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# EMISSIONS TRADING AS AN AIR QUALITY MANAGEMENT TOOL

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# EMISSIONS TRADING AS AN AIR QUALITY MANAGEMENT TOOL

Emissions trading is an established practice in air quality management programs around the world. China has been evaluating emission trading schemes since the 1980's and is now planning major expansion in geographical scope and depth. Specifically, China is considering emissions trading as a way to achieve the Total Emission Control limits in the 12th Five Year Plan, and as a way of mitigating new industrial growth. Previously, China experimented with emissions trading for sulfur dioxide ($SO_2$) and water borne pollutants. This paper examines emissions trading as an air quality management tool and discusses how to apply that tool effectively. No emission trading system is perfect but it is possible to keep defects to a minimum, so that the economy and environment both prosper.

Emissions trading can be used to reduce greenhouse gas (GHG) emissions too, but those programs are fundamentally different from air quality programs both for physical and legal reasons. First, GHG trades involve globally mixed pollutants and can take place anywhere in the world. By contrast, air quality trades are typically limited to single or adjacent air sheds. Second, GHG trades involve long-lived pollutants that linger in the atmosphere for centuries. Air quality trades involve short-lived pollutants that peak in concentration during certain seasons of the year or during poor meteorological conditions. In addition to these physical differences, carbon trading is governed – at least in part – by international agreements set forth by the United Nations Framework Convention on Climate Change (UNFCCC). Conversely, air quality trading is the province of national or local governments. This paper is limited to air quality-based emission trading only.

## Why Emissions Trading?

In theory, emissions trading promotes economic efficiency and rewards actors who achieve better than average environmental performance. Therefore, a properly functioning emissions trading program should encourage industry to do all of the following:

- *Find less expensive ways of reducing downstream emissions*
- *Work upstream to implement pollution prevention strategies*
- *Achieve emissions reductions targets earlier than required*
- *Out-perform emissions reductions targets*
- *Innovate new technologies for reducing emissions*
- *Develop more accurate means for measuring emissions*

In reality, emission trading programs have fallen significantly short of these goals. In some cases, air quality regulators have been too cautious in establishing setting emission reduction targets, inadvertently setting them equal to the status quo and thereby not accomplishing any new reductions. In other cases, air quality regulators have been so strict that they have driven industry away with overly complex reporting systems or excessive transaction costs. To avoid these pitfalls, the designers of emissions trading programs face an enormous challenge. The system has to be rigorous enough to achieve genuine emission reductions yet also inviting enough to promote participation and stimulate economic growth. It is an extremely tough balancing act.

One thing that helps everyone is ***certainty***. There has to be certainty about baseline emissions, certainty about emission reduction targets, certainty about deadlines, certainty about accounting procedures and certainty about penalties. Most important, there has to be certainty about the newly

created market of emission credits – that there will be sufficient supply to match demand at an acceptable price.

To be successful, a number of policy and administrative issues must also be sorted out. Government has to choose what type of emissions trading program to implement (see below), decide on the overall pollution reduction to be achieved, the applicable deadline(s) to meet that goal, which sources of emissions to include in the program, initial allocations, and proper incentives for compliance. Administrative elements include emissions measurement and monitoring, reporting, enforcement, and allowance tracking systems.

## Three Kinds of Emission Trading

In the air quality arena, there are three main types of emissions trading: 1) project-based "offset" requirements; 2) sector-based "compliance mechanisms;" and 3) pollutant-based "cap & trade" programs. These trading systems are very different though the same terminology may be used in all of them such as "baseline," "allowance," "banking," et cetera. For a precise definition of terms, please refer to the attached glossary.

### Project-Based Offset Requirements

In the United States, offsets have been required since the mid-1970s to keep poor air quality regions from getting worse. (Note: "offsets" has an entirely different meaning in carbon trading programs as described in the glossary.) In such regions – defined as "nonattainment areas" –new facilities over a designated "major source" size must purchase offsets (also known as emission reduction credits or ERCs) equal to or greater than the amount of emissions the new operation will add to the polluted airshed. The offset requirement also applies to large existing industrial facilities within nonattainment areas that are undergoing "major modification."

Offsets are required for each nonattainment pollutant or its precursors. Therefore, if the region is nonattainment for ozone, offsets are required for ozone precursors (NOx and VOC). If the pollution problem is particulate matter (PM), offsets are required for directly emitted PM or for the gases than form secondary particulates in the atmosphere (NOx and SOx). Offsets can be required for a single piece of equipment (e.g., a large utility boiler), or for the sum of emissions from all the equipment at the facility. The latter type of rule is typically referred to as a "bubble" rule since the emissions are aggregated under a single bubble and then offset.

