Promoting Innovative Energy Technologies through Output-Based Emission Policies

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ABSTRACT

An array of innovative power technologies offers enormous potential to improve efficiency and enhance the environment. With a growing demand for electricity and the bulk of America's power plants at retirement age, the U.S. faces a unique opportunity to embrace policies that would reduce emissions and provide incentives for energy efficiency. The nation's current regulatory approach – using "input-based standards" – measures emissions based on unit of fuel input into a plant, but this method does nothing to reward efficient production. In contrast, the broad goal of output-based emission regulations is to link emissions to the final output of the process. An "output-based" approach rewards those energy generators that could produce the same amount of electricity or more while emitting fewer pollutants. Output-based measurements calculate emissions based on the amount of electricity generated, which can be represented in pounds of pollutant per megawatt hour. This paper details federal, state, and regional output-based initiatives. A variety of air quality policies stemming from electricity restructuring and clean air laws will be highlighted including multi-pollutant initiatives and distributed generation permitting programs. The results showcase innovative clean air strategies using output-based emission regulations that states and others are undertaking. Legislation and models highlighted can serve as templates for states looking for ways to address air quality issues in the power sector or in distributed generation.

Introduction

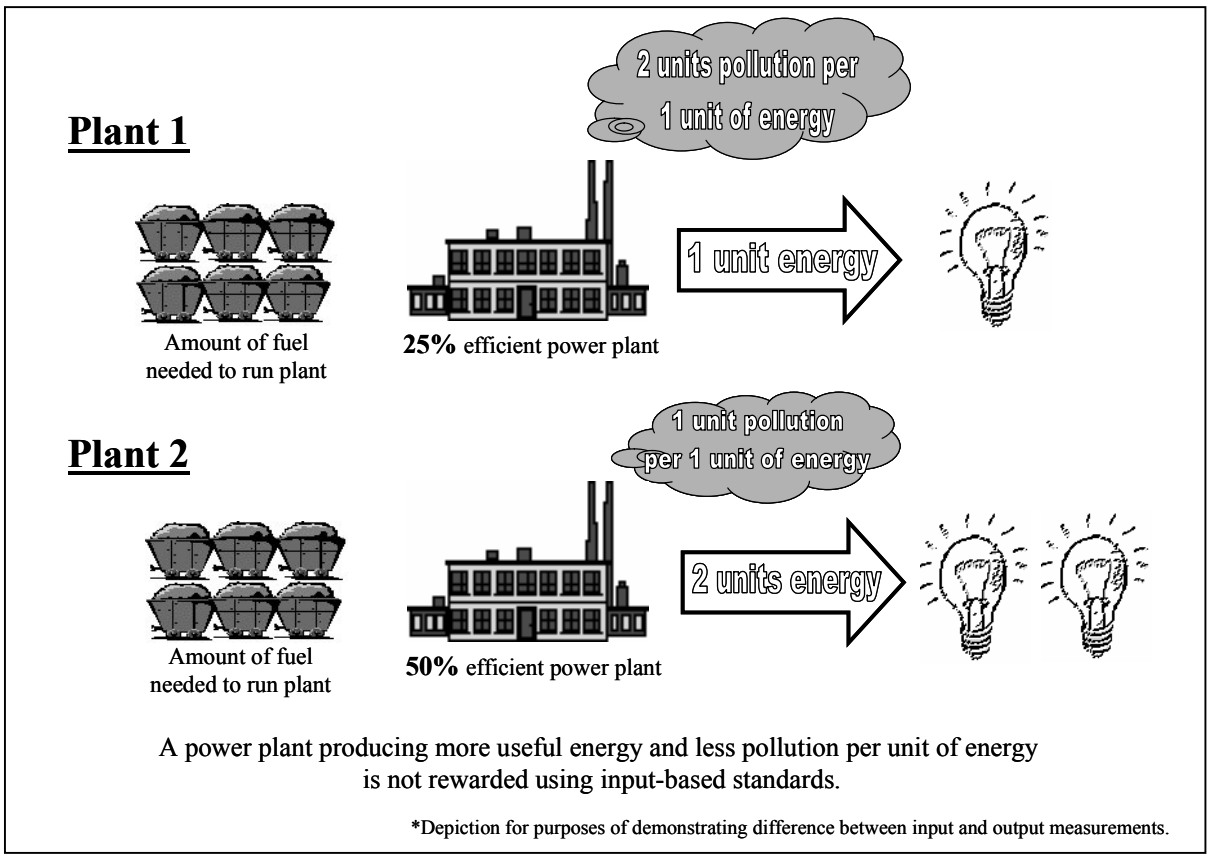
The United States needs a new means to regulate air pollution, one that will reward the more efficient operation of electricity-generating technologies and encourage the introduction of innovative energy processes like combined heat and power, wind, solar, and fuel cells. The nation's current regulatory approach – using "input-based emission standards" – measures emissions based on fuel inputs (measured in pounds of pollutants per BTU of fuel) into a plant. Unfortunately, this method pays no attention to how much electricity or heat is provided and it fails to recognize energy efficiency. Put another way, input-based standards provide no correlation between the amount of fuel used and the amount of electricity generated by that fuel. In contrast, an "output-based" approach (measured in pounds of pollutant per megawatt hour) would reward those generators producing the same amount or more energy while emitting fewer pollutants for that energy product. In an emissions trading scenario, electric generating technologies that are more efficient than the average would fair better under this approach, whereas inefficient plants fair better with an input-based method.

