# Industrial Energy Efficiency in Key Sectors

## Emissions Trading Scheme

**Task 3: Propose a framework for a national emission scheme including the modalities, procedures and structures to be employed.**


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**This report is intended to propose a framework for a national emission trading scheme without any regards for compliance with the Iranian legal, regulatory and financial processes and practices.**

Cap and trade, or emission trading, a market-based policy is defined by certain key components. Part I lists and describes some guiding principles useful to any cap and trade program. Rather than explaining in detail the components of a cap and trade system, it is meant to provide broad tips regarding the system as a whole. In Part II, the way to establish the proper legal framework for emission trading is presented. Setting the proper legal framework and having a proper structure is extremely significant because doing so gives cap and trade the necessary foundation to succeed. Part III offers information regarding emissions inventory. Taking inventory is the step where nations collect information about their current emission levels so that they can appropriately set the level of the cap and make other critical decisions. In the last part of the report, Part IV, the modalities and required procedures, or components, of emission trading are identified and analyzed. This is where the details of cap and trade are laid out. Before delving into the details, however, an overview of some of the guiding principles of cap and trade is required.

## I. Guiding Principles

Even though emission trading was formed as a concept over half a century ago in the 1960s, the practice of cap and trade started much later and is only just starting to fully develop. This being the case, and because emission trading is a long-term process, there has not been much time to look back in retrospect to fully evaluate former and existing cap and trade schemes. Nonetheless, however, certain lessons have been learned from such schemes and, as such, guiding principles derived. Perhaps the most important of these guiding principles include: (1) simplicity; (2) accountability; (3) transparency; and (4) predictability and consistency. Again, these are general, overarching tips policymakers creating an emission trading scheme would benefit to follow. Simplicity, in a field as complex as cap and trade, is undeniably crucial.

### 1. Simplicity

Simplicity is an important goal when designing an effective cap and trade program. Program operation for both emission sources and regulating authorities can be less costly and time-consuming if the rules are not overly complex or burdensome. Markets function better when the rules are simple and easily understood by all participants. Moreover, the environment is more likely to be protected when rules are clear and easily enforced. In contrast, complexity often requires more decisions, debate, and information collection. This situation, in turn, can create uncertainty and unnecessary burden that may lead to delays, opportunities foregone, and ultimately higher costs. In some countries, complexity may also make it more likely that there will be litigation over contentious issues. Another important guiding principle is accountability.

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2. Accountability

A cap and trade program must create a framework of oversight and enforcement that will hold participants accountable for their emissions and ensure compliance with the program's requirements. The basis of accountability is the accurate measurement and verification of emissions and the rigorous and consistent enforcement of penalties for fraud or noncompliance. Without accountability, confidence in the cap and trade program is lost. Such loss in confidence may not only cause the emission trading market to crash, but may also result in increased emissions of greenhouse gases. The regulating authority can facilitate accountability through clear and simple rules. In order to preserve confidence, the regulating authority must also ensure that the cap and trade program is transparent.

3. Transparency

Transparency refers to the full and open disclosure of relevant public and private decisions, such as establishing the rules and regulations for a trading program and determining if an emission source is in compliance. Transparency is important to a well-functioning cap and trade program, both in terms of its design and its operation. Advances in information technology and the internet have made it possible to provide interested parties with timely and useful information about emissions, allowances, and program results.

As set forth, the above guiding principles provide useful tips for how a cap and trade program should be run; in order to create the proper foundation for the cap and trade system to exist, however, the appropriate legal framework must be established.

## II. Legal Framework

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) dates of implementation; (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 the regulating authority can allocate or auction allowances; (5) use of allowances, such as banking and borrowing; (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 and procedures for emission measurement, collect emissions data to determine compliance, and publicize emission and allowance updates to provide transparency and promote confidence in the program; (8) accounting and tracking system; (9) compliance, giving the regulating authority the power to reconcile the emissions of each source with the number of allowances they hold; and (10) 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. These basic components provide the necessary pillars upon which any cap and trade program depends. Without them, cap and trade

is likely to fail. Once the proper legal framework has been set by policymakers, the regulating authority can begin taking emissions inventory.