Offsets typically come from active business enterprises who voluntary agree to cut emissions in exchange for payment. The transaction occurs between the facility owner and the offset provider, is reviewed and verified by government, then is made legally enforceable on both sides. This transaction occurs just once, before the new source begins operation, and is valid for the life of the new project

Government can also set itself up as an offset provider. When government rather than private industry supplies the necessary offset to new facilities, it is referred to as a "growth allowance" or a "community bank." In this situation, the government sets aside a certain portion of annual emission reductions and makes them available to eligible facilities. The reductions may come from mandatory shutdowns, voluntary shutdowns, or by "skimming" a fraction of emission reduction credit off other regulatory requirements. The government also decides who needs its help in obtaining offsets, which might include essential public services, small businesses, or other desirable industries that might otherwise move away. China could establish growth allowances by imposing higher Total Emission Control limits than are already required by the 12$^{th}$ Five Year Plan. Alternatively, China could set aside some of the

emission reductions created through the closure of backward industries and use those to offset newer, cleaner construction.

One of the most difficult aspects of the offsets requirement – at least in the US – is that the emission reductions used as offsets must be surplus to any other requirement. For example, a facility that is required by the US EPA to cut its emissions by 10% cannot offer the same reductions to another facility as an "offset." That means US air quality regulators have to keep close tabs on what is already required so that they do not double count emission reductions. It also means that offset availability is limited in regions with very strict emission controls – like the Los Angeles air basin – since all the easy reductions have already been done.

The goal of offsets is first and foremost to keep polluted air from getting any worse. But in the US, there is an additional objective which is not to interfere with air quality improvement strategies. For that reason, the US prohibits the "recycling" of mandatory emission reductions back into new industrial activity. In practice, this means that major industrial facilities are forced to locate outside of the most polluted areas since they cannot find enough offsets to build within those jurisdictions.

China has to decide what the objectives of its own offset program will be. Will it be to prevent backsliding only? If so, any emission reductions could be used as offsets provided there is no net increase in regional emissions. Alternatively, does China want its offset program to operate in parallel with the Total Emissions Control requirement and alongside the shutdown of backward facilities? If the latter, China has to keep separate accounts of what is already required in each region under government policy, versus which reductions are "surplus" and thus available as offsets.

Whether China demands "surplus" reductions or not, there are four additional legal criteria that apply to emissions reduction credits in the US and those are:

- ***Real:*** An emission reduction is real if it is a reduction in actual emissions, resulting from a specific and identifiable action or undertaking.
- ***Enforceable:*** An emission reduction is enforceable if the provider of credits is known to the regulatory body and has entered into a legal agreement to permanently change his or her operations.
- ***Quantifiable:*** An emission reduction is quantifiable if the calculation methodology is acceptable, transparent and replicable and the raw data required to verify the calculations are available.
- ***Permanent:*** An emission reduction is permanent if the source providing the credits has closed down its operations or surrendered all or a portion of its rights to emit air pollutants.

Regarding which pollutants to cover, the Total Emission Control requirements for NOx and SOx in the 12$^{th}$ Five Year Plan imply that those two pollutants – at least – should not be allowed to increase in already polluted areas. An offset requirement could help by eliminating the upward pressure from large new facilities or major expansions. China may also want to consider requiring offsets for volatile organic compounds (VOC) since VOC is a precursor to ground level ozone, like NOx. China could also consider piloting offsets for new sources of fine particles (PM10), while it deliberates on the appropriate standards and control requirements for that pollutant.

## Sector-Based Compliance Mechanisms

In the solvents, coatings and consumer products sectors, emissions averaging and trading is commonly used to ease compliance burdens. In the US, these mechanisms are collectively referred to as "alternative compliance plans." The basic idea that manufacturers may produce some units that are dirtier than the applicable standards and some units that are cleaner, provided that the aggregate emissions from their entire product line do not exceed established limits. Manufacturers can also over-comply and trade excess compliance credits with another company.

Emissions averaging is particularly helpful when trying to control multiple, small sources of volatile organic (VOC) emissions sold to consumers, like cans of paint. Instead of requiring 100% water-based formulations, paint manufacturers can make 90% water-based paint and provide oil-based enamels for more limited, specialty uses. The same is true for consumer products, where high-VOC products like alcohol based disinfectants can be averaged against lower-VOC products like roll-on deodorants. But even large industrial sources can benefit from these schemes. In the US, emissions averaging is allowed for petroleum refining, synthetic organic chemical manufacturing, polymers and resins manufacturing, aluminum production, wood furniture manufacturing, printing and publishing, and a number of other VOC-emitting sectors. Since many VOC compounds have toxic effects, emissions averaging is allowed within individual facilities only. This avoids shifting cancer risks from one geographical area to another. Yet is still provides significant flexibility to industry to manage their operations and the mix of VOC-containing products on site. As China moves to control VOC emissions more aggressively, it may benefit from consideration of these schemes.

