cap and Trade Program are the six greenhouse gases covered by the Kyoto Protocol, plus nitrogen trifluoride and other fluoridated greenhouse gases.

California held its first auction of greenhouse gas allowances on November 14, 2012. This marked the beginning of the first greenhouse gas cap-and-trade program in the United States since the group of nine Northeastern states in the Regional Greenhouse Gas Initiative, a greenhouse gas cap-and-trade program for power plants, held its first auction in 2008. Emission allowances will be distributed by a mix of free allocation and quarterly auctions. The portion of emissions covered by free allowances will vary by industry, but initially will account for approximately 90% of a business's overall emissions. The percentage of free allowances allocated to the businesses will decline over time. A business may also buy allowances from other entities that have reduced emissions below the amount of allowances held.

The first year of auctions generated over $525 million in revenue for the state. The state made two bills into law, establishing guidelines on how this annual revenue will be disbursed. The two laws do not identify specific programs that will benefit from the revenue, but they provide a framework for how the state will invest cap-and-trade revenue into local projects. The first law requires that the revenue from allowance auctions be spent for environmental purposes, with an emphasis on improving air quality. The second requires that at least 25% of the revenue be spent on programs that benefit disadvantaged communities, which tend to suffer disproportionately from air pollution.

With respect to emissions reporting, registration, and verification, capped entities are required to report annually and must register with the state to participate in the allowance trading market. Reported emissions will be verified by a third party. Entities must provide allowances and/or offsets for 30% of their previous year's emissions. At the end of every compliance period, entities must provide allowances and/or offsets for balance of emissions from the entire compliance period (2 years for the first period, 3 years for the next 2 periods). If a deadline is missed or there is a shortfall, four allowances must be surrendered for every metric ton not covered in time. A percentage of allowances, which increases over time from 1% to 7%, will be held in a strategic reserve by the state in three tiers with different prices: $40, $45, $50 in 2013, rising 5% annually over inflation. Since these prices are not subject to market forces, the strategic reserve will help constrain compliance costs. However, stable prices in the primary allowance market have been reported so far.

Offsets are allowed for 8% of the total compliance obligation. Note that 8% refers to the total amount of allowances held by an entity, not the amount of reduction required by an entity. Thus,

more than 8% of the program's reductions can occur through offsets. Offsets must comply with state-approved protocols. Protocols currently exist for: forestry, dairy digesters, ozone depleting substances projects, and urban forestry. Initially, offsets were limited to projects in the U.S.; however, there is a framework in place for international expansion. All offset projects must be listed with an approved Offset Project Registry.

In October 2013, California and the Quebec Ministry of Sustainable Development, Environment, Wildlife, and Parks officially linked their greenhouse gas cap-and-trade programs. As a result, from January 1, 2014, greenhouse gas emission allowances from California and Quebec are interchangeable for compliance purposes. California and Quebec's link represents the first multi-sector cap-and-trade program linkage in North America. The partnership aims to create a gateway and framework for greater international greenhouse gas reductions. This step came after years of work to coordinate the two programs. California had to align its program with Quebec's and prove that Quebec's program is stringent enough to meet California's requirements. Quebec also had to draft amendments to its regulations in order to harmonize with California's reporting scheme. Both California and its parallel agency in Quebec adopted regulations necessary to link their programs in spring 2013.

Looking ahead with respect to the future of the California Cap and Trade Program, proposed amendments to the overarching legislation include allocation rules, market program implementation, and offset program implementation. Ongoing collaborative initiatives include a Memorandum of Understanding with China indicating increased international participation. The Memorandum of Understanding was signed on September 13, 2013 is expected to last for two years. While these amendments and ongoing initiatives will likely provide more helpful lessons for future cap and trade schemes, it is equally important to consider the history of other existing schemes, namely the Regional Greenhouse Gas Initiative.

3. Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative ("RGGI") is a market-based greenhouse gas reduction program covering carbon dioxide emissions from power plants in nine Northeast and Mid-Atlantic states of the United States. From 2009-2011, the cap was 188 million tons of carbon dioxide per year for the original ten-state region of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. From 2012-2013, the cap was 165 million tons per year for the nine-state region of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. In January 2014, having completed revisions to their State Carbon Dioxide Budget Trading Programs, the RGGI cap was reduced. The new 2014 cap is 91 million tons of carbon dioxide, representing a 45% reduction from the previous cap. The RGGI cap will decline by a further 2.5% each year from 2015 to 2020. The increased level of ambition by these participating RGGI states triggered a doubling of the price per allowance. This shows that increased ambition in cap and trade systems can lead to increased prices.