This paper is based on a larger report that investigated the air quality policies of twenty states, expanded on output-based policy initiatives, and highlighted how these initiatives might increase the deployment of more innovative energy systems, such as CHP.

The authors communicated with state air regulatory agencies in order to assess their actions and/or interest in output-based regulations. Special attention was given to Texas, California, and northeastern and midwestern states since most had adopted utility restructuring and seemed more willing to consider air pollution control alternatives. The authors also conducted a literature review on innovative emission standards and regulations, again focusing on output-based initiatives and market-based approaches. Highlighted models included multiple-pollutant programs, emission performance standards, and distributed generation permits. Different state, regional, and federal bodies use a variety of terms to represent output-based regulations including output-based standards, allowances or allocations, performance-based standards, and energy efficiency based standards. Such terms are also used in this paper to represent the variety of output-based approaches.

Figure 1 contrasts the two regulatory approaches by offering a conceptual picture of two power plants, both using the same amount of fuel. Because Plant 2 is more efficient, it is able to produce more electricity and emit fewer pollutants per unit of energy into the air. Most air regulations for power plants and self generation at industrial sites do not recognize this air quality benefit, while an output-based approach would.

Figure 1. Current Input-Based Regulation Does Not Recognize Efficiency & Lower Emissions



Source: Freedman & Watson 2003

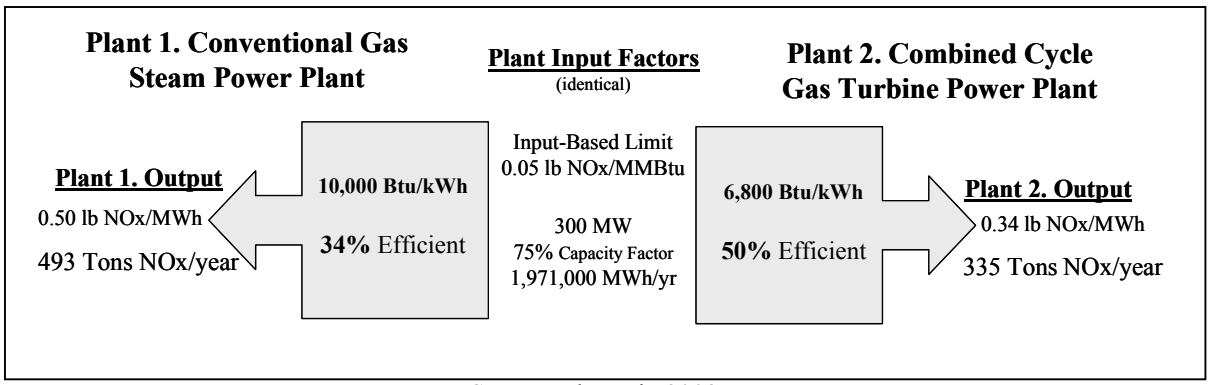
Figure 2 illustrates the relevance of output-based regulation. The figure provides a more detailed contrast of the regulatory approaches using data from two plants. It compares

