Who's Cleaning up the Mess?
Allocating Emissions Reductions in the Metropolitan Washington Region

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EXECUTIVE SUMMARY

The Metropolitan Washington region, comprised of the District of Columbia and portions of Maryland and Virginia, has been designated a severe ozone nonattainment area by the Environmental Protection Agency (EPA).[1] To comply with EPA requirements, the region must decide on and implement measures to reduce ozone precursor emissions by nine percent every three years until it reaches attainment. The process for making these decisions is crucial to their implementation and hence to complying with federal regulations.

The region currently relies on a multijurisdictional committee and metropolitan planning organization to develop measures for emissions reductions and a plan for their implementation. Questions of effectiveness and equity in reductions allocations led us to consider the current process and two alternatives — a multijurisdictional structure devolving responsibility to counties and one involving no formal regional coordination. We evaluated these with respect to feasibility, adequacy, accountability, and equity.

Because equity is a subjective criterion, we attempted to quantify some aspects to better evaluate the fairness of emissions allocations under each alternative. We propose a methodology that we believe redistributes nitrogen oxide and volatile organic compound emissions inventories and reduction allocations to more accurately reflect who is responsible for emitting and thus reducing.

[1] Where "Washington region" is used, it refers to the Metropolitan Washington region. Further, the District of Columbia is considered a state for the purposes of the state implementation plan process and hence for this paper.

Our analysis leads us to conclude that incorporating our proposed methodology into the county accountability alternative, allows for greatest equity and most effective distribution of responsibility.

INTRODUCTION

The Environmental Protection Agency (EPA) currently requires states to attain minimum standards of air quality, National Ambient Air Quality Standards (NAAQS), for six criteria pollutants: particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and ozone. The emissions that yield these pollutants are produced by five types of sources: stationary (point), area (e.g., small industries or consumer products and activities), onroad mobile, nonroad mobile, and biogenic (naturally occurring) emissions sources.[2]

The area represented by the Washington D.C. Metropolitan Statistical Area (MSA), which encompasses portions of Virginia and Maryland and the entirety of the District of Columbia, is in nonattainment for the one-hour ozone standard. As nitrogen oxides (NO_x) and volatile organic compounds (VOC) are the precursors to ozone, reductions of these pollutants will enable the region to reach attainment of the standard. The area must comply with the standard by November 2005 or face loss of federal funding for transportation and air quality projects and the imposition of a federal implementation plan. Each of the region's three jurisdictions (the District of Columbia,

[2] More detailed information on the source types can be found in Chapter 3 of the Severe Area SIP of the Metropolitan Washington Nonattainment Area. Because biogenic emissions are not considered for reductions in the current SIP, we do not consider them in this paper.

Maryland, and Virginia) must submit to EPA a State Implementation Plan (SIP) that outlines the process and procedures that will enable the region to reach attainment.

The SIP requires the establishment of guidelines for achieving attainment and assigns responsibility for the implementation of measures to meet those guidelines. This is done through the calculation of target emissions inventories, which project the maximum amount of emissions that can be produced and still enable the area to meet attainment by the specified deadline. Once target levels are established for the area, the measures for reducing emissions to those levels are selected and then implemented throughout the region.

The Washington region's plan is developed through a coordinated process of consensus among the jurisdictions that also incorporates conformity with regional transportation planning. This paper examines the existing governance structure related to emissions allocations in the multijurisdictional D.C. area, and evaluates it according to the following four criteria: feasibility, adequacy, accountability, and equity. We also use the same criteria to analyze two alternative governance structures: a system in which counties are held accountable and one in which there is no formal regional coordination among the jurisdictions.

Because equity is a subjective criterion, we attempted to quantify some aspects to better evaluate the fairness of emissions allocations under each alternative. We propose a methodology that redistributes NO_x and VOC emissions inventories and reduction allocations to more accurately reflect who is responsible for emitting and thus reducing. We include the calculations based on the distributive methodology in our analysis of

the governance alternatives to determine the most accurate accounting of emissions and subsequently determine the best governance alternative for reaching attainment.

The need for this research and analysis is simple: the Washington region is currently in nonattainment for ozone, a pollutant with serious environmental and human health effects. As governance systems are the means through which air pollution problems are addressed, determining how best to bring the region into attainment requires an examination of governance systems that fit within the existing legislative and regulatory frameworks. Our aim is to identify the governance system and emissions allocation methodology that is the strongest, i.e. the most adequate, feasible, equitable, and that requires participants to be held accountable.

Emissions allocations are currently determined by monitoring in each of the region's counties — emissions registering in a given county are assigned to that county. We argue that this method of allocation misrepresents responsibility for certain types of emissions. We detail the factors involved in accurate representation in the Analysis section of this paper.

Our evaluation of the three alternatives reveals the strengths and weaknesses of each. Based on this assessment, we recommend that the region adopt the county accountability alternative. This alternative maintains the current regional coordination structure and state SIP reporting process. Applying our proposed methodology to this alternative assigns each county a new allocation of actual emissions and a reductions target that better reflects responsibility for emissions producing activities.

BACKGROUND

Legislative History

The framework for the multijurisdictional aspects of today's air quality planning process was laid in the 1960s and 70s. The Clean Air Act of 1963 was the first legislation to require that states establish emissions standards for stationary sources of air pollution. This Act was modified throughout the 1960s to strengthen existing standards and set additional standards for auto emissions. The Air Quality Act of 1967 assigned states the responsibility of issuing and implementing air quality standards. This Act required the establishment of air quality control regions, or "any interstate area or major intrastate area that EPA deems necessary or appropriate for the attainment and maintenance of ambient air quality standards."[3] However, by 1970 fewer than three dozen air quality regions had been designated.

The Clean Air Act of 1970 addressed this public health concern by requiring that EPA set NAAQS to limit quantities of particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, and ozone. Air found to have concentrations of a pollutant higher than the NAAQS was considered in exceedance, or nonattainment, of the standard. Regions within each state were designated as nonattainment, attainment, or unclassifiable based on whether or not that region met the NAAQS. An ozone nonattainment area located within an MSA as established by the U.S. Census Bureau

[3] Clean Air Act, Title 42, Chapter 85, Subchapter I, Part A, Section 7407; 40 CFR part 107.

was required to adopt the MSA boundaries as its own, most often incorporating additional counties into the nonattainment area.[4]

Ozone nonattainment areas were progressively classified as marginal, moderate, serious, severe, or extreme based on the degree of exceedance; each classification included a set of requirements an area would have to meet to comply with EPA regulations. States were given primary responsibility for adopting and enforcing pollution control standards within nonattainment regions and were required to develop and submit SIPs to demonstrate their compliance strategies.

Congress passed major Clean Air Act amendments in 1990, providing for interstate commissions on air pollution control to develop regional strategies for addressing air pollution, and requiring nonattainment areas to reduce emissions by certain "rate of progress" (ROP) percentages in accordance with their classification.

Preparation of a SIP

Developing a SIP is essentially a two-step process: (1) determining target emissions inventories for point, area, and mobile sources, and (2) deciding on control measures to be implemented to reach those target levels by the required deadline.

Emissions inventories, or levels, for each pollutant are calculated by applying a number of growth factors to baseline emissions levels measured in 1990 and adjusting for regulatory changes made in the intervening years. Target inventories are then set by determining the amount of reductions necessary to meet EPA's ROP requirement.

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[4] Clean Air Act, Title 42, Chapter 85, Subchapter I, Part A, Section 7407; 40 CFR part 107.

Calculating target levels for the various source types requires identifying the appropriate emissions thresholds, examining available technologies, and incorporating factors such as population data, home-to-work travel trends, and land use patterns to develop a reliable model.

Every three years, regions must demonstrate a plan for meeting the minimum reductions, either in an ROP plan or by including ROP demonstrations in the SIP as it is revised. A region's ROP percentage is determined by its emissions classification; severe status requires that emissions be reduced by an average of three percent per year, for a total of at least nine percent over a three-year period.[5]

Regions use the SIP process to select control measures — regulatory steps, taxes, transportation plans, or other means — that they believe will reduce the relevant emissions to target levels. The measures to be implemented are itemized in the SIP; their totals must bring the projected emissions levels for the region to within EPA guidelines.

States are responsible for submitting SIPs to EPA. However, metropolitan areas often cover more than one state. In the case of a multi-state nonattainment area such as the Washington region, Section 174 of the Clean Air Act states that the affected states may "jointly, through interstate compact or otherwise, undertake and implement all or part of the planning procedures" for reviewing or updating the SIP.

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[5] This background focuses on severe status as this is the category under which the D.C. region is classified. Specific requirements for each category of nonattainment — marginal, moderate, serious, severe, and extreme — are defined in Section 182 of the Clean Air Act (*Federal Register* Vol. 68, No. 16, January 24, 2003, pp. 3410 – 3425).

Attainment in the Metropolitan Washington Region

The National Capital Interstate Air Quality Control Region was one of the few control regions to be established in the early 1970s. Following the passage of the 1990 Clean Air Act Amendments, the chief elected officials of Maryland, Virginia, and the District of Columbia certified the Metropolitan Washington Air Quality Committee (MWAQC) to develop recommendations for the region's attainment plan. MWAQC is primarily made up of elected state and local officials from around the region and operates within the Metropolitan Washington Council of Governments (MWCOG), the metropolitan planning organization (MPO) for the Washington region (see Appendix A). The committee also includes representatives from D.C.'s Department of Health, Maryland's Department of Environment, and Virginia's Department of Environmental Quality.

In 1990, EPA classified the Washington region as an ozone nonattainment area because the region's air during the summer exceeds EPA's maximum allowable quantity of ground-level ozone during a given hour (the one-hour ozone standard). The region did not meet its original fifteen percent reduction deadline of November 15, 1999, primarily due to pollution transported from outside the region.[6] EPA extended the region's deadline to November 2005. However, EPA's decision was overturned through litigation, requiring the agency to declare in January 2003 that the region did not attain the 1999 standard, and forcing a change in the region's classification from

[6] Section 1.4 of the SIP indicates that transported pollution "contributed to 20-30 percent of the pollution on the worst days of summer."

"serious" to the more stringent "severe" nonattainment status. The reclassification required MWAQC to prepare a new Severe Area SIP.

The Severe Area SIP, the plan to demonstrate that progress is being made and that the region will attain the one-hour ozone standard by November 2005, is due to EPA on March 1, 2004. To meet the severe nonattainment area requirements, the region must demonstrate a three percent ROP from 1999-2002 and from 2002-2005 (in addition to meeting the initial fifteen percent reduction by 1999), revise its motor vehicle emissions budgets based on the newly released model (MOBILE6), submit reasonably available control measures, and adopt contingency measures in the event that the region fails to meet the ROP requirements. The region must comply by November 2005 or face loss of federal funding for transportation and air quality projects and the imposition of a federal implementation plan.