RGGI requires fossil fuel-fired electric power generators with a capacity of 25 megawatts or greater to hold allowances equal to their carbon dioxide emissions over a three-year control period. The first three-year control period took effect on January 1, 2009 and extended through December 31, 2011 for the original ten-state region. The second three-year control period took effect on January 1, 2012 and extends through December 31, 2014 for the current nine-state region. Carbon dioxide allowances are issued by each state in an amount defined in each state's applicable statute and/or regulations. Together, all the carbon dioxide allowances issued by all the RGGI states comprise the RGGI cap.

RGGI provides for allocating carbon dioxide allowances through quarterly, regional carbon dioxide allowance auctions. The RGGI evolvement include two interim adjustments to account for banked carbon dioxide allowances. The first – the First Control Period Interim Adjustment for Banked Allowances – is a reduction in allowances equivalent to the private bank of first control period (2009-2011) carbon dioxide allowances. The adjustment is applied to each state's annual carbon dioxide allowance budget for 2014-2020. The second – the Second Control Period Interim Adjustment for Banked Allowances – is a reduction in allowances equivalent to the private bank of carbon dioxide allowances for carbon dioxide allowance allocation years 2012 and 2013 that are in addition to the total quantity of 2012 and 2013 carbon dioxide emissions. The adjustment is applied to each state's annual carbon dioxide allowance budget for 2015-2020. The first control period adjustment is 57.4 million carbon dioxide allowances for 2014-2020. The second control period adjustment is 82.1 million carbon dioxide allowances for 2015-2020. In addition, New Jersey, the state that left the ten-state region, sold 279,758 "carbon dioxide allowance allocation year 2014" carbon dioxide allowances in 2011, and an estimated 180,894 carbon dioxide allowances for "carbon dioxide allowance allocation years 2012 and 2013" in state set aside accounts will be distributed or auctioned after the second control period interim adjustment. RGGI requires that proceeds from the carbon dioxide allowance allocations be invested in consumer benefit programs to improve energy efficiency and accelerate the deployment of renewable energy technologies.

With respect to recording and monitoring, RGGI states must keep an emissions and allowance tracking system to record and track RGGI market and program data, including carbon dioxide emissions from regulated power plants and carbon dioxide allowance transactions among market participants. The system enables the public to view, customize, and download reports of RGGI program data and carbon dioxide allowance market activity. It also facilitates market participation by enabling the allocation, award, and transfer of carbon dioxide allowances, the registration of offset projects, and the submittal of offset project consistency applications and monitoring and verification reports.

RGGI does allow for the use of offsets (greenhouse gas emissions reduction or carbon sequestration projects outside the electricity sector) to help companies meet their compliance obligations. At this time, the RGGI states limit the award of offset allowances to five project categories, each of which is designed to reduce or sequester emissions of carbon dioxide, methane, or sulfur hexafluoride within the nine-state region. The RGGI states cooperatively developed prescriptive regulatory requirements for each of the five offset categories. These

requirements ensure that awarded carbon dioxide offset allowances represent carbon dioxide-equivalent emissions reductions or carbon sequestration that is real, additional, verifiable, enforceable, and permanent. All offset projects must be located within one of the RGGI states. The use of carbon dioxide offset allowances is constrained to 3.3% of a power plant's carbon dioxide compliance obligation for each control period.

As a price stabilization mechanism, the RGGI states have also established a Cost Containment Reserve of carbon dioxide allowances that creates a fixed additional supply of carbon dioxide allowances that are only available for sale if carbon dioxide allowance prices exceed certain price levels – $4 in 2014, $6 in 2015, $8 in 2016, and $10 in 2017, rising by 2.5% each year thereafter. The Cost Containment Reserve is replenished at the start of each calendar year. The Cost Containment Reserve is 5 million carbon dioxide allowances in 2014 and 10 million carbon dioxide allowances each year thereafter. RGGI's Cost Containment Reserve was triggered for the first time in March 2014.

