Ozone State Implementation Planning
2010 Progress Report to the Governor
Pursuant to Executive Order B 002 09

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February 2011
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i. Executive Summary

RAQC Historical Background

The Regional Air Quality Council (RAQC) was formed in 1989 by Executive Order of the Governor to serve as the lead agency for air quality planning in the seven-county Denver region. As lead planning agency for air quality, the RAQC frames and develops proposed plans (State Implementation Plans or “SIPs”) for protecting air quality and forwards them to the Colorado Air Quality Commission (AQCC) for consideration and approval. Since 1989, the RAQC has successfully developed SIPs for carbon monoxide, PM-10 and ozone (smog), as required by the federal Clean Air Act Amendments of 1990. Through the coordinated efforts of the RAQC, the State of Colorado, local governments, private businesses, and the public, the region has made significant progress in improving air quality and achieving federal air quality standards.

2009 Governor’s Executive Order and RAQC’s Updated Mission

In March, 2009, Governor Ritter signed Executive Order B 002 09 (See Attachment A) recreating and reauthorizing the RAQC. This Executive Order acknowledged the need for the RAQC to make a concerted effort to reduce emissions from vehicles, reduce vehicle miles traveled and other measures that yield emission reductions from the transportation sector, and to do so working more closely with key state partners: The Colorado Department of Public Health and Environment (CDPHE) and the Colorado Department of Transportation (CDOT), the Colorado Department of Local Affairs (DOLA), as well as local and regional leaders of all sectors who serve on the RAQC itself.

The RAQC has a number of prescribed responsibilities defined in the Executive Order, including convening discussions with CDOT, CDPHE, the Denver Regional Council of Governments, the North Front Range Transportation and Air Quality Planning Council, affected municipal and county governments, transit agencies, and others, as appropriate. These discussions are designed to identify, assess and choose from a wide range of strategies that might be available to reduce ozone and greenhouse gas emissions, including those that are being used or tested elsewhere in the country.

Ozone Pollution and Federal Public Health Protection

Inhaling ground-level ozone can result in a number of health effects that are observed in broad segments of the population. Some of these effects include: induction of respiratory symptoms, decrements in lung function and inflammation of airways. Respiratory symptoms can include: 1) coughing; 2) throat irritation, pain, burning, or discomfort in the chest when taking a deep breath; and, 3) chest tightness, wheezing, or shortness of breath.

The Environmental Protection Agency (EPA) is responsible for establishing and periodically updating the federal public health standards, including the standard for ozone. EPA relies on an independent team of expert scientists known as Clean Air Science Advisory Committee (CASAC) for advice in setting appropriate health-based air quality standards.

EPA initially lowered the 8-hour ozone standard from 0.084 parts per million (ppm) to 0.075 ppm in 2008. Then, in 2010, EPA reconsidered the 2008 standard and proposed a further
tightening of this standard to a range between 0.060-0.070 ppm. EPA originally announced its intention to promulgate the new standard in August 2010, but recently announced a delay to July 31, 2011 so that the agency can garner further input and clarification from CASAC. EPA predicts that a new standard in the proposed range would help prevent up to 12,000 premature deaths, 58,000 cases of aggravated asthma and save up to $100 billion dollars in health costs.

Regardless of where within the 0.060 to 0.070 ppm range EPA sets the new ozone standard, meeting it will require unprecedented efforts not only for Colorado, but throughout the United States. Figures 1 and 2 present a map of Colorado’s current ozone nonattainment area, as well as the region’s compliance trends and status.

Given our current compliance status, the region’s efforts to reach ozone attainment will have to be aggressive. They will need to include consideration of strategies to reduce emissions of ozone precursors from stationary sources, the transportation sector, and other source categories. Unless EPA delays its ozone standard implementation schedule, the RAQC must provide a proposed ozone SIP to the AQCC by mid 2012, the AQCC must act upon it by December 2012, and, in 2013, the General Assembly must review it and the Governor must submit it to EPA for approval.