ROLE OF ANALYSIS IN BROADER SCHEME

Five of the United States' ten most populous MSAs straddle state boundaries.[7] As urban centers expand, multijurisdictional governance and the assignment of responsibility for regional problems are of increasing concern to governments and citizens. While states and counties maintain their geographical borders, individual legislatures, and taxing structures, they become ever more intertwined.

[7] United States Census Bureau, 1998.

This type of relationship is clear in the environmental arena — pollution found in the natural environment does not recognize political distinctions, leaving, for example, both Kansas and Missouri responsible for the quality of Kansas City's air.

This is the philosophy behind MPOs and SIPs — that an urban area must consider itself a single entity in terms of planning and environmental effects. However, since most urban areas are not single entities in the political sense, this process usually involves a good amount of negotiation, compromise, and sometimes tension. In looking at the question of emission reductions allocation, we examine the methods by which multijurisdictional issues are addressed and resolved.

ANALYSIS

Nonattainment areas must have a process for achieving attainment and assigning responsibility for implementing reductions. A poorly designed governance structure will be less likely to succeed in its aims than one that is well-planned. Moreover, in the case of the multijurisdictional Washington area, an allocations process that lacks a sense of equity is unlikely to be successful, since jurisdictions that feel distribution is inequitable may be less inclined to undertake reductions.

Limits of Our Analysis

EPA regulations prescribe many of the aspects of the SIP and allocation processes. Because this paper focuses on the governance structure of the Washington region, we chose to examine only alternatives that fit within the existing federal

regulatory framework. Although this restricts our pool of possible alternatives, we felt that recommendations for altering the regional governance structure presented a more feasible goal than would changes to EPA regulations. The three alternatives we discuss below explore the flexibility within the current regulatory limits.

Criteria for Evaluation

The following criteria were used to judge the three alternatives:

- **Feasibility.** The process of allocating reductions should be clear and easily implemented. Jurisdictions should not face illogical resource constraints. Do jurisdictions have sufficient funding, authority, and employees to staff the proposed structure?
- **Adequacy.** The structure should present an efficient method for meeting attainment requirements and deadlines. It should be comprehensive and provide for total reductions sufficient to bring the area into compliance. Is there a method for ensuring that efforts in separate jurisdictions do not hinder one another's contribution?
- **Accountability.** Jurisdictions should be responsible for planning their reductions and be held accountable for their implementation. What penalties does a jurisdiction face if it does not reduce emissions by its agreed-upon amount? What, if any, are the resulting repercussions for other jurisdictions?
- **Equity.** Participants should feel that the process is fair. A sense of fairness in the proposed structure is likely to lead to improved implementation and hence the

increased likelihood of attaining compliance. By contrast, a jurisdiction that feels it is treated unfairly in the process is likely to be reluctant to implement the reductions demanded of it.

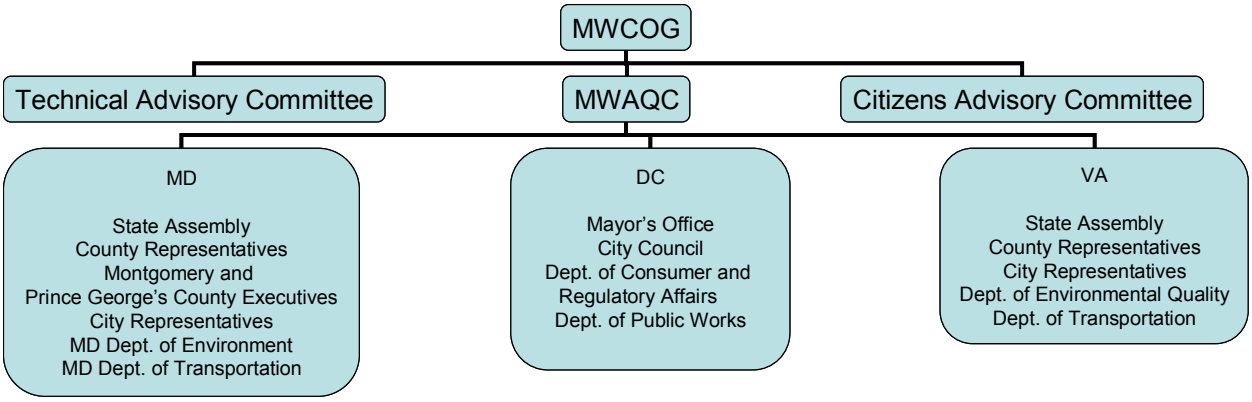
The distribution of allocations need not be equal across jurisdictions to be considered fair, but should have an underlying and transparent rationale condoned by those involved. Some jurisdictions may agree that equity involves equal amounts of reductions, while others may find equal percentage of reductions to be fair. The nature of this criterion makes it the most subjective. To add a quantitative aspect to equity, we looked at the distribution of current emissions and reductions allocations and asked ourselves the following three questions:

- Whose actions result in emissions?
- Who benefits from those actions?
- Who is responsible for reducing?

A discussion of our methodology for addressing the issues raised by these questions is included at the end of the Analysis section of this paper.

Alternatives

1. Current Situation: Cooperative Planning



The Washington region currently has a highly cooperative planning process; Maryland, Virginia, and the District of Columbia jointly prepare the region's SIP through the representative committee, MWAQC. Input is provided by MWCOG's Technical Advisory Committee, the relevant state agencies, and a citizens' advisory committee. MWAQC chooses the control measures and finalizes the regional SIP through consensus. The finalized regional SIP is forwarded to the appropriate air agencies in D.C., Maryland, and Virginia, which independently submit their copies of the SIP to EPA (Region III).

The submitted SIP includes the recommendations from MWAQC, a letter of commitment, and the state's schedules for the adoption of the control measures for reaching attainment. Following submittal of the SIP and the control measures for making the ROP, each jurisdiction is subject to EPA review of its individual ability to

meet the relevant reduction requirement. Each state then adopts the procedures and control measures relevant to that state via its state-specific regulatory or legislative process. EPA imposes sanctions if a state fails to submit a SIP, if the SIP submitted is inadequate for meeting the designated air quality measure, or if a state fails to enforce the control strategies outlined in the SIP.

MWAQC'S CRITERIA FOR EVALUATING CONTROL MEASURES

- Will reduce emissions by the start of the Washington region's 2004 ozone season (5/1/04)
- Are enforceable
- Are technically feasible
- Are economically feasible
- Defined as a cost of $10,000 to $20,000 per ton or less
- Would not create substantial or widespread adverse effects within the region
- Exceed a *de minimis* threshold (0.1 tons per day)
- Reduce the region's ozone levels to 124 parts per billion by 2004
- Potential for intensive and costly implementation

(Source: Metropolitan Washington Severe Area SIP)

Only those areas of Maryland and Virginia contained within the D.C. nonattainment area (Appendix A) are subject to the ROP reduction requirements and the corresponding control measures. To make the ROP, each of the three jurisdictions must reduce their own baseline emissions by an average of three percent per year for a total of nine percent every three years until attainment is reached. They do so by selecting a number of control measures whose estimated emissions reductions sum to the desired total for each jurisdiction.

MWAQC selects the region's control measures by consensus, with technical advice and stakeholder input from MWCOG committees. In response to EPA guidance and a 2002 court decision (*Sierra Club v. EPA*), MWAQC developed a set of criteria for evaluating control measures (see box).

Adopting control measures requires various types of coordination. Some control measures require cooperation between the region and private industry. Input also is required from non-profit organizations, interest groups, and planning associations. MWCOG's Air Quality Public Advisory Committee is comprised of representatives from these various groups.

Control measures included in the SIP must be adopted by each state legislature. These measures are implemented across the region (this practice is referred to within MWAQC as "regulatory equity"), although sometimes there are slight discrepancies. EPA's regulations also provide for voluntary measures that may be implemented by subjurisdictions such as counties or independent cities. These measures receive SIP credit towards emissions reductions, but need only be adopted in a single subjurisdiction.

Feasibility. The current regional consensus structure of the D.C. nonattainment area is clearly feasible. Transportation coordination for the region already occurs through MWCOG; consequently, the framework for air quality coordination through MWAQC already exists. The region is relatively compact and the representatives from each jurisdiction are geographically close. As a result, arranging regular meetings at a central location is fairly easy.

There are several factors that might prevent the consensus approach from functioning smoothly. Conflicting personalities, for example, among the representative members could slow, if not prevent, consensus. There is additional potential for conflict

when jurisdictions have different political interests; MWAQC addresses this through representation of the various interests on its technical and public advisory committees.

Finally, there are bureaucratic differences among the jurisdictions. Once MWAQC agrees to adopt certain control measures, those measures must be approved individually by each state's legislative or regulatory process. These processes are unique to each state and have different timeframes. The Virginia legislature, for example, is sometimes reluctant to implement an MWAQC control measure across its entire state when the control measure is only necessary in the portion of Virginia that is part of the nonattainment region. The absence of simultaneous implementation may prevent the achievement of regional benefits.

Adequacy. Because the Washington region has failed to reach attainment, the current system appears to be inadequate. However, MWAQC attributes this failure to transported ozone. We discuss this in our conclusion, because we believe it to be important but external to the governance process in the Washington region. Further, we believe this problem would apply to and similarly affect each of the three alternatives. We believe the current governance structure itself to be adequate.

Regional growth factors (e.g. housing, land use, population) are incorporated into the target inventories, which helps to ensure that air quality projections and the control measures selected to meet ROP targets are effective. These growth factors allow for a more comprehensive understanding of air quality trends, especially given the

interconnected nature of the region, than would isolated state-by-state projections reported directly to EPA.

MWAQC ensures adequacy in its control measures. It has specified that control measures must "enable the region to meet the ozone standard by May 1, 2004, the beginning of the 2004 ozone season" as one of its criteria for deciding upon measures to be implemented.[8] However, a control measure that cannot be implemented or enforced in one or more of the jurisdictions would not be credited by EPA, meaning that measures which could reasonably be undertaken in Virginia but not Maryland or the District are likely to be discarded.

