Strategic Tree Planting as an EPA Encouraged Pollutant Reduction Strategy:

How Urban Trees Can Obtain Credit in State Implementation Plans

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Summary

As tree programs are new to the SIP process, "to facilitate Federal approval of an emerging or voluntary measure States are encouraged to work with their EPA regional office during the development process".

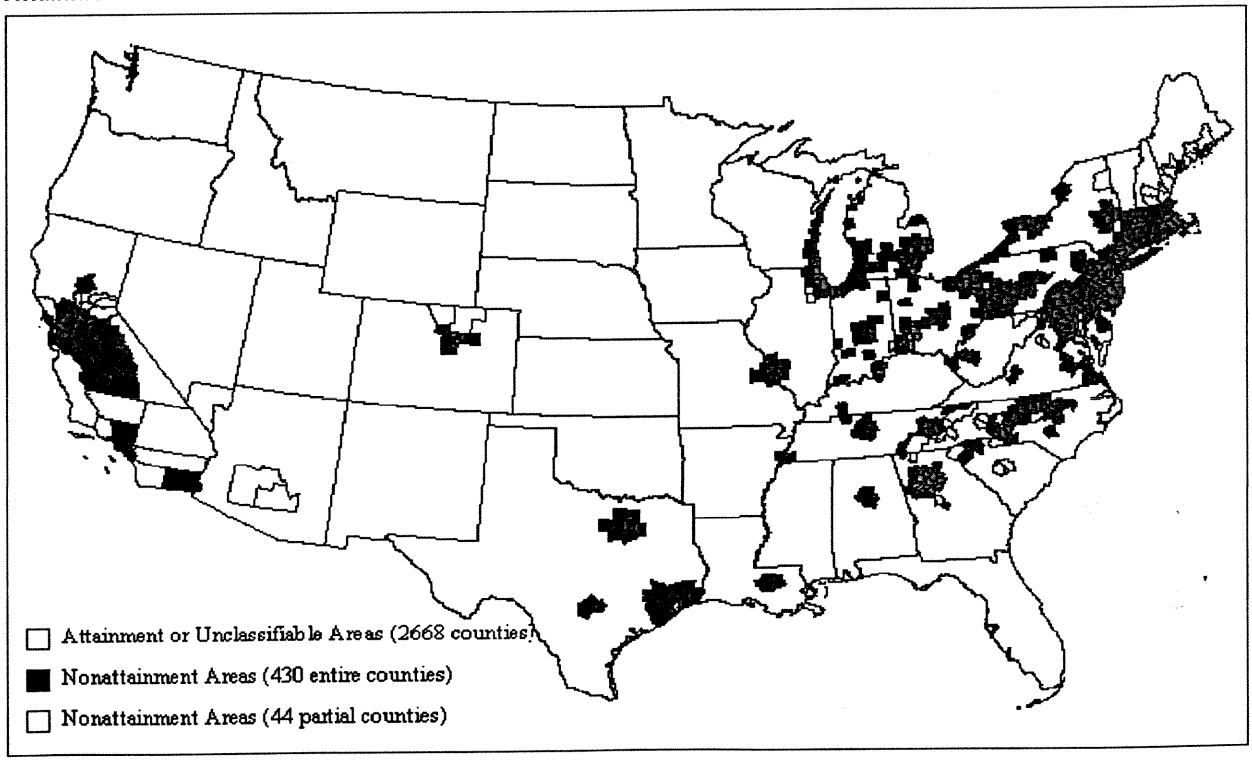
Programs to increase canopy cover in urban areas can achieve many benefits.

- They can help improve air and water quality, as well as other factors related to human health and environmental quality.
- They can be incorporated within State Implementation Plans under "Emerging" and "Voluntary" measures to help meet or sustain clean air standards.
- They will impact the local and regional environment regardless of where they are implemented in the United States; however, they are only applicable for SIP credit in areas designated as non-attainment for ozone where traditional measures can not meet attainment, and in areas designated as SIP maintenance areas.
- They will potentially increase in effect and credit through time as tree canopies grow.