**Ozone SIP Planning**

Ozone SIP planning is presently the RAQC’s highest and most challenging priority. With Colorado’s growing population, vehicle use and industrial activity, and as EPA tightens the 8 hour ozone (smog) standard, maintaining compliance with this public health-based standard has been a continuing challenge. While the Denver/North Front Range region made progress managing ozone pollution, it nonetheless did fall out of compliance with the 1997 ozone standard during the summer of 2007. EPA officially designated the region “nonattainment” in November 2007. In December 2008 the AQCC approved a new ozone attainment plan to demonstrate attainment with the 1997 standard. This plan was framed and developed by the RAQC with extensive input from stakeholders and technical support from the Colorado Department of Public Health (CDPHE) Air Pollution Control Division (APCD). This SIP is pending EPA approval in early 2011.

What happens if the region does not demonstrate attainment of the ozone standard? While there are certainly costs associated with meeting the federal health based ozone standard, there are also very real costs if the region does not meet the standard. Not only does the Clean Air Act give EPA the authority to withhold federal funding for the Colorado Air Pollution Control Division program (which the Agency recently did so for a brief time period due to Regional Haze nonattainment), but it gives EPA the choice to take over Colorado’s air quality program, tighten pollution source requirements and withhold federal transportation funding. An estimated $140 million in annual transportation funding is potentially at risk, and EPA sanctions can restrict the type of transportation projects and limit the flexibility on how the region invests transportation dollars.

By way of example of what EPA can do if the Denver region does not demonstrate attainment via a SIP, in early 2010 EPA Region 8 informed CDPHE that it would withhold slightly over $1M because the EPA did not think Colorado could submit an approvable Regional Haze SIP by the Jan. 15, 2011 deadline. EPA would have used these funds to hire a contractor to prepare a Regional Haze Federal Implementation Plan – a much greater cost than what CDPHE actually needed to prepare the SIP. This action would also
have lead to other CDPHE air program elements being cut. While EPA did withhold the funds for a period of time, it eventually released them to CDPHE in August, 2010 only after extensive work and negotiations to reach an agreement that outlined how CDPHE would “fix” the Regional Haze SIP.

2010 RAQC Activities

The newly constituted RAQC’s 2010 work program was ambitious. It was also unlike previous RAQC efforts involving development of a proposed SIP. It was designed to position the RAQC Board to guide staff priorities on ozone SIP development through the completion in 2012 of the proposed SIP. It was also designed to ensure that a broad list of innovative and traditional emission control strategies are fully considered by the RAQC Board before the RAQC begins selecting ozone SIP control strategies. To this end, the majority of the RAQC’s 2010 time was spent learning about ozone reduction strategy options, including those employed elsewhere in the country, and preliminarily assessing them for their timeliness, feasibility and practicality. Importantly, efforts were made not only to involve representatives from key groups (Air Quality Control Commission, Denver Regional Council of Governments, the Metro Mayor’s Caucus, North Front Range Metropolitan Planning Organization, the Public Utilities Commission, EPA, etc) in the RAQC’s activities, but also to reach out them via RAQC Chair presentations to these key groups.

In keeping with the Governor’s Executive Order, the RAQC 2010 work program emphasized discussion and evaluation of certain potential ozone control measures and their co-benefits. More specifically, discussions involved motor vehicles, motor vehicle fuels, alternative transportation, land use and transportation pricing. It did so, in part, by breaking into several key subcommittees and producing preliminary assessments of each strategy, taken from a master list developed by staff and shaped by the RAQC Board.

Staff also kept the RAQC Board updated on ongoing related technical and policy activities affecting the work of the RAQC (e.g. Regional Haze SIP, Clean Air Clean Jobs Act, Fuels Study, emission inventories, air quality modeling, and EPA activities/announcements involving ozone SIP development).

Key 2010 Recommendations

At the close of 2010, the RAQC Board made several key recommendations based on the results of its work and as presented in detail in this report. They are as follows and should be viewed as “living” since important factors, such as what the final ozone standard will be, when it will become effective, and how EPA will guide its implementation, remain unconfirmed:

1. In early 2011 prioritize and conduct further analysis on select ozone control measures which were preliminarily assessed in 2010.