two 300 MW power plants – Plant 1, a conventional gas steam plant at 34 percent efficiency and Plant 2, a combined cycle gas turbine plant at 50 percent efficiency.

- They both run at the same capacity factor and generate the same amount of electricity.
- They both have the same input-based emission factor of 0.05 lb NOx/MMBtu.

Because of the efficiency difference, however, the less efficient plant creates 493 tons of NOx per year while the more efficient one creates only 335 tons of NOx (Bluestein 2002). Regulations that measure emissions at the point of input do nothing to credit a facility for using energy more efficiently in production.

Figure 2. Output-Based Regulation Brings Attention to Energy Efficiency & Pollution Reductions



Source: Bluestein 2002

Although gains have been made in bringing more renewable energy sources to market, fossil fuels will remain the dominant energy source for our nation for a long time. The only way to mitigate the carbon dioxide emissions from fossil-powered generators is to use that fuel as efficiently as possible. Output-based standards—particularly as part of an emissions trading program or distributed generation permitting program—promote this ideal and could advance an array of innovative power technologies that offer enormous potential to improve efficiency and enhance the environment. One such technology, combined heat and power (CHP), allows for the productive use of much of the waste heat from electricity production, which accounts for about two-thirds of the energy used to generate electricity. With a growing demand for electricity and the bulk of America's power plants at retirement age, the U.S. faces a unique opportunity to clean the air. Unfortunately, CHP and other innovative technologies face environmental barriers. Only output-based measurements can capture the total efficiency provided from such a single source of fuel producing both electricity and thermal energy.

Output-Based Standards in the Environmental Permitting Strategy

An output-based approach may not be widely known but it is not a new concept. Such measurements already are used to limit emissions in other regulated sectors in the US. In the transportation sector, for instance, vehicle emissions are monitored on a grams-per-

mile basis. In September 1998, the EPA revised its New Source Performance Standards (NSPS) for utility and industrial boilers from a fuel-input to an electricity-output basis in order to regulate nitrogen oxide (NOx) emissions, including recognition for CHP. In a memorandum issued October 2001, EPA's Office of Air Quality Planning and Standards advanced the use of output-based standards for CHP systems in order to determine whether they constituted a "new source" under certain permitting conditions.

An output-based permitting approach falls in line with President Bush's goals for helping industry reduce criteria pollutant emissions under the Clean Air Act. In May 2001, the National Energy Plan (NEP) recommended the president direct the EPA administrator to promote CHP through flexibility in environmental permitting. EPA put forth draft output-based guidance for CHP in accordance with this recommendation. The NEP recognized that,

> A family of technologies known as combined heat and power (CHP) can achieve efficiencies of 80 percent or more. In addition to environmental benefits, CHP projects offer efficiency and cost savings in a variety of settings, including industrial boilers, energy systems, and small, building scale applications. At industrial facilities alone, there is potential for an additional 124,000 megawatts (MW) of efficient power from gas-fired CHP, which could result in annual emissions reductions of 614,000 tons of NOx emissions and 44 million tons of carbon equivalent. CHP is also one of a group of clean, highly reliable distributed energy technologies that reduce the amount of electricity lost in transmission while eliminating the need to construct expensive power lines to transmit power from large central power plants (National Energy Policy Development Group 2001).