Another common use of emissions averaging is in heavy-duty diesel retrofit programs. Here, the objective is to achieve the same amount of emission reductions that would occur if every vehicle or engine was retrofit with a fine particle filter and operated on low sulfur fuel. Under an alternative compliance plan, vehicle owners might choose to scrap a portion of the vehicles instead, or convert them to cleaner, alternative fuel like natural gas. Accordingly, opportunities for averaging, trading, and banking are provided by the US and California emissions standards for heavy-duty diesel trucks and buses, locomotives, heavy-duty diesel off-road engines such as bulldozers. The US also has emissions trading for small gasoline engines (e.g., those used in lawn and garden equipment).

China is currently using a yellow label scheme to designate older passenger cars destined for scrappage. If and when it expands that program into the heavy-duty vehicle fleet, it may want to consider fleet averaging schemes. Heavy duty vehicles have significantly longer lives than passenger cars and, because of that economic value, may be worth retrofitting or refueling rather than scrapping. Of course, programmatic simplicity is also a factor since it is easier to scrap vehicles than retrofit them.

It is important to note that emission credits from sector-based programs can only be used within that sector. They cannot be transferred to industrial sources as "offsets" or used for compliance with cap & trade emission limits.

## Pollutant-Based Cap & Trade Programs

Cap & trade is a system for reducing or limiting emissions from a pre-defined group of sources. The most prominent examples of air quality-based cap & trade programs are the US Acid Rain Program for sulfur dioxide ($SO_2$) and oxides of nitrogen (NOx) from fossil fueled power plants, the East Coast's Ozone Transport Commission NOx Budget Programme for utility boilers and large electrical generators, and the South Coast Air Quality Management District's RECLAIM program for NOx and SOx from all combustion sources emitting more than 4 tons per year.

Under cap & trade programs, a government authority sets a ***cap*** (maximum emissions limit) defining how much pollution is allowed during a specific window of time. The cap may be equal to historical emissions thereby preventing any increases, or may be less than historical emissions, forcing an overall reduction. Next, companies are issued "allowances" for that compliance period. If an individual company emits less pollution than its total allowances, it can ***trade*** (i.e., sell) its excess credits to other firms. Conversely, companies struggling to stay within their allotted levels can purchase credits enabling them to emit more. Over time the cap is reduced at predictable intervals, further constraining the total amount of pollution the sources can emit. This paragraph describes the general theory of cap & trade. The text box on the following page describes what has actually happened in the three US cap & trade programs mentioned above.

As shown in by the three examples, there are many ways of setting the targets for cap & trade programs. These methods include: by political consensus, by reference to control technologies, or by atmospheric modeling analyses. All of these methods are valid. The most important consideration is whether the target is ambitious enough to meet current and future air quality needs. Likewise, the program duration can be five years, ten years, or even longer. What matters the most is the predictability of each stair step downward so that industry can plan its compliance path.

Once the cap is settled upon, the next major set of issues concerns the rules governing allowances. Industry will put enormous pressure on government to inflate baseline emission calculations for the starting year, since that is the basis for the first round of allocations. Government needs to resist this pressure. If the starting baseline is too high, there will not be any emission reductions for the first several years of the program. RECLAIM is a perfect example of that.

Government also has to decide if it is going to give allowances away for free, auction them off to the highest bidders, or some combination of the above. Historically, most cap & trade programs have "grandfathered" in the companies that were already there and allocated allowances free of charge. Only a small amount of air quality-related cap & trade credits are auctioned off each year. For example, the US EPA auctions off 2% of SOx credits each year to test market prices, and the State of Virginia once auctioned off 2.5% of its NOx allowances. However, this approach could be problematic for China given the government's desire to eliminate backward, inefficient industries. What China may want to do, instead, is deny allowances to backward industries so that they lose the legal right to operate. China might also want to use auctions to drive up the cost of high-polluting enterprises, thereby internalizing the environmental costs of harmful emissions (particularly since China does not currently impose high enough emission fees).

If the government chooses to auction off any of the available emission allowances, it also needs to decide – ideally in advance – how that revenue will be used. The potential returns are quite large and could be used to advance various policy objectives. These include: increasing government capacity in the environmental sphere, subsidizing small and medium size enterprises, deploying cleaner alternative energy projects, installing additional ambient air quality monitors, or conducting research into the impact of air pollution on public health.