2. Engage EPA as soon as possible to obtain their views on the ability of and means by which emission control measures preliminarily assessed in 2010 could: (a) receive (and take full) credit in the ozone SIP; (b) be used to reduce the emission baseline in the ozone SIP; and/or, (c) demonstrate long term maintenance of the ozone standard. Thereafter, discuss how EPA’s views affect the RAQC’s ozone SIP development strategy.
3. Continue to collaborate with and directly involve key interests and leaders (e.g. business, environmental, public health, local and regional government, state Commissions) during 2011 RAQC meetings, taking steps to reach out to them at strategic moments.

4. As work progresses, continue to develop an understanding of and an emphasis on the co-benefits (e.g. energy consumption, climate, traffic congestion, economy, public health, quality of life and livability, brown cloud and other air pollution concerns) of reducing ozone pollution.

5. Building on ongoing work at CDPHE and the RAQC, assess all stationary source and area source emission reduction strategies (see Attachment G) in a manner consistent with other strategies assessed in 2010.

6. Update and improve air quality modeling used to develop the ozone SIP, taking into consideration 2010 input from modeling experts, and hold a follow-up modeling forum in 2011.

7. Keep the RAQC informed of related activities affecting ozone SIP development (e.g. Regional Haze SIP, HB 1365 implementation, proposal and adoption of federal emissions control measures, etc.).

8. By year end, position the RAQC Board to have a working sense of the magnitude of needed ozone reductions by preliminarily identifying ozone strategies for 2013 SIP and determining further 2012 analysis needed.

Next Steps

The 2011 Meeting Framework is designed to implement the RAQC 2010 recommendations and present “Next Steps”. This document is contained in Attachment F. Its underlying goals are to:

- Position the RAQC to begin bracketing measures to include in or exclude from the ozone SIP;
- Keep the momentum, interest in, and understanding of the RAQC’s work;
- Continue to provide an avenue for expert advice and perspective from those with ozone nonattainment experience;
- Under the leadership of RAQC existing Subcommittees, refine assessments with further analysis as well as input from all sectors and EPA
- Employ analytical tools and existing data to advance understanding of the magnitude of ozone reductions needed
Figure 1: Denver Metro/North Front Range Ozone Nonattainment Area

Figure 2: 8-hour Ozone Compliance Trends and Status

8-hour Ozone --- 3-year Avg. of 4th Max.
Front Range area (key sites)

2009 thru 10/31
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I. Background

The Regional Air Quality Council (RAQC) was formed in 1989 to serve as the lead agency for air quality planning in the seven-county Denver region. As lead planning agency for air quality, the RAQC frames and develops proposed plans (State Implementation Plans or “SIPs”) for protecting air quality and forwards them to the Colorado Air Quality Control Commission (AQCC) for consideration and approval. Since 1989, the RAQC has successfully developed SIPs for carbon monoxide, PM-10 and ozone (smog), as required by the federal Clean Air Act Amendments of 1990. Through the coordinated efforts of the RAQC, the State of Colorado, local governments, private businesses, and the public, the region has made significant progress in improving air quality and achieving federal air quality standards.

a. 2009 Governor’s Executive Order and RAQC’s Updated Mission

In March 2009, Governor Ritter issued an Executive Order (B 002.09 – see Attachment A) that recreated the Regional Air Quality Council Board (RAQC) and, among other things, directed it to develop and report on options to further reduce emissions from vehicles, reduce vehicle miles traveled (VMT) and consider other measures that yield emission reductions from the transportation sector. This executive order also reinforced the RAQC’s traditional planning and public education functions.

Importantly, the Executive Order directed the RAQC to coordinate its effort with the Colorado Department of Public Health and Environment (CDPHE), Colorado Department of Transportation (CDOT), the Denver Regional Council of Governments (DRCOG), the North Front Range Metropolitan Planning Organization (NFRMPO), local governments and other transportation agencies/entities. The Governor appointed a new 25-member board with broad community representation to carry out this new focus.

The Governor’s 2009 Executive Order redefined the RAQC’s mission. Specifically it expanded the Council’s membership, including additional local elected officials and representatives with experience in transportation, land use planning, and transit. It also recognized the importance of coordinating air quality planning efforts with the North Front Range region by appointing a local government representative and other citizens from this area to serve on the RAQC. The duties and powers of the RAQC as presented in the Executive Order further defined the RAQC’s mission and are summarized below:

A. The Council serves as the lead planning agency for air quality that forwards to the AQCC proposed amendments to the SIP to address attainment and maintenance requirements for the metropolitan area under the Clean Air Act.