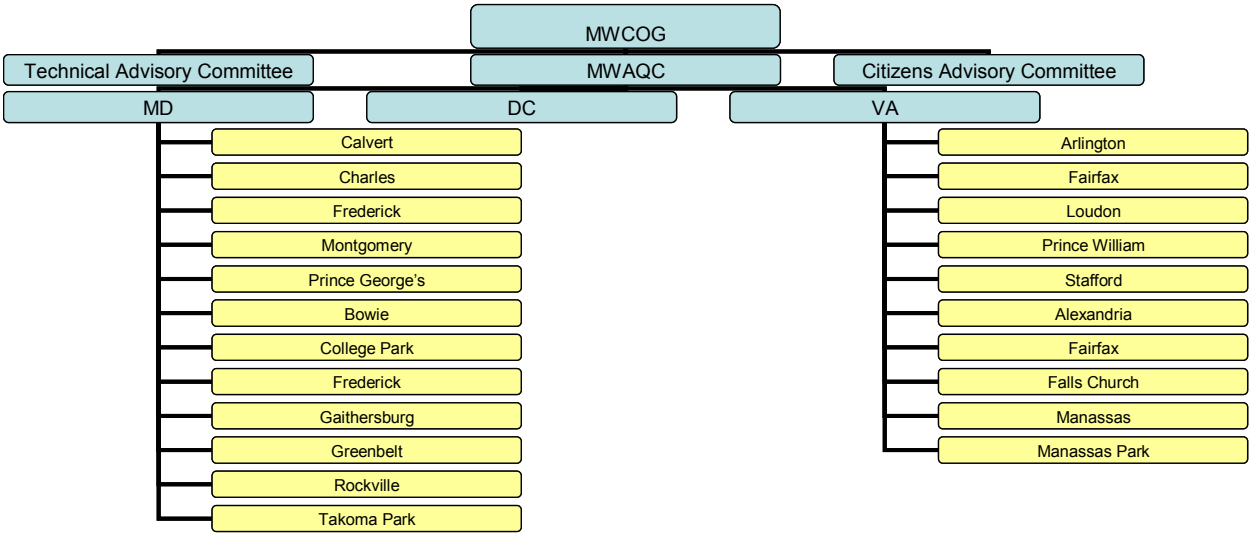
Accountability. Following approval of the SIP, EPA holds each state accountable for the control measures that the region intends to adopt. Should a state fail to meet the control measures it has outlined, that state is accountable and faces loss of federal funding for transportation and air quality projects. However, the regional nature of these projects means that the other states will often be indirectly affected. In addition, if sources in one portion of a state should fail to comply, other cities and counties in that state not included in the nonattainment area could be affected.

Equity. That the current process is done by consensus among the three states and incorporates input from both technical advisory and citizens advisory committees indicates that it is intended to be fair. Equity is reinforced by EPA's demand that each

[8] Metropolitan Washington Severe Area SIP, Section 1.9.

jurisdiction reduce by a given percentage of its own baseline emissions, so that the District, as the smallest emitter, has to reduce by the smallest absolute amount. In this way, no state shoulders a disproportionate amount of the burden. However, the current situation fails to adequately address differences in emissions within each state, despite the availability of such data. Moreover, residents from one state who are responsible for emissions in another state (e.g., Virginia residents driving to work in D.C., D.C. residents consuming electricity generated in Maryland) bear little direct responsibility for those emissions.

2. County Accountability



The second alternative involves transferring a portion of responsibility to counties. Currently, Maryland, Virginia, and the District of Columbia are accountable for reducing their own emissions by the required ROP percentage. Counties are not

held responsible for meeting any targets, despite the fact that counties produce differing amounts of emissions. Although the emissions inventory is done at the county level and thus county emissions data is available, target inventories are calculated for the entire region, with county-level emissions data serving informational purposes only. Thus, the opportunity exists to make individual counties more accountable for reducing their own emissions.

Accountability beneath the county level is not a practical alternative because of the disparity in structure and resources among local governing bodies (particularly when considering unincorporated areas). Additionally, there is no infrastructure for comprehensive, standardized data collection at the local level.

Within the Washington region, counties have different types of sources and produce different amounts of emissions (see Appendix B). For example, in 1999, Fairfax County generated nearly 169 tons of VOCs and NO_x per ozone season day, while Calvert County emitted just over thirteen tons.[9] Under this alternative, each county would have to reduce its own emissions level by three percent per year (on average), keeping the proportionality structure of reductions in place.

MWAQC would continue to function as the coordinating body, choosing control measures for implementation by each county. To stay within the EPA framework as described in the limits of our analysis, counties would need to have sufficient authority to implement reductions measures for this alternative to be viable. States would continue to be accountable for enforcing implementation of measures, the main

[9] See Appendix B for VOC and NO_x emissions for each county in the Metropolitan Washington region.

difference being that counties would be treated proportionally and have their own targets.

Feasibility. It would be feasible to hold counties more responsible for reducing their own emissions. There are currently county government structures in place that could be held accountable (e.g., a county environmental or health department); alternately, a separate county air quality board could be formed to track emissions in the county and ensure that control measures are implemented to reach its target. In addition, since emissions data is already collected at the county level, setting these targets is feasible.

It is also feasible for individual counties to implement reductions that are best suited for that county. For example, Montgomery County currently has a wind power program that receives emissions reduction credit in the SIP, but few other counties in the region would find it both politically and economically feasible to implement such a program. Voluntary SIP measures would allow for flexibility and additional credit for county-specific measures.

However, there are some difficulties with giving each county its own target and holding counties more responsible for reducing their emissions. Emissions are transported across counties, and thus are not confined to the location in which they are generated. In addition, some counties have fewer resources than others (e.g., smaller budgets, tax bases, or staff). In an extreme case of limited resources, a county might not find it feasible to reduce its own emissions. Finally, assigning more responsibility to counties requires increased coordination, and potentially more bureaucracy, between

the county and the state, as the state remains accountable to EPA for reaching attainment and ROP goals. Thus, this alternative would require state monitoring of counties to ensure that all are meeting their targets.

Adequacy. The county structure does allow for taking necessary factors into account. For example, county planning commissions have authority over land use, allowing them to control growth and development in their county, and can be more involved in the modeling stages and in making decisions about reduction measures.

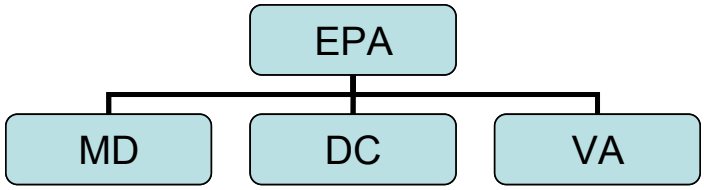
Accountability. Assigning more responsibility to the county level could create a better system of accountability. With more decentralized responsibility, each jurisdiction (county) has a smaller area with which it is concerned (as opposed to a state or region), potentially resulting in better oversight of emitters.

However, delegating responsibility to the county level would still require a larger accountable body such as the state to oversee individual counties' progress, as EPA may be unwilling to perform this function.

Equity. By extending the three percent ROP structure to the county level, counties such as Montgomery and Fairfax, which produce more emissions than others in the Washington region, would be responsible for greater reductions than those with minimal emissions. Equity would be increased through additional reduction demands

at the county level. However, for counties to be responsible for their own emissions, an accurate accounting of the emissions produced by their residents is required.

3. No Formal Regional Coordination



The final alternative is to remove MPO participation and have no formal regional coordination. This alternative is already exercised in regions where states choose not to engage in SIP planning with their neighbors; such is the case in the Chicago-Gary-Lake County MSA, where Illinois and Indiana operate independently. Whereas D.C., Maryland, and Virginia jointly develop a single regional SIP for individual submittal, Illinois and Indiana develop different SIPs for their portions of the Chicago nonattainment area, reducing the emissions in their own territories in accordance with ROP requirements. That is, Illinois prepares a SIP lowering emissions in its eight counties in the Chicago region, while Indiana does the same for its two counties.

Feasibility. This system would be feasible in the D.C. area because states already submit SIPs and enact regulations independently. In the current situation, Virginia sometimes finds it difficult to pass control measures selected by the region through the

state legislature because only a small portion of the state is in nonattainment. Virginia's legislature may find this approach appealing because of the freedom it would give the state in determining its control measures; it would not, however, address the state's existing problem of developing regulations applicable to only ten of its 135 counties and independent cities.

Adequacy. The alternative also holds an advantage in meeting the "adequacy" criterion because it can be more expedient for states to act on their own rather than by consensus. While the submission of SIPs and actual implementation of measures are done individually by each state in the current situation, this option allows each state to select the control measures it finds most appropriate without needing to reach consensus with its neighbors. Thus, there is more incentive for all available control measures to be used, since a state is not limited by the constraints of other jurisdictions.

Planning without regional cooperation potentially means that less information is shared between states, making for less informed decisions. States operating independently also cannot account for what actions adjacent jurisdictions intend to take, meaning that measures implemented in one state (e.g., low emissions paint cans) may be undermined if not implemented in the neighboring state (because citizens of the more regulated state can easily make purchases in the less regulated one).

Emissions transported within the region may also become a problem—while wind patterns do not change with the governance structure, choices affecting the amount of emissions transported from a given site do. Moreover, while states eager to

implement reduction measures may find it easier to do so without regional oversight, the tradeoff is that states reluctant to implement measures may find it easier to drag their feet and hence lower the likelihood of reaching compliance.

Another problem with removing regional coordination is that major urban transportation systems tend to have a strong regional component. Because of the role transportation plays in emissions, it makes sense that transportation reductions be viewed in a regional context rather than by state.

Accountability. This alternative removes all regional accountability associated with transportation conformity lapses; without formal coordination, only the faltering state loses funding. Accountability with regard to the state's responsibility for submitting the SIP is unchanged from the current situation. Without coordination, states are not likely to be aware of the control measures selected by their neighbors, thus removing the opportunity for informal oversight that accompanies regional coordination (apart from that associated with transportation planning).

Equity. Eliminating regional cooperation does not change fairness in terms of proportionality of reductions; each state must still lower its emissions by the same ROP percentage, so fairness on the surface remains unchanged. But demanding participation from each state, as the current situation does, means that D.C. spends a good deal of time and effort helping Maryland (which has substantially more point sources and pollution) develop measures hardly applicable to the District. Removing

the obligation to develop a joint plan would require that each state take full responsibility for its own emissions cleanup. In addition, consensus on control measures across a region could impose a greater burden on companies in one jurisdiction. For example, a regulation imposed on a particular industry (e.g., printing) could be implemented in one jurisdiction that has many printing point sources, but pose a disproportionate burden on sources in another state with very few printing sources.

On the other hand, making each state solely responsible for itself also means that it need only respond to individuals and groups within its borders. This reduces debate that may occur between stakeholders in different jurisdictions who have different concerns. In the current structure, the expression of multiple points of view is encouraged by representation of all relevant jurisdictions in MWAQC; citizen committees and open meetings add representation from across the metropolitan region. The no formal cooperation alternative would limit this democratic aspect of the process.

Table 1 on the following page summarizes the evaluation of the four criteria for each of the three alternatives.