Another tricky thing about cap & trade programs is figuring out what to do with new sources. As noted above, cap & trade programs start with a fixed universe of sources, combine their emissions together, then gradually whittle those emissions down over time via through a system of declining allowances. It is a closed system. Unfortunately, the economy is not static and new industries crop up all the time. To keep new sources from blowing the overall emission cap, they have to be kept outside the cap & trade system completely (the external solution) or integrated in a systematic way (the internal solution). With the external solution, the new emission source receives a standalone permit, applies emissions

controls at least as stringent as the endpoint of the cap & trade program, and obtains offsets for any residual emissions. In this way, it is subject to the same regulatory pressures as the cap & trade sources and does not gain an unfair economic advantage. Alternatively, government can bring the new source under the aggregate emissions cap, adjust the initial baseline to include those added emissions but leave the end point alone. That will put additional pressure on existing sources because the allowances will be spread across more companies, but it also ensures that the aggregate emissions cap is not violated.

## Three Examples of Cap & Trade Programs

Under the US Acid Rain program, the ultimate target was a 50% reduction from 1980 emissions for the fossil-fueled power plans subject to the rule. That was accomplished in two large steps, applicable in January 1995 and January 2000, with a final deadline of 2010. The target ("cap") was negotiated politically during amendments to the 1990 Clean Air Act and gave industry a range of choices including the use of low sulfur coal, repowering, or retrofitting with scrubbers. Environmental groups complained that command and control could have done better, pointing to the EU which accomplished a 70% reduction over the same time period with direct regulations. That said, most parties agree that the flexibility in the US program cut costs by more than half of the original estimates and consider the Acid Rain program a success.

Under the RECLAIM program, the South Coast District set an emissions reduction target equivalent to what best available retrofit control technology would achieve if installed on every source. NOx-emitting industries were collectively given nine years to meet those targets, starting in 1994 and concluding in 2003. Unfortunately, the District erred in making the initial allocations so almost no one had to cut actual emissions until the seventh year. The District also set an unachievable end target for the cement industry based on overly optimistic projects for retrofits on those facilities. Once that error was fixed, the program goals were much less stringent overall. Finally, the District experienced severe price inflation during the California energy crisis in 2001, causing credit prices to soar from $2,000 per ton to $120,000 per ton overnight. To end the fiscal bleeding, the District pulled electric utilities out of program and ordered them to install retrofit controls by the earliest feasible date. In the end, RECLAIM was deemed a failure by almost all observers.

The Ozone Transport Commission (OTC) NOx budget program was aimed at cutting summertime NOx emissions by more than 50% in the northeastern United States between 1999 and 2003. The OTC covers 12 states plus the District of Columbia. The US EPA assigned an emission reduction target ("cap") to the entire area based on interstate transport effects and resulting ozone concentrations. The states then negotiated how that cap would be divided between them. Next, the OTC then established an allowance trading system so that states could trade their allowances with one another. The OTC program applied to large industrial boilers and to all electricity generating facilities with a rated output of 15 megawatts or more. In 2002, the OTC program was superseded by the federal NOx SIP call for a broader list of 21 states. The NOx SIP call also strengthened the target, requiring a 70% reduction from 1990 emission levels by 2008. In 2009, US EPA proposed the Clean Air Instate Rule (CAIR), which set new emission reduction targets for 2015 but was waylaid by litigation. Finally, in June 2010, US EPA proposed and, one year later finalized, the Cross State Air Pollution Rule (CSAPR) to replace all of the foregoing. The new rule has been expanded to cover 28 states and has a final implementation deadline of 2014. It is too soon to say whether this overall program will be successful or not, given all the regulatory turmoil, but emissions trading has been included in every version of the rule thus far.

When government establishes mandatory emission trading programs, industry may request the ability to "opt-in" or to "opt-out." Small facilities below the cap & trade emissions threshold may wish to opt-in to avoid command and control regulations, or because they have excess emission reductions to sell. Companies subject to cap & trade mandates may wish to opt-out, preferring the certainty of fixed emission control requirements and lower transaction costs. There is not right or wrong way to handle these requests. However, but it is important to prevent forum shopping for the least stringent emission control requirements. Also, government should take care not to destabilize the trading market by adding too many new players at any one time.

## Getting Results

Emissions trading programs are vulnerable to accounting errors and fraud. Even with the best intentions, government can "get it wrong." When that happens, imaginary rather than real emission reduction credits are traded, leading to no improvement in air quality or even worse: backsliding. Great care must be taken in the program design phase to avoid those outcomes. The following section describes 12 program components that safeguard emission trading systems from the worst possible defects and increase the probability of net positive results.