B. The Council will work closely with CDPHE. CDPHE, in coordination with the Council staff, has the lead responsibility for developing air quality assessments and air quality improvement strategies and addresses the development of ozone management strategies in a fashion coordinated with other air quality planning processes, such as regional haze and Rocky Mountain National Park nitrogen deposition.

C. The Council shall work with CDPHE and appropriate agencies in evaluating and developing strategies for completing required amendments to the state implementation plan.
D. The Council, in coordination with the Colorado Department of Transportation (CDOT), will convene discussions with the Denver Regional Council of Governments (DRCOG), the North Front Range Transportation and Air Quality Planning Council (NFRTAQPC), affected municipal and county governments, transit agencies and others, as appropriate. These discussions will identify and discuss strategies that might be available from the transportation sector to reduce emissions of ozone precursors and greenhouse gases, in anticipation that emissions reductions may be required from this sector to demonstrate attainment of the ozone standard. The Council shall report to the Governor its plan for coordinating these discussions, as well as the results once the effort is complete.

E. The Council shall be responsible for developing and administering public education and outreach programs regarding air quality and air pollution prevention and control in the Denver Metropolitan Area. Council material shall include discussion of the public health and environmental benefits, as well as the cost effectiveness of providing good air quality in the region.

F. The Council shall serve as an educational resource on regional air quality issues to the elected city and county officials in the Denver metropolitan area and shall provide support to the NFRTAQP as appropriate.

G. The Council may participate in rule-making proceedings where appropriate and consistent with the rules and procedures of the regulatory body involved in the proceeding.

H. The Council shall continue its ongoing efforts to reduce vehicle tailpipe emissions through the Repair Your Air Campaign and diesel retrofit programs.

b. **2010 RAQC Meetings and Highlights**

**RAQC Workplan** - In view of the Executive Order’s emphasis on consideration of transportation-related strategies for reducing air emissions, the RAQC’s 2010 Work Plan (see www.raqc.org) followed an approach for facilitating a conversation by the RAQC about such strategies. This effort was designed to facilitate understanding about strategies that could:

- Reduce emissions of ozone precursors;
- Offer additional air quality benefits, such as reduction of greenhouse gas emissions and fine particulate matter; and
- Support the State Implementation Plan (SIP) for ozone.

**RAQC 2010 Meeting Framework** - The RAQC’s 2010 Meeting Framework (see Attachment B) offered a structure for completing this approach. Each meeting was carefully designed to balance discussion of new ideas for meeting ozone standards with presentations by staff experts on the building blocks of ozone SIP planning, such as emissions sources, air quality data and modeling. First, there were a series of presentations and a dialogue stretching into the summer of 2010 designed to:

1. Give RAQC members a sense of what the region's air quality is, what sources contribute to ozone pollution and how far the region may need to go to meet the proposed new federal ozone standard (recognizing the final standard has not yet been established by EPA);
2. Offer the RAQC ideas on how various transportation and land use strategies for reducing air emissions have been applied elsewhere in the country and how they could be effective in the Denver Metro Area and North Front Range; and

3. Elicit views from other sectors in the region on methods and associated benefits and costs of meeting a tighter federal ozone standard.

Next, the RAQC followed the meeting framework to begin identifying and discussing a wide-ranging host of transportation and land use measures that might be considered for the ozone SIP.

**RAQC Meeting Participants, Highlights and Key Messages** - The first six months included presentations and discussions with key leaders, experts and industries in order to set the stage for the RAQC’s future work and discussions.