Table 1 - Summary of Evaluation of Alternatives

	Feasibility	Adequacy	Accountability	Equity
Current	(+) MWCOG already exists (+) Geographical convenience (-) Political conflicts (-) Bureaucratic differences	(+) Includes growth (+) Control measure guidelines exist	(+) State/regional oversight (-) Loss of funding affects other areas	(+) Technical/citizens advisory committees (+) Equal percentage reduction for each jurisdiction (-) County emissions vary within each state (-) States' effects on each other's reported emissions
County	(+) County governments/data exist (+) Allows for customization of measures (-) Differences in county resources	(+) County planning commissions have better control over land use	(+) Better oversight with smaller area (+) State still accountable	(+) Equal percentage reduction for each county (-) Counties' effects on each other's reported emissions
No Formal Regional Coordination	(+) States already submit SIPs independently (+) State flexibility in determining appropriate measures (+) Legislatures act independently	(+) No need for consensus (-) Less information is shared (-) Transportation and air quality are regional issues (-) Actions can be undermined by neighboring states	(-) No regional oversight	(+) Equal percentage reduction for each state (+) States only devote their resources to their own efforts (-) Loss of full stakeholder input

Reallocating Emissions

In considering the equity criterion, we asked the following three questions:

- Whose actions result in emissions?
- Who benefits from those actions?
- Who is responsible for reducing?

In our judgment, the answer to the third question should be the same as the answer to the first two: those producing and benefiting from emissions should be responsible for reductions. We found the current system of calculating emissions inventories and allocations to be inadequate.

Under the current allocation system, emissions are assigned to the jurisdiction in which they are reported. For example, a resident in Montgomery County who drives to work in the District of Columbia is responsible for car emissions that register in the District. The Montgomery resident's power is supplied by a plant in Prince George's County, making that resident responsible for NO_x emissions that register in Prince George's. However, the current process allocates this resident's emissions to the District and Prince George's rather than Montgomery. A more fair system would properly assign emissions to the jurisdiction whose residents create or benefit from the emissions. The basic model below presents a first step toward a fair redistribution of emissions, and lends a quantitative aspect to the evaluation of equity.[10]

[10] A more complex and more representative version could be developed with better data and greater resources. We discuss the limits of our model in a later section.

Calculation of Actual Emissions

NO_x and VOC inventories are calculated by determining anthropogenic emissions from area, nonroad, point, and onroad sources. We used the region's current inventory of emissions to develop the following equations for redistributing emissions to responsible parties.

NO_x = Area + Nonroad + Point [% regional electricity * regional total] + Onroad [% of regional VMT * regional total]

VOC = Area + Nonroad + Point + Onroad [% of regional VMT * regional total]

We did not redistribute emissions from area and nonroad sources since these emissions are largely self-contained (i.e., emissions registered in the jurisdiction are actually produced in that jurisdiction and that jurisdiction benefits from the activities producing those emissions).

The largest NO_x point source emitters in the D.C. region are power plants, which provide a service whose benefits are shared throughout the region (see Appendix C).[11] In order that responsibility be similarly shared, we distributed point source emissions based on the proportion of regional electricity consumption for a given jurisdiction. We identified workplaces and residences as the two primary locations of power consumption and used the number of jobs and residents to calculate each jurisdiction's share of the region's electricity consumption (see Table 2).[12] Multiplying this

[11] Power plant emissions make up more than 90 percent of overall point source NO_x emissions in the Washington region.
[12] The sum of jobs and residents is designated as the employment-population (EP) total.

percentage by the region's total NO_x point source emissions gives us the distributed NO_x point source inventory for the given jurisdiction.[13]

Table 2 – Calculation of County Electricity Consumption

Jurisdiction	Employment (by workplace)	Population (2000)	Employment-Population (EP) Total	EP as % of entire state	Total annual state electricity consumption (thousands of KWh)	Electricity apportionment by EP (State consumption*EP % of state) (thousands of KWh)	Electricity usage as % of region
DC	635,734	572,059	1,207,793	100.0%	10,616,000	10,616,000	17.8%
Calvert	18,010	74,563	92,573	1.2%		727,762	1.2%
Charles	36,968	120,546	157,514	2.0%		1,238,295	2.1%
Frederick	79,434	195,277	274,711	3.6%		2,159,638	3.6%
Montgomery	449,881	873,341	1,323,222	17.1%		10,402,495	17.4%
Prince George's	304,022	801,515	1,105,537	14.3%		8,691,167	14.5%
MD Regional Total	888,315	2,065,242	2,953,557	38.3%		23,219,356	38.8%
MD State Total	*2,421,899*	*5,296,486*	*7,718,385*		*60,678,000*		
Alexandria City	91,678	128,283	219,961	2.1%		2,023,220	3.4%
Arlington	159,170	189,453	348,623	3.3%		3,206,664	5.4%
Fairfax	542,984	969,749	1,512,733	14.4%		13,914,249	23.3%
Loudoun	97,087	169,599	266,686	2.5%		2,453,001	4.1%
Prince William	83,107	280,813	363,920	3.5%		3,347,368	5.6%
Stafford	24,920	82,448	107,368	1.0%		987,580	1.7%
VA Regional Total	998,946	1,820,345	2,819,291	26.8%		23,932,082	43.4%
VA State Total	*3,436,172*	*7,078,515*	*10,514,687*		*96,715,000*		
Metropolitan Regional Total	2,431,317	4,329,363	6,760,680		168,009,000	59,767,439	100.0%

Sources: U.S. Census Bureau; Bureau of Labor Statistics (Covered Employment and Wages), Metropolitan Washington Severe Area SIP; U.S. Department of Energy, Energy Information Administration

[13] Because over 90 percent of NO_x point source emissions are from power plants, we redistributed the region's entire NO_x point source inventory (626 tons per day). This results in a small over-distribution of emissions but should not inordinately skew the results. Since power plants contribute less than 20 percent of the region's VOC emissions, we did not redistribute point source VOC emissions.

Onroad emissions are the product of vehicular travel. The current inventory process incorporates emissions based on vehicle miles traveled (VMT). In the current system, emissions are attributed to the jurisdiction in which a car is *driven* (i.e., emissions resulting from Virginia residents driving in D.C. are attributed to D.C.'s inventory). To properly assign responsibility, VMT and the resulting emissions should be attributed to the jurisdiction in which the car is *registered*.[14] As with our approach to point sources, we used the proportion of regional VMT produced by a jurisdiction's drivers and multiplied that percentage by the region's total onroad emissions (see Table 3).

Table 3 - Calculation of Onroad Inventory Proportional to VMT

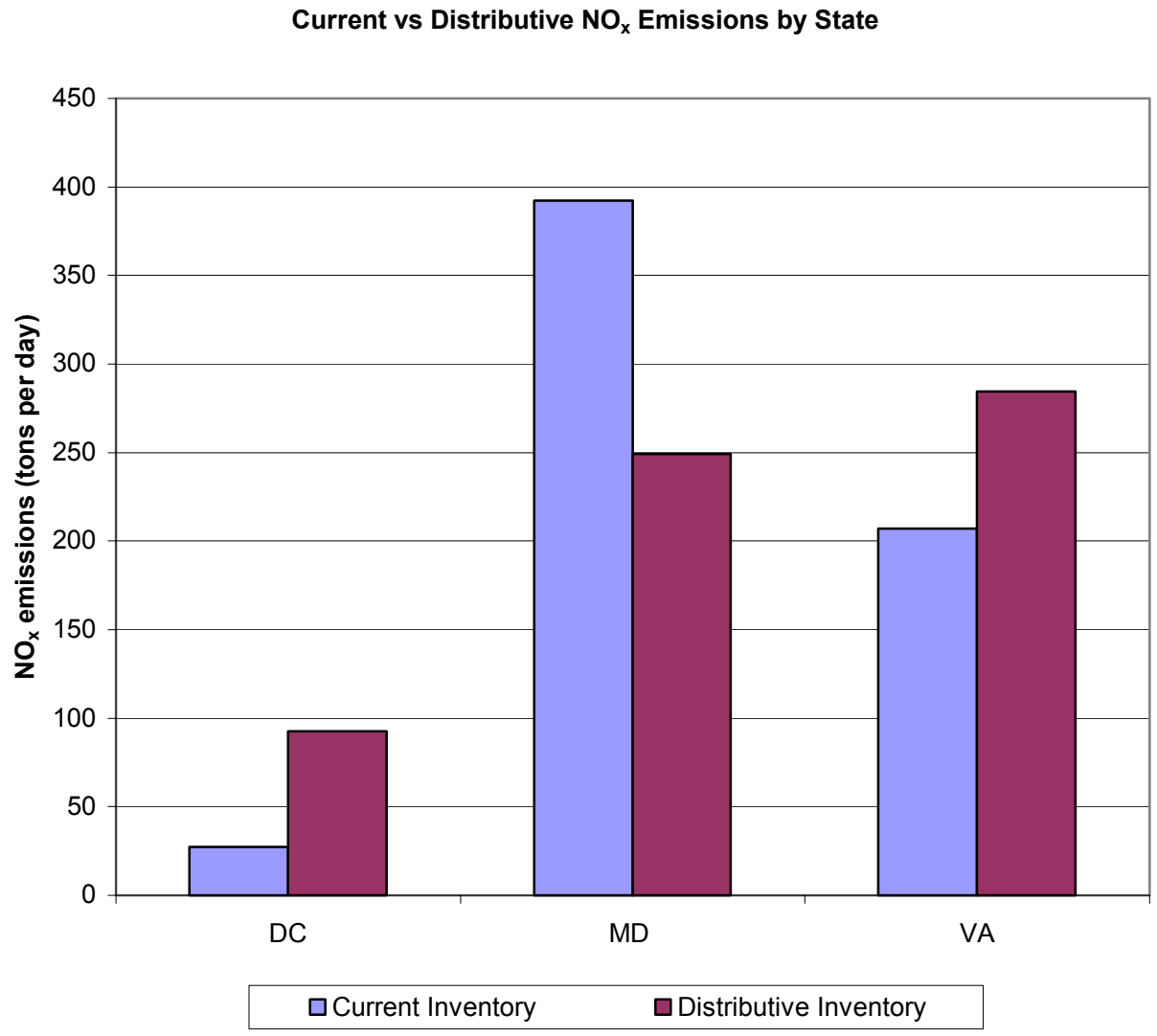
Jurisdiction	Current Onroad VOC Emissions (tons/day)	Daily VMT	% of regional VMT	Redistributed Onroad VOC (% of regional VMT*regional total onroad emissions) (tons/day)
DC	15.3	1510	15.2%	19.4
Calvert	2.13	208	2.1%	2.7
Charles	3.17	259	2.6%	3.3
Frederick	7.73	609	6.1%	7.8
Montgomery	21.66	1404	14.2%	18.1
Prince George's	23.18	1299	13.1%	16.7
MD Regional Total	57.87	3779	38.1%	48.6
Alexandria City	3.76	453	4.6%	5.8
Arlington	7.86	243	2.4%	3.1
Fairfax	27.34	2127	21.4%	27.4
Loudoun	4.52	674	6.8%	8.7
Prince William	7.4	877	8.8%	11.3
Stafford	3.57	256	2.6%	3.3
VA Regional Total	54.45	4630	46.7%	59.6
Metropolitan Regional Total	127.62	9919	100%	127.62

Source: Metropolitan Washington Severe Area SIP, Appendix B, Attachment E.