Many organizations and manufacturers of cleaner technologies advocate a shift from current regulatory methods to an output-based approach. Such groups include the State and Territorial Air Pollution Program Administrators, Association of Local Air Pollution Control Officials (STAPPA/ALAPCO 1999), Ozone Transport Commission (OTC 2000), Pew Center on Climate Change, and U.S. Combined Heat and Power Association. The Pew Center on Global Climate Change in a July 2002 publication stated, "Other reforms to the Clean Air Act also could significantly affect the ability of new highly-efficient generation technologies to enter the market. For instance, air regulations that express limits on an output basis (e.g., pounds per kilowatt-hour, or lbs/kWh) as opposed to input basis (e.g., lbs/Btu of fuel) would encourage investment in new efficient plants" (Smith et al. 2002). Reasons for adopting output-based regulations have included:

- Creating a level playing field for all power generators,
- Recognizing energy efficiency,
- Improving air quality.

States most engaged in output-based regulations, under various approaches, include:

- Massachusetts through targeted multi-pollutant regulation, electricity restructuring legislation, and NOx State Implementation Plan (SIP);

- New Hampshire through targeted multi-pollutant legislation and general air quality policy;
- Connecticut through electricity restructuring legislation, NOx SIP, and New Source Review;
- Texas through output-based regulation for distributed generation permitting; and
- California through output-based regulation for distributed generation permitting.

Policy Framework

If output-based standards could encourage the installation of newer and cleaner generating systems, the obvious question is why they are not used more widely in the U.S. The answer is not simple, but part of it relates to simple inertia. For more than 50 years, the U.S. has employed a "central power paradigm" in which utility monopolies built large central power plants many miles away from urban centers. That paradigm made sense for several decades as larger power plants were more efficient, but by the late 1950s, the electricity industry was operating at only a 33 percent efficiency level, meaning that for every three units of burned fuel only one unit of useful energy was obtained. This dismal efficiency average has yet to improve. Aspects of the Clean Air Act have also unintentionally acted as a hindrance to promoting efficiency.

Electricity Restructuring

Electricity industry restructuring has created an impetus to review how the emissions from power generators are regulated. With the potential of increased competition from a variety of power sources in the wholesale and retail electricity markets, the options for regulating air pollution from a host of sources must be reviewed.

Although restructuring is moving in fits and starts, due largely to the calamitous events experienced in California's energy markets, the process continues in many states with more or less successful results. Electric utilities have remained the nation's last holdout monopoly. The lack of competition has retarded innovation, as evidenced by the utility industry's stagnant efficiency. The growing awareness of waste within today's electricity system has prompted a new round of energy debates. Americans, according to some estimates, pay roughly $100 billion too much each year for heat and power (Munson 2002).

The process of restructuring this industry actually began in the late 1970s, in the midst of concerns about petroleum supplies. Congress in 1978 approved the Public Utilities Regulatory Policies Act (PURPA) in order to advance energy efficiency. The little-noticed Section 210 of that law created the first competitive crack in the utility industry's monopoly structure. For the previous several decades, power companies had enjoyed complete freedom from competition in their service territories in exchange for regulatory oversight by state commissions.

PURPA opened the door for the first time in several decades to the generation of electricity by power plants not controlled by utility monopolies. The legislation required utilities to purchase the extra electricity from qualifying cogenerators and renewable facilities at a cost equal to that utilities' avoided cost of new capacity additions. PURPA spurred the construction of wind farms and combined heat and power units. By the late-1980s, non-utility, independent power producers, many as large as 400 MWs, were entering the

marketplace (Bloomquist, Nimmons & Spurr 2001). These large generators did not qualify to take advantage of the PURPA provisions, but their cheaper electricity production encouraged policymakers to believe that greater competition in the marketplace could reduce electricity prices to consumers.