During the RAQC’s first meeting in January, the Board heard from Jim Martin, former Executive Director of CDPHE and a key architect of the current RAQC structure and mission. Chairman Andy Spielman, who has served as chair of the RAQC since 2008, also shared his perspectives and those of the Governor on the upcoming challenges for the RAQC. The keynote speaker for the kickoff meeting was Fred Hansen, General Manager of Tri-Met in Portland, Oregon and a former Deputy Administrator at EPA in the 1990’s. Mr. Hansen is recognized as a leader in the transit world. He shared what Portland has been doing to integrate transportation, land and air quality planning and delivered a message that land use and transportation must be fully integrated in order to address air quality and global climate change as well as the mobility needs of citizens.

In subsequent Board meetings, the RAQC heard and discussed presentations on transportation and land use measures for managing air quality with a wide range of local, state and national leaders representing various sectors and points of view. These people were:

- Tom Clark, Metro Denver Economic Development Corporation
- Stephen Flaherty, Noble Energy
- Russell George, Colorado Department of Transportation
- Martha Rudolph, Colorado Department of Public Health and Environment
- Jim Martin, Colorado Department of Natural Resources
- Susan Kirkpatrick, Colorado Department of Local Affairs
- Jennifer Schaufele, Denver Regional Council of Governments
- Vickie Patton, Environmental Defense Fund
- Elizabeth Garner, Colorado State Demographer
- Philip Washington, Regional Transportation District
- Geoff Anderson, Smart Growth America
- Shelley Poticha, HUD, Office of Sustainable Housing and Communities
- Bob Yuhnk, Southwest Energy Efficiency Project
- Greg Green, EPA Headquarters Office of Air Quality Planning and Standards
- Lee Cook, EPA Headquarters Office of Transportation and Air Quality
- John Thomas, EPA Headquarters Office of Sustainable Communities
- Callie Videtich, EPA Region VIII Air Program
• Parris Glendening, former Governor of Maryland and President of the Governor’s Institute on Community Design
• Bill Mosher, Trammel Crow in Denver
• Brian Leary, Atlanta Beltline, Inc.
• Mike McKeever, Sacramento Area Council of Governments (SACOG)
• Tom Cosgrove, SACOG Board Member
• Larry Greene, Sacramento Metropolitan Air Quality Management District
• Tamar Shaprio, Governor’s Institute on Community Design
• Clark Wilson, EPA Office of Policy, Economics and Innovation
• Joe Cortright, Impresa Consulting

RAQC staff maintained a list of presenter’s ideas, key points and recommendations that surfaced during these discussions. Highlights include the following and offer a useful perspective for the RAQC 2011 work program:

• The Front Range is not alone in searching for new and innovative ways to address air quality challenges; however, the work that has started here will help those in Region 8 as well as the nation.
• The keys to success are broad public outreach, planning at the corridor scale, incentives, solutions tailored to the context, government wide leadership and working with the U.S. EPA and the Sustainable Communities Partnership.
• Air quality has become an economic problem and it affects how businesses consider the Denver metropolitan area for their business location.
• Good environmental policy is not in competition with good economic policy.
• In 2020, mobile sources are still projected to account for up to 50% of the NOx emissions, and substantial hydrocarbon and PM emissions. Mobile sources will continue to significantly contribute to air pollution problems in many parts of the country.
• To make sustainable change, more VMT and fuel use reductions will be needed to achieve a corresponding change in emissions. Reductions in VMT, fuel use, and emissions of both ozone precursors and greenhouse gases are possible using land use planning, transportation pricing policies and investment priorities.
• Transit is not just about moving people, but needs to include transformational infrastructure to allow communities to develop in ways that otherwise would not have occurred.
• Transit goes beyond Transit Oriented Development (TOD), we must create Transit Oriented Communities (TOC) to address the issues we face.
• Making fundamental decisions from a regional perspective to grow in concentrated areas around infrastructure is critical. In the short term, it is crucial to make little connections which emphasize the investment in transit.
• As a community, it is necessary to make the connection that transportation impacts land use. The ultimate goal should be to create ridership by having people live and work in the area and use transit in a community oriented fashion that connects people and jobs. It is important to drive jobs to where transit is located not just build condominiums and coffee shops around transit lines. The biggest challenge is balancing jobs, residence and parking at stations and finding a balance that creates a reduction in vehicle miles traveled..
• Once local governments feel empowered, choices get made.
• Successful air quality planning in the region will rely increasingly on encouraging local governments who engage in land use planning to more extensively consider the air quality
implications and transportation costs associated with land use decisions. One consideration needs to reflect the implications of shifting costs and paying for services in different ways (e.g. point of service rather than taxes).