[14] Currently, VMT measurements represent miles traveled on a given road regardless of car registration. Our model relies on a VMT measurement of miles traveled by given vehicles regardless of location. In order to demonstrate the methodology, our calculations use the data available as if they reflected the jurisdiction of car ownership.

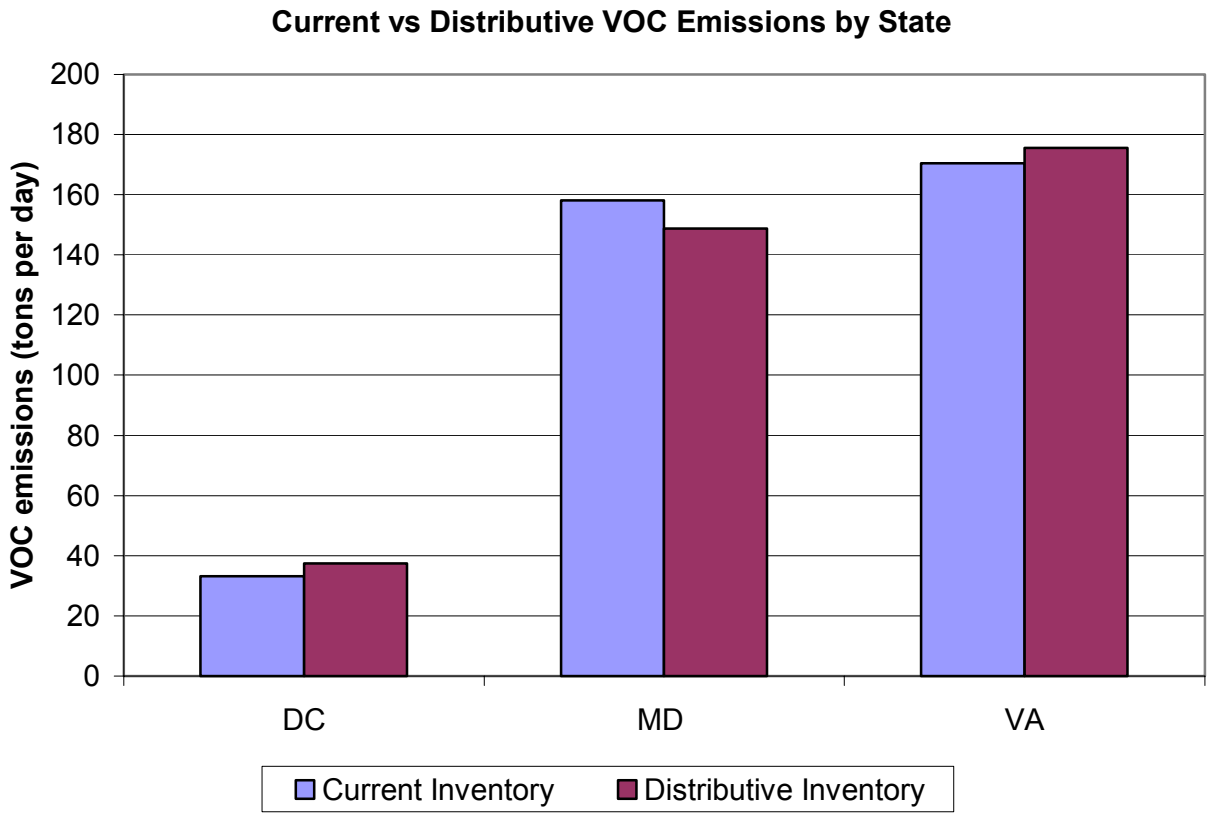
The results of our redistribution of NO_x emissions inventories by state are presented in Figure 1. Maryland's redistributed inventory is significantly lower than its current inventory, while D.C. and Virginia's NO_x inventories increase.

Figure 1



We obtained similar results when redistributing VOC emissions, as presented in Figure 2. However, the differences in current and distributive VOC inventories are not as significant because only onroad emissions were redistributed (as opposed to both point and onroad as in the NO_x calculations).

Figure 2



The same calculations were made to evaluate the second alternative; Figures 3 and 4 present the NO_x and VOC redistributions by county. Here, the variation between current and distributive NO_x inventories was more significant, particularly for D.C., Charles, Prince George's, and Fairfax counties.

Figure 3

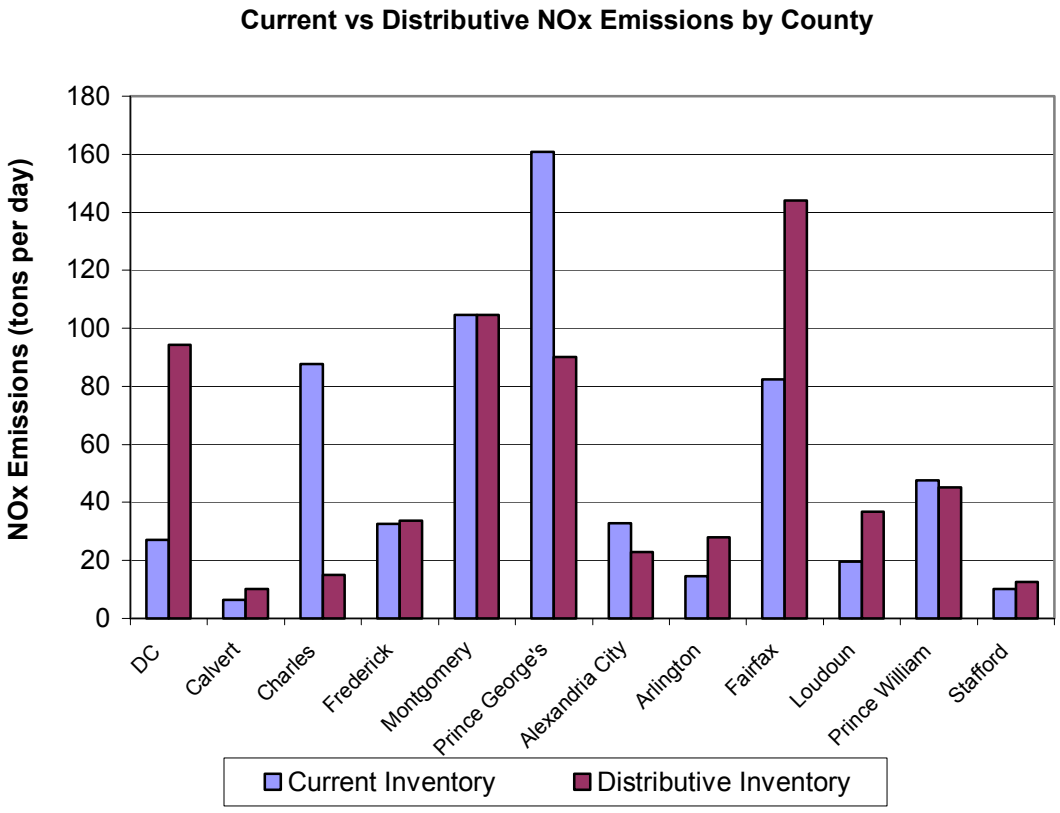
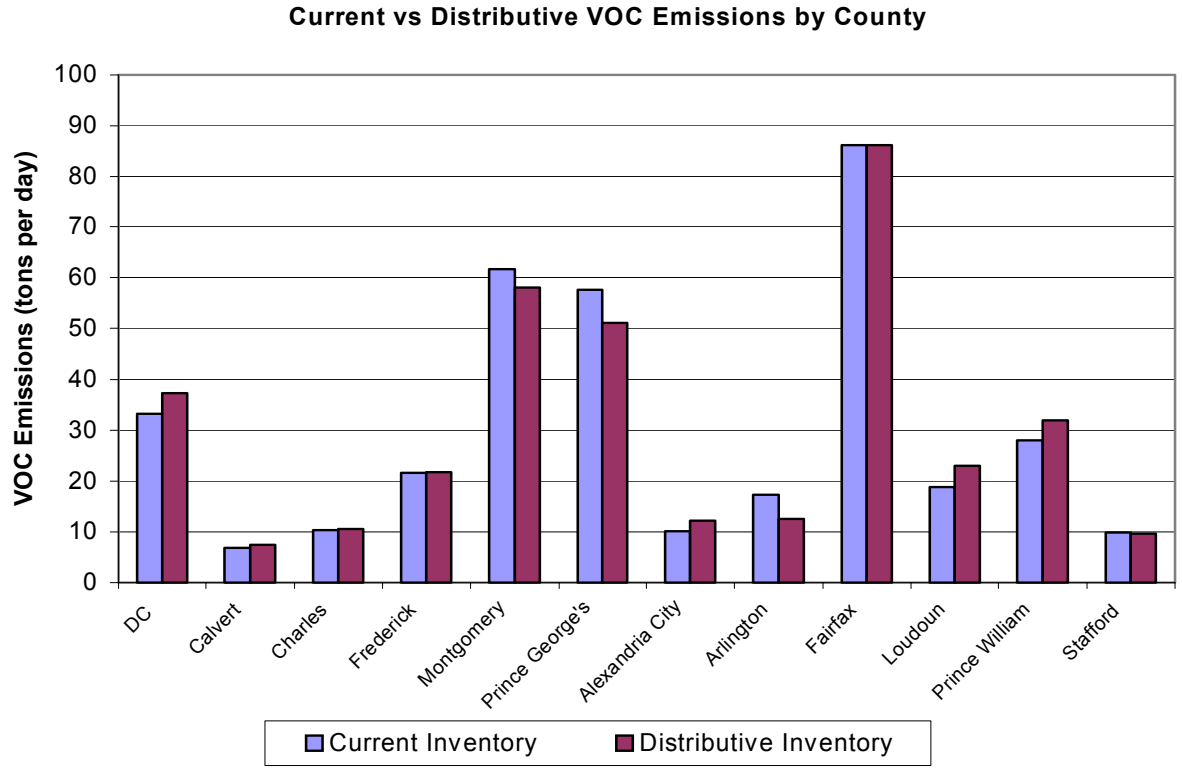


Figure 4



Calculation of Target Emissions

After redistributing emissions inventories to more accurately reflect responsibility, we looked at making the reductions process more equitable. To avoid penalizing jurisdictions with greater populations, we considered using a per capita rate. However, using population numbers alone would not accurately reflect each resident's power usage and the resultant emissions. For example, D.C. has a higher concentration of economic activity than many other jurisdictions, which attracts workers from outside the District. Distributing the emissions produced by these workers among residents alone would give the residents a disproportionate responsibility for reductions. To

account for emissions generated by residential and economic activity, we divided each jurisdiction's total emissions by the jurisdiction's employment-population (EP) total to calculate each county's current emissions/EP rate. The results of these calculations for NO_x and VOC are shown in Figures 5 and 6.