## 12 Essential Safeguards

### 1. Clear Roles & Responsibilities

One governmental institution needs to take primary responsibility for the administration of any emissions trading program. There can only be one set of accounting books and one approval body for transactions. If existing laws do not permit a single entity to manage the program from top to bottom, they need to be modified to provide that authorization before the trading program starts. Other agencies can play a supporting role, but only if the final authority rests in one place. There should be no confusion about who is ultimately in charge. In China, this could be accomplished by making the Ministry of Environmental Protection responsible for establishing emission trading rules, but also allowing MEP to delegate enforcement to local Environmental Protection Boards (EBPs)

### 2. Solid Emissions Baseline

Inflated emission baselines are the single largest problem in emission trading systems, leading to more imaginary emission reductions than any other factor. Therefore, before legitimate emission trading can commence, government needs to define precisely what is being emitted already. For offset transactions, that means having sufficient records about the credit provider's operations to know what was being emitted historically and how much that has been reduced, before allowing a new plant to come on line. For cap & trade programs, it means picking a time period (e.g., calendar year) for which the actual aggregate emissions from all the relevant sources can be established with a high degree of certainty. It also means resisting pressure from industry to inflate those numbers so facilities will have more headroom to grow in the future.

### 3. Ambitious Emission Reduction Targets

Emissions trading is ineffective if it simply moves pollution around without making the air any cleaner. The point is to improve air quality through gradual, market-driven emission reductions. For cap & trade and emission averaging programs, this is achieved by ratcheting down maximum allowable emissions over time. For example, in year 1, the affected sources may emit 100% of the baseline emissions level,

but by year 3 they may only emit 80% of that amount. Project-based offsets are not in the same category since they are primarily used to prevent air quality from getting worse (that is, "no net increase"). But even offsets can be used to achieve air quality goals. For example, new sources can be required to obtain slightly higher emission reduction credit than their new emissions, such as 1.2 tons of reductions for every single ton of pollution added to the atmosphere.

### 4. No Duplication of Existing Requirements

To avoid backsliding, emission offsets should come from efforts that go above and beyond existing regulatory requirements. For example, China already has emission limitations for several types of industrial facilities. Turning those reductions into "credits" would cause all of the progress achieved thus far to be recycled back into the air as offsets for new air pollution sources. China also has mandatory shut down requirements for backward facilities. If every "shutdown" turns into "credits," those benefits would also be lost. On the other hand, voluntary shut downs (full or partial) can be used for emission trading purposes as could a portion of mandatory shutdowns.

### 5. Accurate Monitoring

Accurate monitoring of emissions and timely reporting ensure that a ton from one source is equal to a ton from any other source and that relevant caps are met. Continuous emission monitoring (CEM) is the best way to ensure that emission baselines and annual emissions rates are correct. That is why emission trading programs tend to focus on large combustion sources of NOx and SOx, because those sources have stacks that can be readily monitored. However, regulatory agencies can and do rely on additional sources of data including fuel consumption records, operating conditions (e.g., temperature and oxygen levels), and other parameters that may affect emissions. Regulatory agencies also need to check that CEMs are maintained in good working order and operate around the clock.

### 6. Emission Tracking Systems

Regulatory bodies need to keep track of who's trading with whom, to ensure all air quality trades are above board and legal. For offsets, this is typically accomplished with a permitting system. The new source obtains a permit that specifies, among many other things, where the necessary offsets were obtained. The offset provider also has a permit which is either surrendered (in the case of shutdowns) or modified to show a new, lower emission limit than pertained before the emission trade occurred. For sector based emissions averaging and trading, the tracking system is written into the rules for those sources (e.g., motor vehicle emission standards for model year 2013). For cap & trade programs, more elaborate, on-line tracking systems are needed to reconcile what could be multiple transactions in a short period of time. Such accounting systems operate separate from the underlying permits (where applicable) and establish different sets of rights and obligations.

### 7. Effective Enforcement

Effective enforcement is vital to a stable market for emission trading. Potential buyers, in particular, need to know that the emission reduction credits are real and that relying on them will not subject their companies to unexpected liabilities down the road. This poses special challenges. Unlike command and control, which relies heavily on field inspections, emissions trading is enforced primarily through paper and electronic records. That is why the protocols underlying the program have to be bullet proof and fully enforceable on their face. Government needs to define the methods by which emissions will be calculated and verified, whether third party auditors will be employed, and the right of inspectors to see

any relevant records pertaining to the facility's operations. When a problem is suspected, government also needs to move quickly to contain it so market confidence is not shaken.

### 8. Meaningful Penalties

Progressive discipline is used throughout air quality management programs; emissions trading is no exception. Progressive discipline starts from a penalty "floor" which is imposed in every case, and escalates based on the severity of the offense. At a minimum, the penalty for violating emission trading rules needs to be at least as costly as direct compliance via the installation of pollution control equipment. Alternatively, for cap & trade, the fine can be set at some multiple of credit prices (two or three times the market rate). Expressed in economic terms, the "cost" of violating an emissions limit must be higher than the "benefit" the violator gains by noncompliance. Otherwise, the violator will obtain an unfair economic advantage even after the penalty is paid. To protect credit purchasers from fraud, governments may impose additional liability requirements on fraudulent sellers, whereby they make both themselves and the purchaser "whole" through the provision of higher fines. Identified "bad actors" can also be removed from the market, excluded from future credit transactions, and subject to direct command-and-control instead.