Introduction

Recently, the U.S. Environmental Protection Agency (EPA) released a guidance document titled "Incorporating Emerging and Voluntary Measures in a State Implementation Plan (SIP)."[1] This EPA guidance details how new measures, which may include "strategic tree planting," can be used as a means to help meet air quality standards set by the EPA. Due to the new ozone standards[2], many urban areas are designated as non-attainment areas for the ozone clean air standard, and are required to reach attainment typically by 2007–2010 (but up to 2021 for Los Angeles). As many of the standard

Attainment and Nonattainment Areas in the U.S. 8-hour Ozone Standard, November 2004.



strategies to meet clean air standards may not be sufficient to reach attainment, new and emerging strategies (e.g., tree planting, increased surface albedo) may provide a means to help an area reach compliance with the new clean air standard for ozone. "In light of the increasing incremental cost associated with stationary source emission reductions and the difficulty of identifying additional stationary sources of emission reduction, EPA believes that it needs to encourage innovative approaches to generating emissions reductions."[1] This paper is a brief summary of the EPA guidance report and details actions to help facilitate the inclusion of urban tree canopy increases within SIPs to meet clean air standards.

What are State Implementation Plans?

The Clean Air Act requires attainment of National Ambient Air Quality Standards (NAAQS)[3] for criteria air pollutants that cause human health impacts (e.g., ozone). The Act requires each state to develop a State Implementation Plan (SIP) to attain the NAAQS by the applicable attainment deadlines. SIPs must be approved by the EPA and contain sufficient measures to attain the NAAQS in a timely manner. SIPs contain a series of requirements that are structured to reduce emissions, or prevent additional emissions from occurring that contribute to air quality problems. Upon approval by EPA, SIP requirements can be enforced against regulated sources by the EPA and any citizen.

If a state fails to submit an approvable SIP according to schedules in the Act, EPA is required to impose sanctions that can include reduction of federal transportation funds and implementation of procedures that would make it more difficult to establish new or modify existing stationary sources. SIPs are not a single document; rather they are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, and permitting), district rules, state regulations, and federal controls. SIPs include plans to meet attainment and also include plans on how to maintain attainment. The maintenance plan specifies techniques to be used to sustain compliance with the NAAQS for at least 10 years after being redesignated as compliant.

The SIPs must include these provisions.

1) Monitor ambient air quality.

2) Establish rules, regulations, permitting restrictions, and other programs to limit emissions.

3) Establish legal authority, resources, and enforcement sufficient to ensure compliance.

4) Model the airshed to: a) estimate the air quality impact of state and federal rules, regulations, and other programs; and b) demonstrate that the restrictions on emissions will actually achieve air quality compliance over time.

SIP Requirements

The following are requirements for a measure to be acceptable within a SIP.

- **Enforceable**, emissions reductions and other required actions are enforceable if: a) they are independently verifiable; b) they have defined violations; c) liability can be identified; d) state and EPA maintain ability to apply penalties and corrective actions; e) citizens have access to information from the source; and f) citizens can file lawsuits against sources for violations.
- **Quantifiable**, can be reliably and replicably measured or determined.
- **Permanent**, continue throughout the term that credit is granted.

However, with emerging and voluntary measures, some of these requirements can be modified to allow for newer, less-proven approaches (e.g., tree planting) to be incorporated into SIPs.