To determine emissions responsibilities within the states, we evaluated each county's emissions/EP rate relative to the average of all county rates. We then calculated the regional rate necessary to reach the current ROP requirements (i.e., the region's target emissions divided by the region's EP), represented as the target EP rate in Figures 5 and 6.[15] For the region to meet ROP requirements, all counties would need to emit at an EP rate of .1595 pounds per day for NO_x, and .1004 pounds per day for VOC (see Tables 4 and 5).

[15] EPA's "NO_x Substitution Guidance" allows for the substitution of NO_x emissions reductions for VOC reductions, which the Washington Metropolitan Region has opted to follow. We calculated our target rates based on the overall target levels MWCOG has outlined in its ROP plan (i.e., 339 tons per day of VOC and 539 tons per day of NO_x). Given this substitution, the target rates do not reflect a nine percent reduction in both VOCs and NO_x but instead a 14 percent reduction in NO_x and an eight percent reduction in VOCs from 1990 levels.

Figure 5

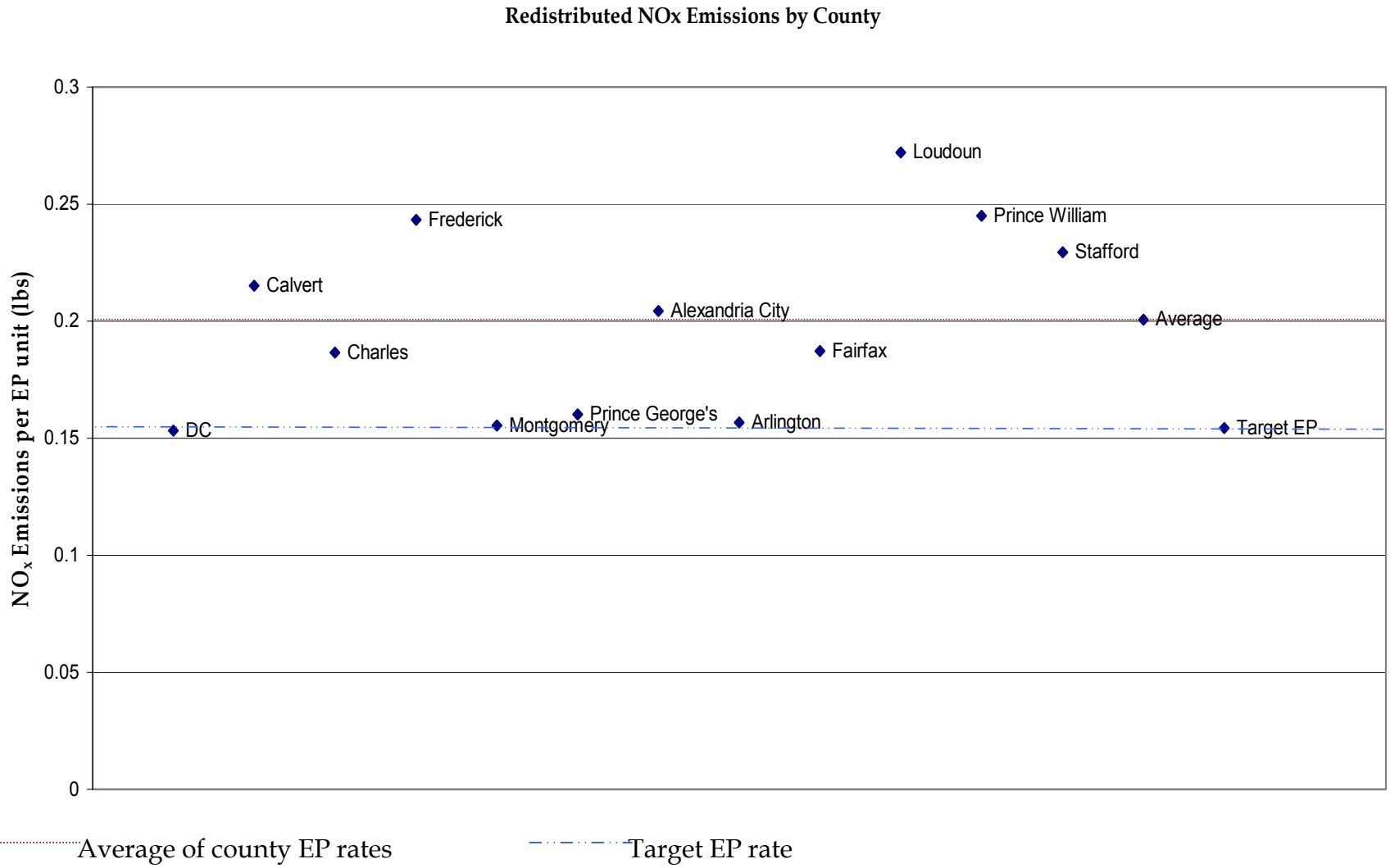

Redistributed NOx Emissions by County
NOx Emissions per EP unit (lbs)
0.3
0.25
0.2
0.15
0.1
0.05
0
Loudoun
Prince William
Stafford
Frederick
Calvert
Alexandria City
Average
Charles
Fairfax
Prince George's
DC
Montgomery
Arlington
Target EP
Average of county EP rates
Target EP rate

Figure 6

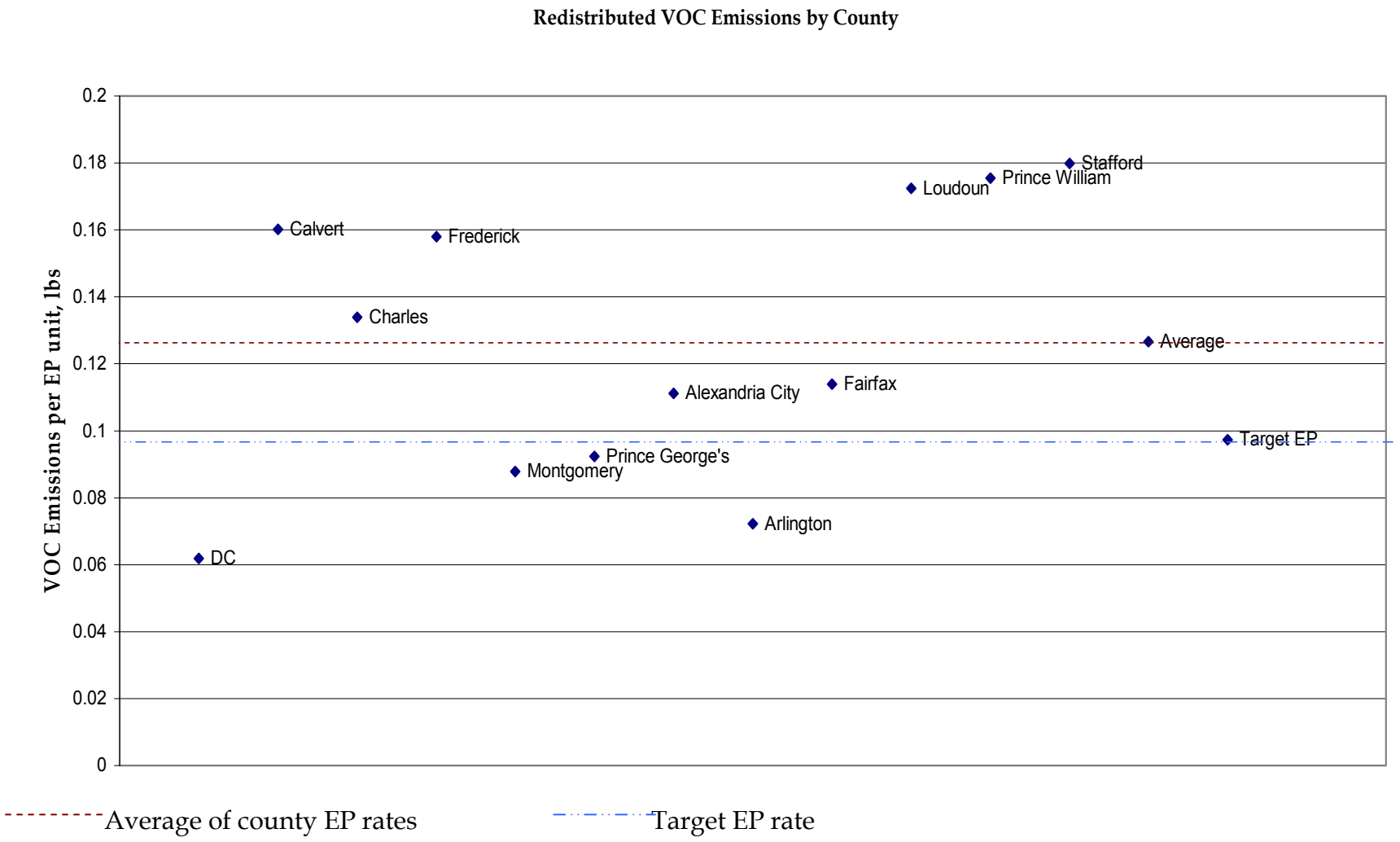

Redistributed VOC Emissions by County
VOC Emissions per EP unit, lbs
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Stafford
Prince William
Loudoun
Calvert
Frederick
Charles
Average
Alexandria City
Fairfax
Target EP
Prince George's
Montgomery
Arlington
DC
Average of county EP rates
Target EP rate

Table 4 – NO_x EP Rates Necessary to Meet ROP Requirements

Jurisdiction	EP by County	Current NO_x Inventory (tons/day)	Redistributed Inventory (tons/day)	Redistributed EP rate (lbs/day)	Target EP rate (lbs/day)	Absolute Emissions at Target Rate (tons/day)	Reduction in Redistributive Inventory (tons/day)	Current Inventory -9% (tons/day)	Redistributed -9% (tons/day)	Redistributed EP Rate -9% (lbs/day)
DC	1,207,793	27.2	92.51	0.1532	0.1544	93.3	(0.7)	24.8	84.2	0.1394
Calvert	92,573	6.46	9.96	0.2153	0.1544	7.1	2.8	5.9	9.1	0.1959
Charles	157,514	87.61	14.70	0.1866	0.1544	12.2	2.5	79.7	13.4	0.1698
Frederick	274,711	32.62	33.42	0.2433	0.1544	21.2	12.2	29.7	30.4	0.2214
Montgomery	1,323,222	104.6	102.75	0.1553	0.1544	102.2	0.6	95.2	93.5	0.1413
Prince George's	1,105,537	160.82	88.51	0.1601	0.1544	85.4	3.1	146.3	80.5	0.1457
MD Regional Total	2,953,557	392.11	249.34	0.1688	0.1544	228.1	21.3	356.8	226.9	0.1536
Alexandria City	219,961	32.89	22.46	0.2043	0.1544	17.0	5.5	29.9	20.4	0.1859
Arlington	348,623	14.56	27.31	0.1567	0.1544	26.9	0.4	13.2	24.8	0.1426
Fairfax	1,512,733	82.39	141.62	0.1872	0.1544	116.8	24.8	75.0	128.9	0.1704
Loudoun	266,686	19.67	36.29	0.2722	0.1544	20.6	15.7	17.9	33.0	0.2477
Prince William	363,920	47.49	44.57	0.2449	0.1544	28.1	16.5	43.2	40.6	0.2229
Stafford	107,368	10.11	12.32	0.2295	0.1544	8.3	4.0	9.2	11.2	0.2089
VA Regional Total	2,819,291	207.11	284.57	0.2019	0.1544	217.7	66.9	188.5	259.0	0.1837
Regional Total	6,980,641	626.42	626.42	0.1795	0.1544	539.0	87.4	570.0	570.0	0.1633

Sources: U.S. Census Bureau; Bureau of Labor Statistics (Covered Employment and Wages), Metropolitan Washington Severe Area SIP
Notes: Averaging the 12 county EP rates gives a rate of .2007 lbs/day, or an absolute total of 701 tons/day. Lowering this average rate by nine percent would give an EP rate of .1827 and an absolute emissions total (637 tons/day) higher than what currently exists. Lowering the regional average (i.e., total regional emissions/total regional EP) by nine percent would be the same as lowering current or redistributed inventories by nine percent.