### 9. Spatial & Temporal Equivalence

Air pollution varies in time and location, producing peak concentration "hotspots" at certain times of day or during certain seasons of the year. To be truly "equivalent," emissions trading needs to consider those differences and which population groups are exposed when. For project based offsets, that means giving preference to single pollutant trades (NOx for NOx), obtaining emission reductions from nearby or upwind sources, and adjusting the ratio of trades by the distance between sources ( obtaining greater emission reductions offsets for sources that are farther apart). In China, this could be accomplished by restricting emissions trading to the same major metropolitan area (e.g., Beijing, Hubei and Tianjin) and to closely connected city clusters.

If government wishes to allow inter-pollutant trading as well, it should first conduct urban air shed modeling to determine whether such transactions would have the same air quality effects. It is unreasonable to perform modeling for every single trade, but government can at least do a sensitivity run to see how atmospheric ozone responds to VOC vs. NOx reductions, as just one example. Another issue to consider is the relative toxicity of one VOC species versus another.

Regarding timing considerations, it is important that the emission reductions occur relatively close to the time that new emissions are added to the system. If the emission reductions happen in year 1, and the emission increases happen in year 4, the public will perceive that as a worsening of air quality. Government can prevent those discontinuities by retiring credits over a certain age.

### 10. Market Liquidity

Hoarding is the second largest problem in emissions trading programs. Hoarding happens when well capitalized firms buy up all the available emission credits to prevent their competitors from operating. Hoarding can also result from companies "sitting on" emission reduction credits that are not currently needed, just in case they wish to grow at future date. Government bodies cannot completely eliminate hoarding but they can take steps to contain it. Step one is to retire credits after a certain age, thereby turning them into a depreciating asset. Step two is to prohibit any single company from buying more than a maximum number of allowances within a cap & trade system.

### 11. Transparency

Openness and transparency about emissions trading is extremely helpful in preventing fraud and ensuring market stability. Affected industries and civil society are both keenly interested in these transactions. Transparency is needed to foster public and private trust in the trading system. The only information that should be withheld is confidential, proprietary business information, such as the exact formula of chemicals in a finished product.

### 12. Regulatory Backstop

Cap & trade has important advantages over command and control, but direct regulations still have their place – particularly if cap & trade falls short or is ill-suited to certain kinds of emission sources. Government has both the right and the responsibility to use the most effective public policy tools to achieve its objectives. In some cases, that will be emissions trading. In others, it will be direct retrofit control mandates. It is up to government to decide which tool or tools to use, based on close and frequent monitoring of overall program success.

## Evaluating the Performance of Emission Trading Programs

An emissions trading program can be evaluated on the basis of how well it meets its air quality objectives and how well it functions.

Meeting emissions reduction targets is a key indicator of success. Ideally, an emissions trading program will improve air quality faster or by a greater degree than would have occurred through traditional regulation. But at a bare minimum, it should be at least as good as direct controls. Achieving this outcome at the same or lower cost is the second most important indicator of success. To assess that result, government needs to compare the projected costs of command-and-control against the actual costs of the emissions trading program. And to be complete, that comparison should include the costs of the emissions reduction measures implemented; monitoring expenses; administrative costs for participants, regulators and others; transactions costs, capital and operating costs, and the costs to government itself for program development and ongoing enforcement.

Regarding functionality, the most basic indicator of process efficiency is trading activity. If there are no trades, the theoretical advantages of emissions trading are not being realized. However, it may take some digging by government to find out what is causing such problems. Are the transaction costs too high? Are companies hoarding credit? Was the initial baseline overly inflated? Only when these factors are examined can regulators determine what is truly happening and if the observed problems can be corrected. Emissions trading has worked best when allowances or credits being traded are clearly defined and tradable without case-by-case pre-certification. That in turn, requires careful preparation so the market will work smoothly once it is open for business.

Viewed historically, emissions trading has been undeniably successful in its major objective of lowering the cost of meeting air quality goals. Moreover, the use of emissions trading has generally enhanced—not compromised—the achievement of cleaner air. China can enjoy the same success if it learns from the experiences of other countries and judiciously applies the safeguards discussed in this document.

## Glossary of Terms

**Actual Emissions:** emissions in tons per year of any regulated pollutant emitted by a stationary source. Actual emissions are calculated using the stationary source's actual operating hours, production rates, installed control equipment, and types of materials processed, stored, or combusted during the calendar year.