The Energy Policy Act (EPAct) of 1992 tried to remove barriers to increasing competition in the electric power sector. While PURPA moved regulatory authority toward the Federal Energy Regulatory Commission, especially at the transmission and wholesale level, EPAct further encouraged the use of a market-based approach to electricity generation and advanced a customer's ability to choose his or her power supplier (Abel & Parker 2001).

Since the mid-nineties, 24 states and the District of Columbia have either enacted utility restructuring legislation or have issued regulatory orders to implement retail access. Texas has gone to actual retail competition with some success, while California is in full retreat and has suspended its restructuring process for the foreseeable future. Several of the restructured states are developing output-based initiatives. Restructuring legislation in Massachusetts, New Jersey, and Connecticut called for the development of output-based (performance-based) standards for retail electricity suppliers if certain criteria are met. Massachusetts and New Hampshire also have set output-based regulations targeting emissions reductions from their dirtiest power plants. Texas, one of the first states to adopt full retail competition, has created a permit system for distributed generation systems on an output basis that also allows credit for recovered heat in CHP.

Clean Air Act

The Clean Air Act, approved in 1970 and amended in 1977 and 1990, regulates air emissions from the nation's central power plants. At least two provisions of the law inhibit the development of innovative and efficient electricity technologies. One is a "grandfather clause" under New Source Review that allows less efficient plants – those built prior to 1977 – to avoid the costs associated with more stringent environmental regulation and permitting. As a result, new facilities – even those that are significantly more efficient – are required to absorb the bulk of the required emission reductions. Although upgrades at grandfathered plants have occurred, few have been characterized as "significant modifications" that would require the plant to face stricter clean air rules. (That issue, however, sparked several pending lawsuits.) Regarding the second barrier, since emissions are regulated on the basis of fuel inputs, power companies usually try to reduce emissions at the "end of the pipe" by installing pollution control equipment. That equipment, however, increases a plant's costs and further lowers its efficiency.

The Clean Air Act gives EPA the authority to protect ambient air quality. It also requires pollution sources to obtain permits, managed at the state level through individual state implementation plans (SIPs). The extensive state-by-state permitting system regulates energy-generating technologies, largely systems over one megawatt (1 MW) in size and considered "major sources."

The EPA also designates National Ambient Air Quality Standards for certain pollutants. Primary standards set limits to protect public health, while secondary standards set limits to protect public welfare and prevent environmental and property damage. A geographic area that meets or does better than the primary standard is called an attainment

area; areas that do not meet the primary standard are called nonattainment areas. Again, SIPs are required to detail the steps states will take to achieve national air quality goals.

The Clean Air Act also established New Source Review (NSR), the air pollution control program under which most new electric generation sources fall. In non-attainment areas, NSR requires pollution control technologies to achieve the lowest achievable emissions rate, as well as emission reductions to offset any increases. As stated earlier, plants built before 1977 were exempted from strict air pollution restrictions; these were "grandfathered" under NSR. Congress included the exemption with the expectation that these electricity and boiler plants would soon be retired. Yet such expectations have not been realized, and these older units continue to spew a disproportionate amount of pollutants into our air.

EPA established a NOx Budget Trading Program that requires certain states, primarily in the Northeast and Mid-Atlantic, to address stricter ground-level ozone and regional haze problems. In May 2000, the EPA released a guidance document for states joining the NOx Budget Trading Program under the NOx SIP Call (Environmental Protection Agency 2000). That document assists states in determining whether to use output-based NOx allocations for their SIPs. The guidance describes options for developing NOx allowance allocations for power plants, industrial boilers, and turbines using electric and thermal output. It also provides sample regulatory language for state environmental agencies to use. Some states have followed this guidance and adopted output-based standards for their NOx Budget Programs.