Table 5 - VOC EP Rates Necessary to Meet ROP Requirements

Jurisdiction	EP by County	Current VOC Inventory (tons/day)	Total Emissions - Redistributed Inventory (tons/day)	Redistributed EP rate (lbs/day)	Target EP rate (lbs/day)	Absolute Emissions at Target Rate (tons/day)	Reduction in Redistributive Inventory (tons/day)	Current Inventory -9% (tons/day)	Redistributed -9% (tons/day)	Redistributed EP Rate -9% (lbs/day)
DC	1,207,793	33.2	37.3	0.0618	0.0972	58.7	(21.4)	30.2	34.0	0.0562
Calvert	92,573	6.9	7.4	0.1602	0.0972	4.5	2.9	6.3	6.7	0.1458
Charles	157,514	10.4	10.6	0.1340	0.0972	7.7	2.9	9.5	9.6	0.1219
Frederick	274,711	21.6	21.7	0.1580	0.0972	13.4	8.3	19.6	19.7	0.1437
Montgomery	1,323,222	61.7	58.1	0.0878	0.0972	64.3	(6.2)	56.1	52.9	0.0799
Prince George's	1,105,537	57.6	51.1	0.0924	0.0972	53.7	(2.6)	52.4	46.5	0.0841
MD Regional Total	2,953,557	158.1	148.8	0.1008	0.0972	143.5	5.3	143.9	135.4	0.0917
Alexandria City	219,961	10.2	12.2	0.1112	0.0972	10.7	1.5	9.2	11.1	0.1012
Arlington	348,623	17.3	12.6	0.0722	0.0972	16.9	(4.4)	15.8	11.5	0.0657
Fairfax	1,512,733	86.2	86.2	0.1140	0.0972	73.5	12.7	78.4	78.4	0.1037
Loudoun	266,686	18.8	23.0	0.1724	0.0972	13.0	10.0	17.1	20.9	0.1569
Prince William	363,920	28.0	31.9	0.1754	0.0972	17.7	14.2	25.5	29.1	0.1597
Stafford	107,368	9.9	9.7	0.1798	0.0972	5.2	4.4	9.0	8.8	0.1636
VA Regional Total	2,819,291	170.5	175.6	0.1246	0.0972	137.0	38.6	155.1	159.8	0.1134
Regional Total	6,980,641	361.8	361.8	0.1036	0.0972	339.3	22.5	329.2	329.2	0.0943

Sources: U.S. Census Bureau; Bureau of Labor Statistics (Covered Employment and Wages), Metropolitan Washington Severe Area SIP
Notes: Averaging the 12 county EP rates gives a rate of .1266 lbs/day, or an absolute total of 442 tons/day. Lowering this average rate by nine percent would give an EP rate of .1152 and an absolute emissions total (402 tons/day) higher than what currently exists.

Our proposal for assigning reductions is that counties have as their targets the absolute emissions value consistent with the target rate and the EP for their jurisdiction ("Absolute Emissions at Target Rate" in the tables). Counties below the target rate could engage in a form of emissions trading with those above the target, whereby low-EP emitters could sell their excess allotment to high-EP emitters, much as is now done with point sources. We believe this would be a more fair system than requiring equal-percentage reductions because it in essence rewards those jurisdictions with low-EP practices and penalizes high-EP emitters.

As can be seen from the table and charts, only the District of Columbia is currently below the target rate for NO_x. For VOC emissions, four counties (D.C., Arlington, Montgomery, and Prince George's) are already emitting at EP rates below the target and would be in a position to sell portions of their emissions allotment.

Limitations of the Distributive Method

The methodology presented above is an initial step towards a more comprehensive approach to better incorporate responsibility in the emissions inventory and allocations processes. Several factors limited our analysis:

- **Data availability.** There were two categories for which the available data were less than satisfactory. Our methodology applies VMT data to represent VMT by residence of a given jurisdiction. In fact, current measurements of VMT are nonstandard across the states but tend to represent VMT traveled on roads in a

given jurisdiction and are not related to vehicle registration data. We have used the available VMT data as though they reflected driver residency to demonstrate how a more comprehensive model would work.

Secondly, electricity consumption data are not readily available at the county level. Using the number of jobs and residents to calculate each jurisdiction's share of the region's electricity consumption implies that these two factors are a good indicator of electricity consumption. However, certain kinds of jobs in one locale might be disproportionately dependent on power, which would make our estimates of consumption less accurate. In addition, our NO_x calculations actually involve an over-redistribution of the few point sources that do not address electricity (e.g., cement and printing sources). Finally, a more detailed model would calculate the percentage of VOC point emissions from power plants and redistribute those emissions accordingly.

- **Virtual redistribution.** The distributive methodology redistributes the responsibility for emissions; it does not specifically address the physical location of the emissions produced by those deemed responsible. As a result, making reductions allocations based on responsibility may not fully address those sources which most influence the location of emissions. In order for a jurisdiction to reduce its overall emissions rate it is not required to make reductions that affect a specific source type or behavior that produces emissions. To meet the target emissions rate, jurisdictions could select those control measures that are easiest to implement but

may not actually affect the source of emissions which most influences the location of emissions. An undesirable consequence could conceivably result wherein jurisdictions meet their target rate requirement, but air quality problems may persist in certain locations.

CONCLUSION AND RECOMMENDATION

The D.C. area has been in nonattainment since ozone air quality standards were first developed. Allocating and implementing emissions reductions within a multijurisdictional nonattainment area is complex — the governance structure influences how the region is able to address this problem. Where reductions should be made and who is held accountable requires a close look at how inventories are calculated, how reduction responsibility is allocated, and to what degree the various jurisdictions coordinate. To reach attainment, the region needs a governance structure that is feasible, adequate, equitable, and holds jurisdictions accountable. Failure to designate responsibility for emissions reductions would keep the region in nonattainment, subjecting it to harsh federal penalties and posing a health hazard for its citizens.

Recommendation

After reviewing the redistribution of emissions, we recommend the county accountability alternative. However, rather than having every county reduce by an equal percentage, we recommend setting the target EP rate in accordance with the

desired absolute emissions goal for the region. We believe that the current coordination among the states through MWAQC should be maintained as transportation and air issues are regional. However, there are no current measures to ensure that counties make their share of reductions. We have proposed a methodology that more accurately reflects responsibility by redistributing the current emissions inventories and reduction allocations.

As the current system stands, allocations are proportional among states but some counties within states may bear a disproportionate share of the burden for reducing emissions. For example, the majority of Charles County's emissions are from point source power generators, sources that other states may benefit from. However, only Maryland is responsible for reducing emissions from its power sources. By redistributing emissions based on consumption or other emission producing activities, the burden for reductions is shared. Under the county alternative, MWAQC would remain responsible for identifying control measures for the region, but would do so with a focus on meeting targets within each county. This change would preserve the benefits of the existing system while increasing equity among jurisdictions within each state.

Our recommended approach of assigning target reduction levels to counties is feasible because county emissions data is already collected on a regular basis. The county alternative works within the current regulatory framework; further allocating responsibility does not require a change in EPA's requirements. Additionally, our recommendation may lead to more awareness at the local level and increase the

incentive for implementing more county-specific measures that receive credit in the SIP, since each county now has its own target.

The county alternative increases adequacy by making the reductions process more comprehensive because counties forced to meet their own targets can independently pass land use and other measures affecting reductions.

The alternative also increases accountability by assigning more responsibility to each county for reducing its emissions. The accountability structure could be expanded by having states assume an enforcement role whereby they could administer penalties (e.g., loss of state funding for projects) to counties for compliance failures.

By specifying allocations that correspond to responsibility for emissions production and requiring counties to emit at the same EP rate, we ensure that counties are treated fairly across the region while continuing to operate within a regional context through MWAQC representation.

The county alternative is not without its weaknesses. Devoting too much responsibility to counties could excessively fragment the process and result in greater inequity due to vast differences in county resources (e.g., county budgets). In addition, it is possible that one county could implement control measures prescribed in the SIP more easily than another, leading to easier emissions reductions in one county. For example, the District of Columbia has less control over land use and a smaller property tax base, making it harder to implement reductions based on land use and property tax policies. Despite these weaknesses, we think the county alternative presents the best overall option.

Issues for Further Consideration

Although the preceding analysis explored systems of governance and reduction allocations in the context of the D.C. area, air quality issues are not confined to regional boundaries. An important issue for further analysis is that of ozone transport between regions. Equity is equally as important among regions as it is within a region. In the example of the D.C. area, MWCOG's modeling results suggest that the D.C. region did not meet the 1999 attainment deadline due to transported pollution from outside the region. MWCOG reports that transported pollution contributed twenty to thirty percent of the D.C. area's pollution on the worst days of summer.[16] According to the Maryland Department of the Environment, only 31 percent of the metropolitan area's ozone is created within the region itself. [17]

A second issue for consideration is that eventually, focus on purely technological measures will not be sufficient and more control measures will need to address behavior (e.g., transportation mode choice, consumer products) than is currently the case. How can we better encourage jurisdictions to plan development that affects behavioral patterns? In other words, how do we deal with development potential? Can we give credit for long-range planning? These questions pose challenges for air quality modelers and policy decisionmakers, and warrant further study.

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[16] Metropolitan Washington Severe Area SIP, Section 1.2.

[17] Tad Aburn, Maryland Department of the Environment, and Jeff Stehr, University of Maryland. "The Role of Ozone Transport in the Washington, D.C. Area." Presented at the September 12, 2003, MWAQC meeting.