**Air Pollutant -** Any substance in air that harms people, other animals, vegetation, or material. Pollutants may be solid particles, liquid droplets, gases, or combinations thereof. Pollutants fall into two main groups: (1) those emitted directly and (2) those produced in the air by chemical or physical interactions. Air pollutants are often grouped as: solids, sulfur compounds, volatile organic chemicals, particulate matter, nitrogen compounds, oxygen compounds, halogen compounds, radioactive compound, and odors.

**Airshed:** a geographical area that shares the same air because of topography, meteorology and climate.

**Allocation:** The assignment of emission allowances to a pre-defined group of sources to establish an emission trading market. Allocations are created by regulatory bodies and may be assigned through a grandfathering method, auctioning, lotteries or some combination thereof.

**Allowance:** (see Emissions Allowance.)

**Alternative Compliance Plan:** A policy that allows facilities to choose their own methods for achieving defined emission-reduction goals or risk-reduction targets instead of command-and control regulations that specify standards and how to meet them.

**Banking:** A system for recording surplus emission reductions (beyond regulatory limits) for later use in bubble, offset, or netting transactions. (See: Emissions Trading.)

**Baseline emissions:** For any existing source, the average rate, in tons per year, at which the unit actually emitted any air pollutant during a consecutive 12-month or 24-month period, unless some other time period is more representative of normal source operations. The calculation of baseline emissions includes fugitive emissions to the extent quantifiable, plus emissions associated with regular startups and shutdowns. Emergency operations and breakdown conditions are not included.

**Bubble:** An air pollution control strategy wherein a facility complies with a multi-unit aggregate emissions limit or cap, in lieu of unit-specific limits, on a pollutant-specific basis for carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, PM10, or volatile organic compounds (VOCs). To establish an air emissions bubble, the sum of emissions of each pollutant from emissions units under the bubble, is expressed on both a short-term and long-term basis. The short term baseline is calculated by summing the allowable emissions of each unit after converting the allowable emissions to the equivalent pounds per hour. The long term baseline is calculated in tons per year by multiplying the allowable emissions times the actual capacity of each unit, defined as the average of the highest two of the last five calendar years.

**Cap:** (See: Emission Cap.)

**Cap and Trade:** A system for controlling aggregate emissions from a pre-defined group of sources at costs that are lower than if each source was regulated individually. Under a cap and trade system, an allowable overall level of pollution is established by government for each compliance period (e.g., one year) and allocated across firms. Companies that keep their emissions below their allotted level may sell their surplus allocations to other firms.

**Community Bank:** A repository of emission reduction credits created by the government and used to advance the public good.

**Continuous emission monitoring systems (CEMS):** Machines that measure, on a continuous basis, how much pollution is being released into the air from an individual smoke stack. USEPA requires that CEMS monitor sulfur dioxide (SO2), nitrogen oxides (NOx), airflow, and opacity (process parameters that reduce the transmission of light and obscure the view of a background object).

**Emissions:** Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts.

**Emission Allowance:** The legal right to emit one unit of air pollution (e.g., one ton).

**Emission Allowances:** The total emissions allowed to be released by an emission source within a given period of time. Emission Allowances are created by a regulating entity and distributed to emitters by grant, auction or a combination of the two.

**Emissions Averaging:** programs that allow the offsetting of emissions from higher-emitting (under-controlled) sources with lower emissions from other sources (over-controlled) in the same sector, so that the average emission *rate* achieves a predetermined level.

**Emission Cap: T**he maximum quantity of emissions which may be released from a group of stationary sources during a defined period of time.

**Emission Inventory:** An estimate of the amount of pollutants emitted from mobile and stationary sources into the atmosphere over a specific period such as a day or a year.

**Emission Reduction Credits (ERC): C**redits awarded by a regulatory body for emission reductions beyond those required by any national, regional or local air quality rule. ERCs are measured in tons (or pounds) per year and the reduction is assumed to be the same each year over the life of the emission reduction action. Emission reduction credits must be real, enforceable, quantifiable, permanent, and surplus. Interpretation of the criteria rests with the regulatory authority when it decides which credits to accept or reject for compliance purposes. Subdefinitions:

- ***Real:*** An emission reduction is real if it is a reduction in actual emissions, resulting from a specific and identifiable action or undertaking.
- ***Enforceable:*** An emission reduction is enforceable if the provider of credits is known to the regulatory body and has entered into a legal agreement to permanently change his or her operations.
- ***Quantifiable:*** An emission reduction is quantifiable if the calculation methodology is acceptable, transparent and replicable and the raw data required to verify/audit the calculations are available.
- ***Permanent:*** An emission reduction is permanent if the source providing the credits has closed down its operations or surrendered all or a portion of its rights to emit air pollutants.
- ***Surplus:*** An emission reduction is surplus if it is a reduction that is not otherwise required by law.