## III. Emissions Inventory

The types of data and appropriate level of detail for the emission inventory will depend upon the intended use of the data. The emission inventory is likely to be useful in making the following design decisions: (1) program applicability, that is, which sectors to include, where to apply the obligation to hold allowances (e.g., at the fuel distributor or the emission source), and what thresholds should be set to determine if a source is affected by or exempted from the program (e.g., production capacity); (2) allowance allocations, to analyze the effects of different allocation options on emission sources and to decide on a method for distributing allowances; and (3) aggregate cap, to analyze the potential costs and benefits of different emission caps, as well as to assess the performance of the program once implemented. Minimum data requirements for the emission inventory include: (A) individual emission source characteristics (e.g., size, location, name-plate capacity, process type, boiler type, fuel type); and (B) emission levels for individual sources based on output, fuel use, and/or emission data. These data requirements will vary depending upon: (a) the types of sources to be regulated under the cap and trade program; (b) the pollutant; (c) the choice of allowance distribution method; and (d) the method for setting the overall cap.

For cap and trade programs that require emission sources to hold allowances, sources can be inventoried at five different levels of detail: (1) the company level; (2) the plant level, which denotes a plant or facility that could contain several emitting activities; (3) the point or stack level, where emissions exit to the ambient air from stacks, vents, or other points; (4) the process or segment level, representing the unit operations of specific source categories (e.g., a single boiler that burns both coal and gas would count as two segments); and (5) the unit level (e.g., each individual boiler). The most significant factors in making this decision, are: (A) program design considerations; (B) cost of data collection and availability of data; (C) completeness; and (D) measurement method. Having covered the fine points of emissions inventorying, it is now appropriate to take a closer look at the several modalities and components of an emission trading scheme.

## IV. Modalities and Procedures

When creating a national emission trading scheme, policymakers must be sure to include certain components and procedures in their proposed framework. The most important of these components address the following: (1) applicability; (2) setting the level of the cap; (3) length of the compliance period; (4) quantification; (5) allowance distribution; (6) allowance use; (7) auditing and verification procedures; (8) accounting and tracking; (9) compliance determination; and (10) enforcement and penalties. Each of these elements will be briefly discussed in turn. First and foremost, policymakers must determine the applicability of their emission trading scheme.

1. Applicability

A. Sources

After deciding that cap and trade is the preferred approach to reducing the emissions of a particular pollutant, policymakers must determine which emission sources to include in the cap and trade program. Ideally, all sources, sectors, and emissions would be included for full coverage and maximum environmental effectiveness and economic efficiency. The more sources of emissions included, the less the impact on each affected sector and the greater the sense of fairness. In general, cap and trade programs should include enough sources to create an active trading market for allowances. If there are too few sources, there may be few opportunities for trading.

B. Point of Obligation

Closely related to the questions of which sources and sectors are covered in a cap and trade program is the question of where there is an obligation to hold allowances. There are several points where this would apply to emissions that can be capped in an economy, including: (1) point of emissions; (2) upstream; and (3) hybrid. First, a point of emission, or downstream, program focuses on direct emission sources (e.g., electricity generators and large industrial sources) where the pollutant(s) are released to the atmosphere. This approach works well if the production or combustion process affects emissions (e.g., nitrogen oxides from industrial boilers). Second, an upstream program focuses on any point prior to the emission source (e.g., fuel producers and processors such as coal mines or oil refineries). An upstream program does not have a direct cap on emissions. Rather, the cap is set on the emission potential inherent in the fuel. The restriction at the fuels level restrains supply and can cause fuel prices to increase. This "price signal" encourages fuel consumers to reduce demand for the fuel, either by finding more cost-effective alternatives or creating new technologies that use the fuel more efficiently. In this way, it operates much like a pollution tax, but has the benefit of a cap on total emission potential. Last, a hybrid approach could be used to cap some entities upstream and some entities at the point of emissions. For example, large emitters such as electricity generators might be capped at the point of emissions, while emissions from transportation might be capped upstream.