A Shift to Output-Based Regulations in Air Policy

Various federal, state, and regional agencies have adopted, or are proposing, output-based initiatives. These efforts have been made under a variety of air quality policies: multi-pollutant programs, distributed generation permitting programs, new source review, emissions performance standards for power plants, and the NOx Budget Program.

Although these initiatives and models vary in their applications and the factors they employ, each suggests that output-based regulations are the preferred way to recognize a power facility's energy efficiency and better address air emissions. Some models and state initiatives see output-based regulations as a way to level the playing field among all fossil-fuel-burning power generators, old and new. Output-based allocations in multiple pollutant programs also can inherently showcase zero-emissions power supplies, such as wind, hydrogen, solar, and other renewable resources.

Multi-Pollutant Strategies and Output-Based Allocations

There are many components to multi-pollutant legislation and programs—which are intended to limit emissions from power plants or other large generators. Generally three or four pollutants are covered—carbon dioxide being the wild card—and emissions ceilings or "caps" are set and made stricter over time to reduce emissions. Another component to "multi-pollutant" programs is the way in which emissions credits are allocated. Output-based emission allocations would create incentives for energy efficient and low or zero-emitting processes.

At the state level, New Hampshire and Massachusetts have output-based standards for targeted multi-pollutant programs. The state of New Jersey has called for output-based, multi-pollutant reductions from one utility's power plants stemming from an enforcement decision on new source review violations.

Massachusetts enacted Regulation 310 CMR 7.29, "Emissions Standards for Power Plants,"—a regulation that targets the five oldest and least efficient power plants in state. The goal is to reduce emissions from its most polluting power plants. It requires reductions of NOx, SO2, CO2, and mercury beginning as early as 2004. This is accomplished by establishing output-based emission rates for NOx, SO2, and CO2 and establishing an emissions cap on CO2 and Hg emissions from affected facilities. A summary of the standards, compliance paths, and dates are in Table 1.

Table 1. Massachusetts Power Plant Clean Up Standards

Pollutant	Emission Standard	Standard Pathway Compliance Dates	Repowering Pathway Compliance Dates
NOx	1.5 lbs/MWh	October 1, 2004	October 1, 2006
SO2	6.0 lbs/MWh	October 1, 2004	October 1, 2006
SO2	3.0 lbs/MWh	October 1, 2006	October 1, 2008
CO2	1800 lbs/MWh annual avg.	October 1, 2006	October 1, 2008

Source: Kwetz 2002

The Massachusetts regulation defines "output-based emission rate" as an emission rate for any pollutant, expressed in terms of actual emissions in pounds over a specified time period per megawatt-hour of net electrical output produced over the same time period. "Output-based emission standard" is defined as the emission standards for each applicable pollutant, expressed in terms of pounds of pollutant emitted per megawatt-hour of net electrical output produced.

Similarly, New Hampshire has enacted output-based standards targeting four pollutants from the state's highest-polluting power plants. In January 2001, it released the "Clean Power Strategy," calling for emissions caps based on electricity output for all large electrical generating facilities in the state; put another way, it does not "grandfather" any existing power plant. The Clean Power Act, House Bill 284, was signed into law in May 2002, and became effective July 2002. The law requires emissions reductions in SO2, NOx, CO2, and mercury. Section 125-O:3 states that the multi-pollutant strategy be implemented in a market-based fashion allowing trading and banking of emission reductions to comply with a statewide annual emission caps. It also declares that allowances be allocated to each affected source based on output. In general and to the extent it can, New Hampshire tries to regulate all air emissions on an output basis and is currently updating many of its regulations to reflect this approach (Bodnarik 2002).