**Emissions Trading:** The creation of surplus emission reductions at certain stacks, vents or similar emissions sources and the use of this surplus to meet or redefine pollution requirements applicable to other emissions sources. This allows one source to increase emissions when another source reduces them, maintaining an overall constant emission level.

**Enforcement: L**egal actions taken by national, regional or local regulators to obtain compliance with environmental laws, rules, regulations, or agreements, including the imposition of penalties or criminal sanctions for violations.

**Facility:** All emissions units located on one or more contiguous or adjacent properties, and which are under the control of the same person (or persons under common control).

**Growth Allowance:** A quantity of emission reduction credits set aside in a community bank to use, in lieu of offsets, for particular types of sources (military installations, essential public services, etc.). In the US, growth

allowances must be approved as part of the State Implementation Plan and shown not to interfere with attainment or maintenance of national air quality standards.

**Major Modification:** Any physical change in or change in the method of operation of a major stationary source that would result in a significant emissions increase from that source. Excludes any emissions resulting from routine maintenance or repair. Also excludes the replacement of a single piece of equipment with an identical piece of equipment. As with "major source" (see below) the definition of major modification varies by the severity of each region's nonattainment status.

**Major Source:** In the US, major is defined in terms of emissions per year. Also, the definition of major varies with the severity of nonattainment status in each region. For example, in extreme nonattainment areas, "major" is defined as any source that emits more than 10 tons per year of any nonattainment pollutant or its precursor. In moderate nonattainment areas, the threshold for "major" is 100 tons per year.

**Maximum Allowable Emissions:** The total emissions that may be allowed from a single facility or group of sources over a specified period of time. (See also: Emissions Cap.)

**Netting:** An internal accounting procedure for adding and subtracting all emission changes at a single source to determine whether there is a "net emissions increase" from various physical or operational modifications. When the net emissions change is less than certain thresholds, the source is not subject to additional regulations such as best available control technology or offsets. (See also: Bubble.)

**Nitrogen oxides (NOx):** A criteria air pollutant produced from combustion. Nitrogen oxides are major component of ozone, acid rain, and a major contributor to the formation of fine particles.

**Nonattainment Area:** In the US, "nonattainment area" is defined as a region that exceeds the applicable national air quality standards on more than 3 days in a rolling 12 month period.

**Offsets**: In air quality programs, offsets means a reduction in emissions from existing facilities in a given nonattainment area to fully mitigate emissions produced from a new facility in the same nonattainment area. Offsets may be between different companies ("external offsets") or between sources of emissions within the same plant ("internal offsets"). Typically, offsets are approved and implemented on a case-by-case basis.(See also: Bubble, Emissions Trading, Netting.) In the carbon world, "offsets" means emission reductions obtained outside the closed market trading program (typically from developing countries), which may be substituted for emission allowances allocated or sold within that program.

**Opt In Provisions:** A mechanism that allows companies not covered by a mandatory emissions trading scheme to request voluntarily inclusion. Facilities opt into trading programs for two reasons: first, because the marginal control costs are lower than would otherwise apply to them under conventional regulations; second, because they have excess emission reduction credits to sell and want to gain access to large buyers. Opt in provisions have the advantage of increasing the overall "span of control" for a trading program and expands the pool of buyers and sellers. However, they can also lead to emission increases if they allow opt-in facilities to postpone emission reductions that would otherwise occurred.

**Opt-Out Provisions:** The permission for individual companies to withdraw from or be excluded from a mandatory emissions trading scheme, in exchange for installing equivalent emission controls. Regulatory bodies determine what counts as "equivalent" and must be vigilant to prevent companies from shopping around for the least stringent requirements.

**Ozone ($O_3$) -** An invisible gas occurring naturally in the upper atmosphere but at ground levels is a major component of smog. Ozone is not emitted directly but formed as a result of complex chemical reactions between when VOCs and NOx in the presence of sunlight.

**Particulate Matter:** Fine liquid or solid particles directly emitted to the air or formed in the atmosphere through physical and chemical processes.

**Permit:** A document that resembles a license, required by the US Clean Air Act for all major stationary sources of air pollution. Permits include information on which pollutants are being released, allowable limits, and control methods used to meet those requirements.

**Potential to Emit:** The maximum capacity of an emission unit or facility to emit a pollutant given its physical and operational design.

**Sulfur Dioxide (SO2)**—A heavy, colorless, gaseous air pollutant formed from the combustion of sulfur containing fuels such as coal, diesel and heavy distillates.

**Volatile organic compounds (VOCs):** Organic chemicals that contain carbon. VOCs produce vapors at room temperature and normal atmospheric pressure. Volatile organic chemicals include gasoline, industrial chemicals such as benzene, solvents such as toluene and xylene, and tetrachloroethylene, perchloroethylene (a dry cleaning solvent). Many volatile organic chemicals, such as benzene, are also hazardous air pollutants.