C. Gases

Just as a cap and trade program should cover as many sources as is practical, it should also cover as many greenhouse gases as is practical. An emission trading program should include all relevant greenhouse gases adjusted for their global warming potential. As defined, greenhouse gases, both natural and anthropogenic, trap heat in the Earth's atmosphere, causing the greenhouse effect. The emission of greenhouse gases through human activities (such as fossil fuel combustion or deforestation) and their accumulation in the atmosphere is responsible for contributing to climate change. Water vapor, carbon dioxide, nitrous oxide, methane, and ozone are the primary greenhouse gases; however, the six greenhouse gases identified by the United Nations Framework Convention on Climate Change are carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. As examples, the Chinese pilot emission trading schemes cover only carbon dioxide, with no regulation of other greenhouse

gases, while the European Union Emissions Trading Scheme and the California Program do have specific regulations on other gases, with the European Union including carbon dioxide, nitrous oxide, and perfluorocarbons, and California including carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and other fluorinated greenhouse gases.

### D. Linking and Offsets

Linking refers to the ability to easily connect one emission trading scheme with another, so that carbon credits traded over one market can be traded with those from the other. Linking national or regional carbon trading programs would reduce emissions price volatility by increasing the number of market participants and the liquidity of the market. For example, tying a potential U.S. emission trading program to the European Union's Emissions Trading Scheme would provide market depth, as well as other opportunities, such as allowing U.S. businesses with European Union operations to reduce emissions where it is most efficient. Another way to perhaps improve market liquidity is by allowing offset credits use.

An offset credit is an emission reduction of a specific quantity of a pollutant (e.g., 1 ton) verified through a project-based program. An offset credit can be applied to regulatory emission limits as an authorization to emit that specific quantity of pollutant. Offsets would allow companies to meet their own emissions targets by financing abatement projects by non-regulated sources both domestically and abroad. Thus, in periods in which the market price of allowances are high, emitters could tap into countless carbon containment opportunities – everything from accelerating the replacement of coal-burning boilers to sequestering carbon in new forests.

### E. Opt-Ins

It is important to note that some sectors may not meet the criteria for inclusion in the cap and trade program but have individual sources that can meet the criteria. In such cases, it may be desirable to allow these sources to voluntarily "opt-in" to (participate in) the program. These sources receive an allowance allocation and are subject to the same requirements as sources under the cap. Theoretically, these sources will have cost-effective emission reduction opportunities that warrant the expense of meeting the monitoring and other requirements associated with the cap and trade program. If policymakers allow opt-ins, sources that choose to opt-in should be subject to all the terms of the program. It is imperative that any sources opting in employ a measurement protocol that is equivalent in consistency and accuracy to the methods used by the affected sources. This ensures that the reductions achieved from opt-ins are real, verifiable, and comparably valued.

## 2. Setting the Cap

### A. How to Set the Cap

Setting the level of the emission cap is one of the most important decisions for policymakers and the regulating authority. 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.

### B. When to Implement the Cap

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.

### C. Who is Covered by the Cap

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. 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. Where possible,

however, these instruments should be used to reduce emissions to levels where marginal abatement costs in the uncapped sectors are roughly equivalent to the marginal abatement costs in the sectors participating in the cap and trade program.

D. What Type of Cap

Furthermore, an absolute emissions cap, one defined in carbon-equivalent tons per year, would be more effective than an intensity target (tons per million dollars in GDP). Intensity targets have some following since they ease the abatement obligations of business in periods of rapid economic growth. But absolute emissions caps are easier for the public to understand and thus more politically palatable. An absolute target has practical consequences as well, as it clarifies expectations and provides direction regarding future. Absolute targets are the preferred model and used in the European Union Emissions Trading Scheme and under the Kyoto Protocol.