Although these three schemes do not encompass the entirety of carbon emissions trading, since there are many other schemes throughout the world (such as the Switzerland Emissions Trading Scheme, the Alberta Greenhouse Gas Reduction Program, in Canada, the Quebec Cap and Trade System in Canada, the Kazakhstan Emissions Trading Scheme, the Australia Carbon Pricing Mechanism, the New Zealand Emissions Trading Scheme, and various schemes set up in Japan), they represent some of the best practices in cap and trade to date. Having analyzed the details of these schemes, it is now appropriate to extract in more general terms the best practices that a cap and trade system can adopt.

IV. Best Practices

The following sub-sections provide the best practices, by topic, of existing cap and trade schemes. The topics for discussion are: (1) using an absolute cap versus a carbon intensity cap; (2) auctioning versus allocating; (3) banking and borrowing; (4) linking; (5) offsetting; and (6) measuring, reporting, and verifying. These best practices are meant to be able to serve future cap and trade programs as guidelines for implementation. Because cap and trade schemes must be tailor-made to fit within their unique environments, however, some of these best practices may not necessarily be best for all. ***In other words, there is no one-size-fits-all cap and trade scheme***. Therefore, although the following guidelines should be considered general best practices, they surely need to be adjusted accordingly. To start, it is strongly agreed that the use of an absolute cap is superior to that of a carbon intensity cap.

1. Using an Absolute Cap versus a Carbon Intensity Cap

In terms of whether policymakers should decide to use an absolute cap (i.e., a cap that allocates a fixed supply of emissions allowances, or a firm cap beyond which emissions cannot rise) or a carbon intensity cap (i.e., a limit which slows growth in emissions), experience and common sense dictate that an absolute cap is best. This is because an absolute cap best is more likely than a carbon intensity cap to meet the environmental goal of cap and trade, which is to prevent the

dangerous anthropogenic interference with the climate system. There is consensus in the international community that an absolute reduction target (say, tons emitted per year) rather than an intensity goal (say, tons emitted per million dollars' worth of Gross Domestic Product) is a better mechanism to ensure compliance with whatever goal is set. This is a particularly important topic in China as much detail is yet to be resolved regarding a Chinese national market, if that were to proceed, and critically whether that would include an absolute cap on carbon emissions. So far, most of the regional Chinese carbon markets launched have an absolute cap on emissions by industry. Next, in distributing allowances, most agree there must be a balance of auctioning and allocating.

2. Auctioning versus Allocating

Under cap and trade, the allowances can be introduced into the system either by auction or through free allocation. A concern sometimes leveled against cap and trade is that free allocation eliminates the recipient's incentive to reduce emissions. But theory suggests otherwise. Even when allowances are received for free, each additional unit of emissions carries an opportunity cost: one more unit of pollution either reduces the number of allowances the covered firm can sell, or it raises the number of allowances the firm must purchase to remain in compliance. On the other hand, however, it is generally known that a higher level of auctioning leads to a more liquid market by causing participants to trade permits more often than otherwise. Studies suggest that the revenue from 100% free allocation would substantially overcompensate firms for the costs they would otherwise face under these programs. In fact, these studies show that a fairly small share of the allowances – generally less than 30%– need to be freely allocated in order to provide sufficient revenue to prevent an overall decline in firm's balance sheet. In the first phase of the EU ETS, over 95% of the allowances were given away for free. In keeping with the analysis above, this generated windfall profits to many of the regulated firms. Partly in reaction to this result, there was a distinct shift towards greater emphasis on the auctioning of allowances in RGGI and other climate bills. In addition, Phase III of the EU ETS allocates a much greater percentage of allowances through auctioning. Therefore, studies and experience show that there must be an appropriate balance between auctioning and allocating allowances. In terms of banking and borrowing allowances, both should be permitted.