At the federal level, Congress has begun a new round of debates on the Clean Air Act. Several bills addressing multiple pollutants ("multi-pollutant" bills) were introduced in the 107th Congress, one of which called for emissions to be measured on an output basis. The proposals differed markedly. For much of the 107th session, attention focused on the contrast between a four-pollutant bill from Senator James Jeffords, then chairman of the Environment and Public Works Committee, and the Bush Administration's "Clear Skies" initiative, a three-pollutant proposal introduced by Senator Bob Smith in the Senate and

Representative Joe Barton in the House. Senator Thomas Carper in October 2002 introduced a third "multi-pollutant" bill to bridge the gap between the Jeffords and administration proposals. While both the Jeffords and Carper bills would regulate carbon dioxide, the most harmful of the greenhouse gases, the Carper bill regulates most pollutants on an output basis while the Jeffords legislation considers this as one method but does not commit to a methodology. The Clear Skies proposal does not regulate carbon dioxide, and it does not regulate emissions on a performance basis that could improve air quality.

Although EPA has been moving toward output-based standards, even adopting them for utility boilers in NSPS and providing guidance for nitrogen oxide allocations in a regional trading program, the Clear Skies Initiative discourages innovation by providing generous pollution allowances to dirty and inefficient generators, while handicapping clean and efficient facilities. Needed instead is an updated output-based allocation system that encourages lower emissions and higher efficiency. Clear Skies has already been reintroduced in the 108th Congress and the other multi-pollutant bills are expected to follow. The Carper bill, with bipartisan support, could be where compromise is found, although it is too early to tell the fate of these bills, the output-based allocation component, or of CO2 restrictions.

Distributed Generation (DG) Permits and CHP

While an output-based approach recognizes energy-efficiency, this approach could still be a barrier to combined heat and power systems if the added value from producing both thermal and electric energy is not accurately credited. Since a CHP system provides thermal energy, it can avoid the need for (or displace) a separate stand-alone boiler that has its own fuel demands and pollution. Unless special guidance recognizes and accounts for a CHP system's added efficiency, the output-based policy will not be fully effective, nor truly reflect the market value of CHP, thereby stifling investment in highly-efficient, reliable, and low-emitting power technologies.

At the state level, Texas' and California's output-based distributed generation programs are noteworthy. The Texas Commission on Environmental Quality[1] established a standard air-emissions permit for NOx from distributed generation to encourage the most energy-efficient configurations, such as CHP. The Air Quality Standard Permit for Electric Generating Units (EGU), Texas Administrative Code (TAC) Rule 106.511, is a standard permit designed to be an expedited method of authorizing clean electric generating units. The permit, issued under Texas Clean Air Act's Health & Safety Code Sections 382.011 also establishes pre-certification requirements for a power system.

The Texas DG permit applies to all electric generating units that emit air contaminants, regardless of size and reflects the best available control technology for electric generating units on an output basis in pounds of NOx per megawatt hour, adjusted to reflect a simple cycle power plant. For this air quality permit, the state has been divided into two regions – East Texas and West Texas – in order to address ozone nonattainment problem in the East Texas region. The permit gives credit to CHP units for producing two useful energy outputs. To meet the emission standards, CHP units may take credit for useful thermal output at the rate of one megawatt-hour for each 3.4 million BTUs of heat recovered. If a CHP unit is not pre-certified by the manufacturer, the owner or operator may submit documentation of

[1] The Texas Commission on Environmental Quality was known as the Texas Natural Resources Conservation Commission before September 2002.

the system to receive a CHP credit. The CHP credit is designed to encourage users to install and use CHP in order to improve the efficiency of generating units where there is a valid need for the recovered heat.

The California Air Resources Board (CARB) established a DG certification program using output-based emissions standards for NOx, CO, VOCs, and particulate matter. The regulation went into effect on October 4, 2002, and applies to DG units that had otherwise been exempt from air pollution control requirements. CARB set emissions standards for 2003 and 2007, and offered limits for units with and without CHP. In 2005, CARB will produce a technical review of the DG technologies and emissions criteria to determine if any modifications to its certification standards are necessary. The air quality benefits of CHP applications were given special consideration: the guidance states that "efficient" CHP systems will receive an emissions credit for thermal output. Efficient CHP applications must maintain a minimum efficiency of 60 percent in the conversion of the energy in the fossil fuel to electricity and process heat.