E. Why Price Caps Should be Discouraged

To deliver on the promise of an effective cap-and-trade program, the carbon price signal must reflect actual abatement costs to achieve environmental and market efficiency objectives. This requires that a carbon trading program must be allowed to function without an artificial cap on the market price of emissions allowances. With a price cap, capital markets cannot be expected to direct economic resources in ways that most efficiently address market demand. The inverse is, of course, the most compelling argument for market-based policy. The imposition of a price cap compromises the emission cap because sources are able to continue to emit carbon so long as they pay the fixed price for additional allowances, and the consequences are likely to be substantial. Also, price caps discourage investment in low-carbon technology. This is because the prospect of compensatory financial returns must exist for private investors to commit capital in the research and development of low carbon technologies, which is by its nature high risk. For these reasons, price caps are strongly discouraged.

3. Length of Compliance Period

The length of the compliance period should be linked to the environmental problem and reflect operational considerations. If the environmental problem is continuous and long-term, as in the case of climate change, the compliance periods should be continuous, covering all months of the year. With respect to carbon emission trading, the basic structure of the cap and trade program should be kept intact for decades. In fact, any trading regime should extend to 2050. A commitment of this length would provide a stronger price signal and better inform both businesses investing in new equipment and enterprises developing new abatement technologies. Most of the relevant capital investments being made or contemplated today will have at least a thirty-year project life. Investors need an extended program that will allow them to undertake projects that have long lead times but that present greater opportunities for cost-effective greenhouse gas reductions. Ensuring long-term carbon cap and trade program stability is essential.

4. Quantification

A. Accuracy and Consistency

One of the most important features of a cap and trade program is that sources measure total mass emissions 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. First, with respect to consistency, the regulating authority should create clear and consistent protocols for sources to determine emissions. This means employment of standard procedures and the use of sound engineering practices. Second, for a cap and trade program, accurate measurement is more important than consistency over time. Policymakers should consider enhancements to measurement methods or using different methods if better approaches are available and practical. The monitoring program can also be designed to include performance standards that reward sources that achieve better accuracy than required. For example, for less accurate approaches, sources should use more conservative estimation methods that are biased toward overestimating emissions. Ultimately, it is most important to avoid systematic underestimation of emissions.

B. Pollutant

The pollutant to be measured, the conditions under which it is created, and the mode in which the emissions enter the atmosphere will affect the types of emission measurement techniques available. For example, measurement issues related to emissions of sulfur dioxide, nitrogen oxide, and carbon dioxide from stationary source combustion will vary because emissions of sulfur dioxide and carbon dioxide are directly linked to the combusted fuel, while emissions of nitrogen oxide also depend on the combustion conditions. Therefore, an appropriate measurement method for carbon dioxide, such as mass balance based on carbon content in the fuel, will not be appropriate for nitrogen oxide. Instead, accurate measurements of nitrogen oxide emissions from stationary source combustion must be taken from exhaust gases.

C. How Emissions Enter the Atmosphere

How emissions enter the atmosphere can limit the choice of methodology. For example, continuously measuring actual emissions is an option only if emissions are vented through a stack or other contained area where measurement equipment can be located. In contrast, measuring fugitive emissions (i.e., emissions that escape directly into the atmosphere in a diffuse manner) may depend on estimation techniques based on processes, equipment and inputs.

D. Emissions Abatement Options

The abatement options available for sources to reduce their emissions are also a factor in the choice of measurement method. It is important that the measurement method be able to accurately capture the reductions made. For example, measurement methodologies based on fuel

inputs may be appropriate for sources that reduce emissions by switching or conserving fuels, but it would be much less appropriate for sources that use reduction technologies such as combustion modification or post-combustion control. In choosing a standard measurement approach, it is important to allow sources full flexibility of compliance/mitigation options.

### E. Frequency of Measurement

Although a cap and trade program requires a complete accounting of each unit of emissions, the minimum frequency of measuring emissions or the parameters used in calculating the quantity that is emitted will need to be determined (e.g., continuous emission monitoring, periodic monitoring). The nature of the problem to be solved, the potential variability of the measured parameters, and the length of the compliance period will influence the appropriate frequency. For a cap and trade program aimed at solving a problem caused by a total accumulation of emissions in the atmosphere, such as greenhouse gases, the frequency will be dictated by the ability to capture variations in emissions which contribute to an accurate estimate of total emissions. Furthermore, greater frequency of measurement is warranted when emissions, or the parameters used to calculate emissions, have the potential for high variability (e.g., for units that use fuels with varying characteristics).