We believe that the most successful governance structures and emissions accounting processes will provide incentives for jurisdictions to engage in innovative long-range planning that accounts for how population growth, land use patterns, development growth rates, and the types of sources within a region affect behavior.

LIST OF ACRONYMS

EP	Employment-Population
EPA	Environmental Protection Agency
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
MWCOG	Metropolitan Washington Council of Governments
MWAQC	Metropolitan Washington Air Quality Committee
NAAQS	National Ambient Air Quality Standards
NO_x	Nitrogen Oxides
ROP	Rate of Progress
SIP	State Implementation Plan
VOCs	Volatile Organic Compounds

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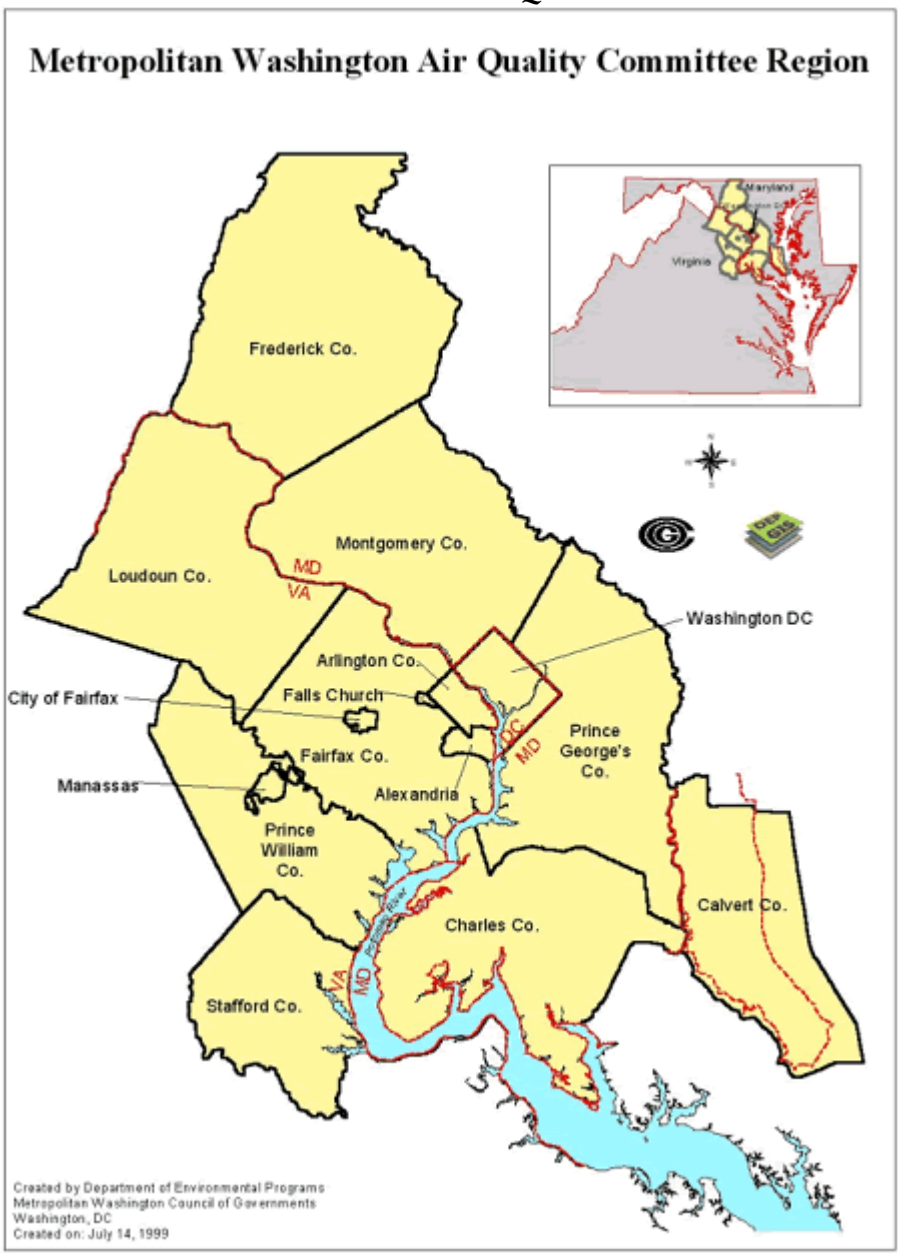
http://www.ku.edu/pri/ksdata/ksah/energy/18ener7.pdf, available as of December 4, 2003.

APPENDIX A - METROPOLITAN WASHINGTON AIR QUALITY COMMITTEE REGION



Virginia Counties	Cities	Maryland Counties	Cities
Arlington	Alexandria	Calvert	Bowie
Fairfax	Fairfax	Charles	College Park
Loudon	Falls Church	Frederick	Frederick
Prince William	Manassas	Montgomery	Gaithersburg
Stafford	Manassas Park	Prince George's	Greenbelt
			Rockville
District of Columbia			Takoma Park

Source: http://www.mwcog.org/environment/air/mwaqc1a.asp

APPENDIX B - 1999 OZONE SEASON DAY EMISSIONS (CURRENT INVENTORY)
[tons per ozone season day]
Metropolitan Washington Nonattainment Area

VOC emissions (TPSD)

	DC	Calvert	Charles	Frederick	Mont-gomery	Prince George's	**MD total**	City of Alex-andria	Arlington	Fairfax	Loudoun	Prince William	Stafford	**VA total**	Region total
Point	**0.60**	0.00	0.94	1.15	0.87	2.41	**5.40**	0.28	0.00	5.07	0.42	1.30	0.11	**7.20**	13.15
Area	**12.90**	2.78	4.09	7.58	25.16	24.05	**63.70**	4.92	6.93	36.85	8.21	12.64	3.22	**72.80**	149.33
Nonroad	**4.40**	1.96	2.19	5.13	13.99	7.91	**31.20**	1.20	2.53	16.92	5.69	6.70	3.03	**36.10**	71.65
Onroad mobile	**15.30**	2.13	3.17	7.73	21.66	23.18	**57.90**	3.76	7.86	27.34	4.52	7.40	3.57	**54.50**	127.62
Total	**33.20**	6.87	10.39	21.59	61.68	57.55	**158.20**	10.16	17.32	86.18	18.84	28.04	9.93	**170.60**	361.75
% of region's total	**9.18**	1.90	2.87	5.97	17.05	15.91	**43.73**	2.81	4.79	23.82	5.21	7.75	2.74	**47.16**	

NO_x emissions (TPSD)

	DC	Calvert	Charles	Frederick	Mont-gomery	Prince George's	**MD total**	City of Alex-andria	Arlington	Fairfax	Loudoun	Prince William	Stafford	**VA total**	Region total
Point	**3.40**	1.05	78.49	6.19	47.57	104.12	**237.42**	25.77	0.00	9.97	0.55	23.36	0.00	**59.65**	300.47
Area	**3.00**	0.18	0.48	1.84	2.69	3.22	**8.41**	0.89	4.10	8.70	3.68	3.44	0.60	**21.41**	32.82
Nonroad	**4.60**	1.78	2.58	8.00	18.44	14.46	**45.26**	1.94	2.01	18.54	6.20	5.98	1.41	**36.08**	85.94
Onroad mobile	**16.20**	3.45	6.06	16.59	35.90	39.02	**101.02**	4.29	8.45	45.18	9.24	14.71	8.10	**89.97**	207.19
Total	**27.20**	6.46	87.61	32.62	104.60	160.82	**392.11**	32.89	14.56	82.39	19.67	47.49	10.11	**207.11**	626.42
% of region's total	**4.34**	1.03	13.99	5.21	16.70	25.67	**62.60**	5.25	2.32	13.15	3.14	7.58	1.61	**33.06**	

Appendix C - Point Sources by Jurisdiction (Current Inventory)

Jurisdiction	# Point Sources	Total NO_x from Point Sources (tons/ day)	Average NO_x tons/day emitted per source	% of Total NO_x from Power Sources	Comments on Largest NO_x Point Sources	Total VOC from Point Sources (tons/day)	Average VOC Emitted Per Source (tons/day)	% of Total VOC from Power Sources
DC	**56**	**3.40**	**0.06**	**51%**	**Largest source (PEPCO - Benning Gen. Station) emits 41%.**	**0.60**	**0.01**	8%
Calvert County	1	1.05	1.05	100%	One source (Cove Point LNG Terminal)	0.00	0.00	0%
Charles County	3	78.49	26.16	99%	One source (PEPCO Morgantown) emits 99%.	0.94	0.04	72%
Frederick County	14	6.19	0.44	0%	One source (Essroc Cement) emits 83%.	1.15	2.60	0%
Montgomery County	17	47.57	2.80	93%	One source (PEPCO-Dickerson) emits 84%.	0.87	0.31	30%
Prince George's County	37	104.12	2.81	99%	One source (PEPCO-Chalk Point) emits 99%.	2.41	0.85	32%
MD Total	**72**	**237.43**	**3.30**	**95%**	**Largest source (PEPCO-Chalk Point in PG) emits 43% of Maryland's total.**	**5.36**	1.63	**32%**
Alexandria City	3	25.77	8.59	92%	One source (Potomac River Generating Station) emits 92%.	0.28	0.09	53%
Arlington County	0	0.00	0.00	0%	No point sources	0.00	0.00	0%
Fairfax County	13	9.97	0.77	81%	One source (Ogden Martin-Fairfax) emits 78%.	5.07	0.39	1%
Loudon County	2	0.55	0.27	98%	One of two sources (Columbia Gas Transmission Corp) emits 98%.	0.42	0.21	44%
Prince William County	7	23.36	3.34	75%	One source (Virginia Power Possum Point) emits 75%.	1.30	0.19	17%
Stafford County	1	0.00	0.00	0%	One source (not power generating)	0.11	0.11	0%
VA Total	**26**	**59.65**	**2.29**	**83%**	**Two largest sources (Potomac River Generating Station - Alexandria City and Virginia Power Possum Point - Prince William County) emit 40% and 29% of Virginia's total.**	**7.18**	**0.28**	**9%**
Region's Total	154	300.47	1.88	92%	Largest source (PEPCO - Chalk Point) emits 34% of the region's total.	13.14	0.64	18%

Notes:
-This table was adapted from Appendix B of the 1999 Periodic Emissions Inventory for the Metropolitan Washington Region.
-This is not a complete list of point sources. For example, Maryland's point source list only includes facilities producing over 25 tons/year of NO_x or 10 tons/year of VOC or 100 tons/year of carbon monoxide.
-Point sources contribute approximately 50 percent of the region's total NO_x emissions (300.5 of 626.4 tons/day).
-Each state has one source that is emitting 40 percent or more of the state's regional NO_x from point sources.
-Each county has a source emitting 75 percent or more of the county's point sources (Calvert and Stafford only have one point source).