Emerging Measures

An emerging measure is a measure or strategy that does not have the same high level of certainty as traditional measures for quantification purposes. Strategic tree plantings are an example of an emerging measure that is new and relatively unproven compared to more traditional measures. Tree planting, or canopy enhancement programs, should be incorporated into a SIP through the emerging measures policy. Emerging measures provide some flexibility in meeting the SIP quantification requirements. Even though there is uncertainty with emerging measures, these measures need to apply the best available science in developing, justifying and evaluating their programs. By reducing air temperatures and building energy use, and directly removing ozone and NO_x from the air, trees reduce ozone concentrations[7]. However, trees can also increase (e.g., biogenic emissions from trees) or decrease (e.g., urban emissions from temperature dependent sources) volatile organic compound (VOC) emissions that can lead to ozone formation. Because not all of a tree affects impact emission rates, but they all affect ozone concentrations, tree strategies should focus on reducing ambient ozone concentration. Ambient concentration reduction strategies can be used for maintenance and attainment requirements in the SIP. "Estimating pollutant reductions for programs of this type will generally rely on ambient air quality modeling based on the application of the best available scientific and engineering information."[1]

For these types of programs (tree planting, other urban heat island reduction measures), reductions are related to the level of activity involved. "Programs of this type will need to promote a level of activity over an area necessary to create an impact in the modeling and actual results"[1]. Small programs in an isolated neighborhood are not likely to demonstrate a sufficient impact on their own, and would therefore, probably not generate creditable pollutant reductions. "Some emerging measures may also take a substantial period of time to fully implement. Tree planting and protection pro-

grams, for instance, may take decades to fully realize potentially beneficial impacts. Estimates of pollutant reductions should reflect the schedule on which the measures are being put in place and growth rates over time as well as loss of trees due to disease or removal."[1] Because of the length of time required for these programs to mature, some of these strategies may be better suited as maintenance strategies rather than as attainment strategies.

Voluntary Measures

A voluntary measure is a SIP measure or strategy that is not enforceable against an individual emission source. This measure allows for flexibility in meeting the SIP enforceability requirement. Tree-planting programs can choose to use this measure, but it is not required.

Even though an individual source would not receive direct benefit from participating in a voluntary measures program, there are incentives for sources to participate. These include a desire on the source's part to contribute to improved air quality and possible recognition by the state or others of the source's contribution to air quality improvement.

While voluntary measures are not enforceable against the source, a state would be responsible for assuring that the reductions credited in the SIP occur. The state would make an enforceable commitment to monitor, assess, and report on the reductions resulting from the voluntary measures and to remedy any shortfalls from forecasted reductions in a timely manner.

Basic Rules

Some basic rules[1] of emerging and voluntary air pollution reduction measures include:

1) Measure cannot replace existing measures ("antibacksliding" provision which encourage new control strategies).

2) Measure cannot be used to meet any other emissions reduction requirement.

3) States must ensure that the emissions reductions are achieved. This includes a commitment to evaluate the effectiveness of the measure.

4) Evaluation period of measure must not extend beyond attainment year. If the evaluation extends beyond these timeframes, the measure should be used solely for maintenance purposes.

5) If projected effects are not achieved, the state needs to quickly remedy any shortfall by providing enforceable emission reductions from other sources or by showing that the emissions reductions are no longer needed for attainment.

6) Measure can be continuous or seasonal (in effect only during the season of high pollution concentrations). Tree programs will likely be considered continuous, though their ozone effect is seasonal.

Percent Limitation

Because of the untested mechanisms that are allowed in emerging and voluntarry measures, the limit of credit for these measures is six percent of the total amount of emissions reductions required for attainment.

This limit applies to the total number of emissions reductions that can be claimed from any combination of voluntary and/or emerging measures. This limit also does not apply to the total area emissions, but only the increment in emissions reduction necessary to achieve attainment. However, the EPA believes it may approve measures into a SIP in excess of six percent where a clear and convincing justification is made by a state as to why a higher limit should apply.

As an example, if an area needs to reach an emission level of 400 tons per day (tpd) and has current total emission of 1,200 tpd, but the current SIP measures would reduce the emissions to 700 tpd, this would lead to 300 tpd shortfall (700–400 tpd). A voluntary and/or emerging measure could only receive a credit of 18 tpd (6% of 300 tpd shortfall).

As tree-planting programs will most likely focus on ozone reduction, and not reduction in tons of emission precursor chemicals, it is not clear how this six percent limit will apply to a tree-planting program. One possible solution is to convert the reduction in ozone concentration due the program to an equivalent reduction in emissions (e.g., 1 ppb reduction in the area is equivalent to x tons of emissions reduction per day).