Nongovernmental organizations have also developed output-based models for distributed generators. An October 2001 report by the American Council for an Energy-Efficient Economy, the Natural Resources Defense Council, and the Center for Clean Air Policy endorsed output-based regulation in order to encourage energy-efficient power technologies and to reflect the air quality benefits of CHP (Shipley et al. 2001). The report provided a model for certifying CHP systems that recognized the emissions produced in relation to the two usable energy products generated – thermal and electric.

The Regulatory Assistance Project (RAP) in October 2002 released a final-review-draft model emissions rule[2] for distributed generators. RAP is a non-profit organization, committed to fostering a restructuring of the electric industry in a manner that creates economic efficiency, protects environmental quality, assures system reliability, and applies the benefits of increased competition fairly to all customers. RAP's draft model DG rule contains output-based emissions standards in pounds per megawatt-hour for NOx, particulate matter, CO, and CO2 for power generating units too small to trigger new source review.

The Ozone Transport Commission (OTC) released a report and draft model rule to streamline environmental permitting for small-scale distributed generators in March 2001. In order to foster low-emitting distributed generation technologies and limit the growth of high-emitting sources, OTC proposed that states could ease permit requirements for clean technologies while ensuring that high-emitting diesel engines receive careful review. Low-emitting sources would not need permits unless the units exceeded a given size threshold. The permit emissions thresholds would be reviewed within three years.

The U.S. Combined Heat and Power Association (USCHPA) is a proponent of shifting air quality regulations from input- to output-based measurements. It is a non-profit association formed to promote the merits of CHP and achieve public policy support. USCHPA argues that air regulations should recognize and credit CHP systems for their increased efficiency and reduced emissions. The National CHP Roadmap identifies environmental permitting as one of the top barriers to siting more of these highly-efficient systems and recognizes the adoption of output-based standards as a solution. The Roadmap Action Agenda calls for the development of output-based emissions standards by working

[2] The rule "applies to all non-mobile generators that are not subject to major source review under the Clean Air Act, 40 CFR 51" installed on or after the rule's effective date.

with EPA in the analysis of alternative technical approaches, development of guidance to state and local air quality officials, and the offering of technical assistance (USCHPA 2001).

Conclusion

Within the United States, a slight shift can be seen towards output-based approaches to regulate air emissions from electric and thermal generation technologies. Output-based emission regulations are being recognized at the state and federal levels, as well as in models developed by regional organizations and environmental groups. Such standards:

- Create a level playing field for all power generators regardless of plant age or geographic location;
- Address multiple pollutants in one policy or regulation;
- Provide incentives for energy efficiency by linking air emissions to the end energy product; and
- Protect air quality.

The sooner the U.S. adopts output-based emission regulations, the sooner the nation will see innovative energy-efficient technologies improve our air quality and enhance our economic trading position internationally. This change in emissions measurement may occur slowly since owners of inefficient power generation plants realize that they will be disadvantaged by a change in the status quo, yet such a change would increase the energy industry's efficiency and reduce pollution.

The movement toward output-based regulations will continue as consumers learn more about how electricity generation affects the environment. Tracking emissions per megawatt or kilowatt-hour is a logical next step in monitoring air quality. Adoption of output-based regulations also will reward and encourage the businesses bringing innovative technologies into the marketplace.

Since the use of output-based regulations is still relatively new, much educational outreach to state air regulators, the federal government and other stakeholders needs to be done. States need to learn from each other how best to integrate those measures into future emissions-permitting and in determining allocations in multi-pollutant programs. Federal direction also will be needed. Regulations must reflect the environmental benefits of more energy-efficient, cleaner technologies. The marketplace is ready for this change. Policymakers must change the means of regulating air emissions if the nation is to enjoy the benefits of innovative energy systems.

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