3. Banking and Borrowing

As discussed above, banking allows sources to carry over unused allowances for use in a later compliance period when there might be more restrictive requirements or higher expected costs to reduce emissions. Essentially, banking gives sources some flexibility in the timing of emission reductions (i.e., temporal flexibility). It is defined as a form of temporal flexibility that gives sources the opportunity to save unused allowances and/or offsets for future use in a later compliance period. Likewise, borrowing is the ability to use or purchase allowances from a future trading period in the current period. Both options should be permitted; if appropriately utilized, both could add flexibility and reduce the risk of market volatility in the transition from one trading period to another. Such temporal flexibility makes the current supply of allowances more elastic and thereby can damp price volatility. Banking of emissions has a longer track

record, as it has been successfully used in the U.S. Acid Rain Program. Borrowing is less developed as a concept and has policymakers worried that sources would overshoot, borrowing beyond what they could ultimately pay back. However, with an appropriate enforcement strategy and long-term trading period, this risk would be much reduced. Accordingly, both banking and borrowing should be allowed. In order to create the largest carbon market possible, linking should also be permitted and even encouraged.

4. Linking

Climate change is a global problem requiring a global solution. Cap-and-trade provides a means of establishing rigorous, measurable, and enforceable targets across the globe. National trading systems can be linked with other such systems, delivering over time a global carbon market. The bigger and broader the market, the wider the range of projects, leading to lower overall cost. Linking separate emissions pricing programs yields greater abatement effort in the region with the initially lower emissions price and less abatement effort in the region with the initially higher emissions price, thus spurring equal abatement at overall lower costs. However, linkage can be difficult when the programs being linked have design differences. Nonetheless, when done correctly, experience has shown that linking between markets, both directly and indirectly, is powerful and effective. The same can be said of offsetting.

5. Offsetting

As discussed, an offset is a credit for emissions reductions achieved by an entity in a sector that is not covered by a given cap-and-trade system. By encouraging emissions reductions in areas or sectors outside the cap-and-trade program, offsets broaden the reach of the program and help promote the achievement of overall emissions-reduction goals at lower cost. An offset designates the emission reductions from project-based activities that can be used to meet compliance or voluntary objectives vis-à-vis greenhouse gas mitigation. It can be used to offer emission sources the flexibility to seek lower cost emission offsets from sectors outside a regulatory program.

Emission offsets, or credits, are typically calculated by comparing actual emissions against a baseline. The baseline is an estimate of what emissions would be in a hypothetical situation (e.g., if the project had not been created). Determining the baseline is often the biggest challenge with project-based trading. Designing effective protocols to verify offsets is difficult because it requires making a determination about whether the emission reductions from an offset project would have occurred anyway. This type of test is known as "additionality." If emission reductions from a project are not "additional," there is a risk that these reductions could dilute an emissions goal and lead to increased emissions compared to a case in which no offsets are allowed.

Two issues must be addressed for project-based trading–the effect on total emissions from "non-additional" offsets and "leakage," which is an increase in emissions or decrease in sequestration caused by the project but not accounted for in the emission baseline for that project activity. The

underlying concept is that a particular project can produce offsetting effects that fully or partially negate the benefits of the project. For example, a project that protects a forest tract slated for deforestation may simply accelerate logging of the next most suitable location. Projects that temporarily sequester emissions (e.g., forestry projects that sequester carbon dioxide) also raise issues of "permanence." If the emission reductions from the project are used to offset other emissions, and the project subsequently releases the sequestered emissions, not only is the environmental benefit lost, but the credits may allow emissions to increase. Despite these potential issues, as with cap and trade, project-based trading can reduce the economic costs of achieving an emission goal by adding flexibility for sources to develop appropriate compliance strategies. For example, a polluting facility may invest in an offsite emission abatement project to earn emission reduction credits. If approved, these credits may be used to offset emissions from the facility. It is generally agreed that the use of offsets should be allowed and encouraged. Last, but certainly not least, a credible emissions measurement, reporting, and verification system is a perquisite for any emissions trading scheme to be successful.

6. Measuring, Reporting, and Verifying

Accurate measurement of emissions and timely reporting are critical to the success of a cap and trade program and the integrity of the cap. After emissions data and allowance transaction information are reported, the regulating authority can provide detailed or summary information to the public. This transparency, or access to information, can provide confidence in the effectiveness of the program. Mandatory reporting, an important data source and regulation tool, should be introduced and implemented as early as possible. National Clean Development Mechanism projects have generated relevant methodologies and protocols for monitoring, reporting, and verification that can be adapted to emissions trading schemes with further refinements. However, data and transparency would be a concern if insufficient amount of data collected, as well as its quality and data integrity.