### F. Frequency of Reporting

In addition to deciding upon the frequency of measurement, the regulating authority should consider how often to receive the data. Requiring sources to compile and send emission reports on a quarterly basis is helpful with market behavior even though compliance is determined on an annual basis. Factors to consider when setting the frequency of reporting include: allowing enough staff time to review the data (e.g., not waiting until the end of the year to review all data at once); giving time to sources to correct any errors found during review; and providing timely, reviewed data summaries to the public.

### G. Cost and Feasibility

Within a cap and trade program, there may be sources that emit small quantities of emissions because they are small, clean, or operated infrequently. Alternative and less costly methodologies may be appropriate for such sources due to the high cost of the standard methodology. It is important to the integrity of the trading system to ensure that less accurate methodologies are conservative in nature, as well as to keep the number of sources treated in this fashion relatively small. It is also important to keep in mind that the cost of accurate emission monitoring should be considered in light of the cost savings afforded by the cap and trade approach over traditional approaches to environmental protection. The added cost of accurate measurement may be a small percentage of the savings achieved by implementing a cap and trade program versus another form of regulation, and the resulting accuracy and confidence in the emission data may be well worth the expense.

## 5. Allowance Distribution

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 and historical emission), 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 programs have allocated 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). This section explains the incentives and decisions associated with allocations, auctions, and direct sales.

If policymakers decide that allowances will be allocated free of charge, many different methods can be used to distribute the allowances. The regulating authority will need to consider the following issues, each of which will be discussed in turn: (1) data foundation; (2) reference period; (3) allocation period; (4) length of allocation; (5) preserving the cap; and (6) incorporating new sources. First, with respect to data foundation, there are three different aspects of a unit's operation that may be measured and used as a basis for allocating allowances: mass emissions, fuel (or heat) input, and production output. Policymakers should consider the character and quality of existing data and the behavior they want to reward. Second, the reference period for allocations could be historic, current, or even projected. Allocations using historic reference periods are attractive to firms that typically have been big emitters, or in the case of input or output approaches, near their maximum capacity in the past because they are guaranteed a relatively large allocation under the new cap and trade regime.

Third, with respect to allocation period, policymakers must decide whether allocations will be permanent or updated periodically. Because updating systems change allowance allocations at periodic intervals, entities may have an incentive to do more of the activity that will earn them more allowances. Therefore, updating allocations can influence future behavior. The time period of the interval will affect the level of influence updating has on future behavior. Permanent allocations, on the other hand, provide no such incentive because changes in behavior will not affect future allocations. Fourth, the regulating authority may decide to allocate allowances to emission sources in advance of the allowance vintage period (i.e., the period in which the allowance can be used for compliance). Having allowances allocated in advance can add liquidity to the market because sources and other market participants can trade future allowances. Fifth, once policymakers determine the method for distributing allowances and calculate the sources' allocations, policymakers should compare the resulting allocations and the size of the cap so that the total allocation matches the number of allowances in the cap. Last, with respect to incorporating new sources, policymakers must decide how new entrants into the program will obtain the allowances needed to operate. In some systems with updating allocations, new emission sources may receive some allowances. In the case of permanent allocations, new units may obtain needed allowances from the market. Alternatively, an allocation set-aside could be created for new entrants.

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). Benefits of auctions can be: (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. One possible approach would be to begin with an allocation system and transitioning to an auction-based system over time. This would increase economic efficiency over time and decrease political opposition from emission sources worried about the cost of allowances.

Another tool that can be used in allowance distribution is an allowance set-aside. Under a set-aside, the regulating authority withholds a certain number of allowances from within the cap for a specific purpose. The set-aside can be a fixed number of allowances or a percentage of the total amount of allowances. The regulating authority can distribute the set-aside allowances for purposes such as an incentive for certain technologies, as a way to address equity issues, or as a reserve for new units as explained earlier. Policymakers can create set-asides that last for a fixed period, such as five years, after which the set-aside expires, or it can last in perpetuity.