Program Evaluation

"Program evaluation is the process of retrospectively assessing the performance of an emerging measure.

Tree can be used to increase air quality.

The primary purpose of program evaluation is to quantify the amount of actual reductions realized through the program and to serve as a basis for adjustments to the amount of emission reductions available if the original estimates of emission reductions are not being achieved."[1] In the SIP submittal, the state should develop and include specific program evaluation procedures for the emerging and/or voluntary measure.

"The state should carefully consider which approach can provide the most effective means to accurately evaluate the emerging and/ or voluntary measure. The approach will depend greatly on what type of measure is being evaluated. The actual effect of some measures on pollutant levels may be impossible to accurately determine by empirical measurement and will depend instead on updated modeling or scientific calculations. In that case, the state of the science behind the original emission reduction assumptions should be carefully reviewed and updated to reflect any new information that may now be available."[1] In all cases, there should be some activity measure that can be evaluated to ensure that the emerging and/or voluntary measure is being implemented.

For example, strategic tree-planting strategies to enhance urban canopy cover require actions to increase the amount of healthy leaf surface area and cover in urban areas. Although these actions are not direct measures of ozone reduction, they are necessary to implement an ozone reduction strategy through trees and can be directly measured and compared to the original assumptions and modeling. At the same time, the ozone modeling should be updated to reflect any better science or new information available regarding the efficacy of trees as an ozone reduction strategy.

Urban Forestry Options

There are two potential options for incorporating urban forests within SIPs. One program accounts for new tree plantings, the other accounts for landscape change. Both programs are designed to reach a future greater tree canopy level.

New Tree Plantings

This approach uses monitoring of new tree plantings to ensure that the new canopy cover prescribed in the SIP is attained. If the SIP program is designed to add a certain number of acres of new canopy by a certain year, then estimates of the number of trees needing to be planted or established annually is calculated (accounting for tree growth and mortality) to develop a verifiable program that will reach the canopy cover goal.

New tree plantings should include all trees added within the area, including areas where trees are allowed to regenerate naturally, forest regeneration programs, and new street, park, and yard trees planted by public agencies or private citizens. Non-profit groups, municipal organizations, and nurseries could be involved with enhancing the tree canopy cover and recording information on new tree plantings within a regional database.

To evaluate the tree-planting program, statistical sampling of the new tree population (with locations recorded in a database) could be used to verify the amount of new canopy attained as part of the SIP program. This program could only get credit for new tree establishment and assumes the existing landscape will not change.

Landscape Change

As urban landscapes often change due to development and other causes of public and private tree removal, a more realistic approach to account for tree effects is to incorporate projected landscape change. In this approach, tree cover in the region is monitored, for example, using aerial photography or satellite images. The concept here is to establish a desired level overall canopy cover for some point in the future. If urban development projections are that the region's tree cover is to drop from 25% to 15% in the next 20 years, the goal of the SIP's urban tree program may be to maintain the current tree cover level (25%). Using a landscape approach, net change in canopy cover is important, and both new tree planting and preservation of existing canopy cover can be given credit in a SIP toward sustaining the desired enhanced canopy level. However, successful implementation of the landscape change canopy program relies on programs that go beyond trees and must incorporate urban development strategies.

This landscape approach will likely yield the most successful results in attaining the National Ambient Air Quality Standards in the future as development must be incorporated into attainment projections. However, as current SIP projections do not necessarily have to account for future landscape changes, the new tree planting option may be the most appropriate option for now. Discussions with local air quality personnel will help determine the best potential tree approach for each region.