In addition to creating rules governing the distribution of allowances, policymakers must also consider how allowances will be used.

6. Allowance Use

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 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. While banking implies a tradeoff between the short and the long term, it encourages sources to reduce their emissions sooner and make reductions when and where it is most cost-effective to do so. In other words, banking adds another source of flexibility in compliance – that of timing flexibility.

"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. For example, if prices reach a certain level, sources might be allowed to buy allowances from the government that would be deducted from allowances available in future compliance periods. The potential downsides of borrowing are that emission reductions are delayed and there is a greater risk of future non-compliance if an emission source cannot "repay" the borrowed allowances. In addition, borrowing can create an incentive for emission sources to act to disrupt the cap and trade program's performance and longevity in order to avoid "repayment" of allowances. Furthermore, the health and environmental benefits of emission reductions today are delayed until the future.

It is prudent for both banking and borrowing to 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.

Furthermore, a cap and trade program should give "early action" credits to sources that have already begun to reduce emissions. Businesses should be rewarded for committing to greenhouse gas reductions before the official start of the trading program. By the same token, companies should not be rewarded with larger initial allocations of emissions allowance because they have rushed to complete facilities (notably, coal-fired power plants) that are heavy emitters. Therefore, in determining allocation levels, regulators should account for emissions for involved parties prior to the implementation of any emissions-reduction program. Once policymakers establish guidelines for allowance use, they must determine how to audit and verify the allowances in order to prevent fraud.

7. Auditing and Verification

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 and must be documented with records that can be audited and verified.

8. Accounting and Tracking System

Accounting for allowances works in a similar way to a banking system. Each affected emission source and market participants should have an allowance account to hold and retire allowances and compliance instruments and to participate in transacting with other account holders. The accounting and tracking system will be used to: record ownership of compliance instruments and information related to accounts; enable and record compliance instrument transfers; facilitate compliance verification; and support market oversight through the collection of relevant information. Equally as important is the regulatory body's responsibility to ensure compliance.

9. 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. At the end of each compliance period and during the time when sources are assuring the quality of their emission data, the rules should provide for a short grace period so that sources can make final allowance trades. This will allow sources to assure that their account has allowances equal to or greater than their emissions. The regulating authority should specify an allowance transfer deadline—the final date for sources to trade allowances for use in the compliance year—in advance. It may be advisable to freeze allowance transfers into or out of accounts after the transfer deadline until the regulating authority completes the compliance determination and deducts allowances for compliance.

10. Enforcement and Penalties

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. 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, each of which are discussed below.

Deterring noncompliance typically takes the form of either allowance or financial penalties. With allowance penalties (i.e., where a source would have to turn in a multiple of its allowance shortfall at a ratio greater than one-to-one) the aggregate cap of emissions in the next compliance period is reduced. The environmental benefits of the program increase due to the allowances that are deducted as a penalty, but this could lead to further noncompliance because the necessary reductions are greater in the following compliance period. Alternatively, market volatility may tempt some to speculate and intentionally be in noncompliance if they believe the market price for allowances will drop in the future. Furthermore, taking allowances out of the market reduces the supply and raises the price of allowances for all participants, not just those that are out of compliance. For these reasons, a financial penalty (in addition to the one-to-one offset) may be preferable to deter noncompliance.

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. Policymakers could also create a graduated financial penalty to reflect the severity of the violation or the length of delay in making payment. Eliminating penalty negotiations between regulating authority and emission source promotes impartiality and equity and reduces opportunities for dishonest behavior. In addition, it sets clear expectations so that sources know the consequences 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. In other words, criminal penalties force market participants to be personally accountable for their intentional violative behavior. To provide notice, owners, operators, and designated representatives should be required to sign each form that is submitted to the regulating authority for the source (e.g., allowance transfers or emissions reporting) indicating that they are liable for acts and omissions within the scope of their responsibilities under the cap and trade program.