Tree Growth and SIPs

Tree-planting, tree maintenance, and preservation programs can be used to help reach or maintain attainment within a SIP. Regardless of which approach is used, tree effects on air quality will likely increase through time as new tree canopies grow (assuming growth is greater than loss due to tree mortality). If program benefits increase through time, there is the potential for increased credit through time. For example, imagine a tree program that yields a canopy increase of two percent to help reach SIP attainment by 2010. The canopy level will likely increase after that date, and could increase to six percent by 2020. This additional four percent increase in canopy may be creditable under the maintenance SIP (assuming the area is designated as maintenance area in the future). These issues need to be explored with the EPA, but there is potential for increasing credit through time if the canopy is verified to increase.

EPA Encouragement

The EPA "**wishes to encourage states to develop and adopt voluntary and emerging measures for meeting SIP requirements.**"[1] States are encouraged to work with their EPA regional office during the development process. However, states are expected to use more traditional methods that may be available before attempting to use voluntary or emerging measures.

In addition to EPA encouragement to use emerging and voluntary measures, which include tree planting, states should be encouraged by the fact that a tree-planting program will provide numerous other environmental benefits at no additional cost, such as:

- Water quality improvement;
- Reduced air temperatures;
- Reduced ultraviolet radiation loads;
- Enhanced building energy conservation; and
- Improved living environment.

These additional benefits can also improve human health and environmental quality, and reduce associated costs in urban areas. In addition, these benefits will increase through time as the trees grow.

Implementing a Tree Planting Program within a SIP

This final section details how forestry professionals can assist state air quality personnel in developing a SIP that includes tree planting. There are four overall steps for incorporating trees in a SIP.

1) Resource Assessment. What is the current tree cover level and how much can tree cover be increased in the area? Using National Land Cover Classification cover maps[5] that are currently being developed or digital aerial photos, the amount of tree cover or plantable space can be determined. Based on these data, state forestry officials need to determine how much of this potentially plantable space can be reasonably increased through tree planting or natural regeneration.

2) Air Quality Modeling. Based on data in number one, air quality modelers can model the effects of increased canopy cover on ozone concentrations. This modeling process incorporates various models that simulate the effects of trees on changing air temperatures, anthropogenic and biogenic emissions, and pollution removal. In addition to tree effects, urban heat island strategies and/or energy reduction programs may also want to be included in the SIP modeling effort (include changing the reflectivity of urban surfaces to reduce air temperatures and/or strategically planting tree around residences to reduce summer-time building energy use and consequently emissions from power plants).

3) Develop a Verifiable Strategy to Increase Canopy Cover. This is an important part of the program, particularly related to program verification. State forestry and air officials need to develop a verifiable means to ensure that the tree-planting program is successful and reaching the projected canopy increase that was modeled (see stop number two). Various ideas on how to enhance urban canopy cover for use in SIPs have been proposed[6]. However, given the program evaluation guidelines, it is likely that some sort of database will need to be developed detailing all the new tree plantings or change in tree cover occurring in the non-attainment or maintenance region (see "Urban Forestry Options").

A specific program evaluation procedure will need to be developed to verify that the estimated reasonable increase in tree cover (see number one above) is attained by the projected date.

4) Submit Measure within SIP. If state modeling results shows reductions in ozone concentration (as past studies have) and the reduction is considered significant relative to the tree-planting and verification program costs, then the program should be considered for inclusion in the SIP (either for attainment or maintenance). Compared with other measures to reduce ozone, tree planting may or may not be the most cost-effective program. However, as noted earlier, the benefits of a tree canopy enhancement program extend well beyond just ozone air quality. Tree canopy enhancement programs should be considered by the state as an environmental and human health enhancement program that includes multiple facets of the environment (e.g., air, water, social) that can be used to aid in meeting air quality standards within a SIP.

Footnotes

1 www.epa.gov/ttn/oarpg/t1/memoranda/evm_ievm_g.pdf

2 www.epa.gov/ozonedesignations/

3 http://epa.gov/air/criteria.html

4 www.fs.fed.us/ne/syracuse/TREE Air Qual.pdf

5 www.mrlc.gov/mrlc2k_nlcd.asp

6 http.fs.fed.us/ne/Syracuse/Pubs/Downloads/Final_report_March2002_Davey.pdf

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