- Through the Livable Centers Initiative, the Atlanta region made a fundamental decision to grow in concentrated areas around existing infrastructure. In the short term, it was crucial to make little connections to emphasize that the investment was worthwhile. Clearly communicating options and associated flexibility to the community of the options is a key component to gaining support for innovative action.
- Corridor alliances of partners, which would include government, business and neighborhood groups, are needed in the Denver region to coordinate communications and to get a land use initiative developed.
- Sacramento Council of Government's Blueprint: Transportation and Land Use Study focused on principles including housing choice, transportation choice, compact development, use of existing assets, mixed uses, high quality design and protection of natural resources. The process to develop the Blueprint brought broad based support which has decreased VMT and decreased trip length through the land use changes developed in the Blueprint. SACOG worked with EPA to allow their SIP to consider aspects of the "Blueprint".
- Energy efficiency and renewable energy (EE/RE) measures are of interest and EPA is developing a roadmap manual from existing EPA guidance to facilitate incorporation of these EE/RE measures into SIPs.
- Incorporating effective land use strategies into air quality planning is not a new idea and these strategies go beyond just reducing emissions.
- Agencies need to figure out how to loosen the State Implementation Plan (SIP) process to recognize transportation and land use measures that might be included in the Ozone SIP in addition to the more traditional measures.

The RAQC website (www.raqc.org) contains all materials provided and discussed during these meetings, as well as the meeting minutes.

**Discussions and Presentations with CDPHE/RAQC Technical Staff** - To ensure the RAQC’s 2010 work remained well coordinated with and complementary to that of the AQCC, the RAQC also received and discussed presentations by CDPHE and RAQC staff on key ongoing air quality planning and analytical efforts underway, including:

- Ozone planning, analysis and control strategies (e.g. fuels study) considered and adopted to-date;
- Past and current ozone modeling procedures and results;
- Regional Haze State Implementation Plan development; and
- Implications of HB 1365 – Clean Air Clean Jobs Act – on metro area power plant emissions.

**The Governor’s Institute on Community Design** - The RAQC also enjoyed instrumental support from The Governor’s Institute on Community Design. On June 4, the RAQC convened and co-hosted a meeting of leaders from across the community and the Country (including Sacramento, California and Atlanta, Georgia and listed above) to advance the region’s understanding about ways to improve air quality, through such efforts as connecting transportation and land use planning – all aimed at reducing vehicle use and Colorado ozone pollution. The meeting was co-hosted by the office of Governor Ritter, the
Denver Regional Council of Governments, the North Front Range Metropolitan Planning Organization and the Metro Mayors Caucus; and was sponsored by the Governors’ Institute on Community Design.

Topics at the workshop included “connecting transportation and land use with Clean Air Act planning needs at the regional level” and “how the state can support innovation in transportation and land use planning to meet air quality goals.”

**Collaboration With EPA** - The RAQC also benefited in 2010 from early ozone SIP planning expertise and involvement from EPA; and has set a course for continuing this critical collaboration. In addition to regular meeting attendance by EPA Region VIII staff, the October meeting was special. Under the leadership of senior EPA and CDPHE staff, EPA Headquarters personnel from North Carolina, Ann Arbor and Washington DC joined Region VIII staff and RAQC Board members in broad ranging discussion about the ozone standard and SIP planning.

The discussion centered on the following topics:

- Overview of ozone standard implementation approaches and Federal air quality control measures under consideration to help states address tough new ozone challenges.
- How mobile source measures will be viewed for SIP purposes; with emphasis on fuels/motor vehicle and transportation and land use measures, since this is the current focus of the RAQC at this early thinking stage.
- Insight into other area(s) where specific innovative measures, such as those under consideration by the RAQC have been advanced either to establish SIP baseline or as SIP measures.
- How states like Colorado with ozone transport concerns can address compliance with the standard when it is known that a significant portion of ozone is transported from beyond the state and elsewhere within Colorado.
- A process for collaborating into 2011 with EPA to get feedback from the agency on the preliminary high levels assessments of fuels, motor vehicles, transportation pricing, and alternative transportation and land use strategies that the RAQC subcommittees have worked so hard on during the last quarter of 2010 (see c. below and Attachment C). This process will provide the RAQC Board during the in 2011 a sense of from EPA about:

1. Whether a particular measure for reducing ozone (and other pollutants of concern or “co-benefits”) has been used elsewhere in the US for attainment planning purposes, including where, to what degree, and to what success;

2. Whether, how and to what extent each measure is likely to be eligible for SIP credit; or whether it is more likely to be eligible to effect the nonattainment area’s baseline calculation, in which case how EPA would prefer to see the measure addressed in the ozone SIP;

3. Which measures will simply not be eligible for SIP credit and why.

The RAQC recognizes the critical role EPA can play in the region’s successful efforts to attain federal air quality standards primarily because the relatively “easy” strategies have already been tapped. Future ozone attainment efforts will be very difficult and require innovation, collaboration and tough decisions.
**National Governor’s Association** - The RAQC also enjoyed support from the National Governor’s Association. Along with four other states, Colorado was accepted into the Policy Academy on Shaping a New Approach to Transportation and Land Use Planning. This has been a great opportunity to look at the types of transportation and land use decisions that allow the region to meet ozone and other air quality standards, as well as obstacles that prevent state, regional and local leaders from making decisions that meet air quality standards.

Meetings in Washington, D.C. and Washington State, involving several RAQC members, offered plenary sessions and one-on-one consultations with other state leaders and experts on key design and implementation opportunities and issues, including:

- The link between transportation and air quality and economic development;
- Reshaping governance models;
- Innovative financing mechanisms;
- Improving the planning process;
- Developing performance metrics (e.g. SIP measures);
- Key federal, state and local partnerships needed to proceed successfully;
- The outcome of this continuing support is a plan for further defining and acquiring technical assistance from the NGA for specific RAQC ozone planning needs. During the January meeting, a nationally recognized consultant will discuss the results of his analysis of the Denver region on the economic impacts of reducing VMT in Metro Denver. Future NGA support may be available to help the RAQC design how best to set the RAQC up for success in identifying, analyzing and choosing SIP measures that include both stationary and transportation options.
- Bring economic perspective and analysis tailored to Denver that will help the RAQC (and others) understand how and in what direction transportation and land use decisions drive the region’s economy;
- Initiate steps to have state of the art transportation and land use scenario planning tools employed along the Front Range to facilitate long term maintenance of air quality standards, as well as DRCOG sustainability and other goals.

c. **RAQC Subcommittees and Preliminary Assessments of Potential Ozone Control Measures**

The RAQC meeting discussions occurring the first half of 2010 resulted in development of a comprehensive list of potential transportation and motor vehicle-related emission control measures to be considered in developing the ozone SIP (Note: stationary and area source measures will be evaluated in 2011 and are discussed later in this document).

The Board determined subcommittees comprised of RAQC members should be convened to assess the strategies. The strategies were segmented into five categories:

- Fuels
- Motor Vehicles
- Alternative Transportation
- Land Use
- Transportation Pricing
The subcommittees created are: Fuels/Motor Vehicles, Alternative Transportation/Land Use, and Transportation Pricing. To aid the subcommittees, RAQC and CDPHE staff prepared high-level assessments that summarized current knowledge and utilization of the strategies and identified where additional analysis and input should occur in 2011 as part of the Ozone SIP planning process. The high-level assessments assembled first-cut information on descriptions of the scope of the measure, anticipated costs and air quality benefits, additional technical analysis to refine the benefit/costs estimates, implementation feasibility, demonstrated ability to include in a SIP as a designated or baseline measure, timing of implementation, co-benefits, and other considerations based on past experience locally or in other areas.

The subcommittees and ultimately the full RAQC Board reviewed each assessment and generally identified the next steps along four possible outcomes:

- Potential measures for SIP inclusion that require further analysis/input in 2011 and what that analysis should be;
- Potential measures important for meeting the ozone standard, but not likely to be a SIP measure and require further analysis/input in 2011;
- Potential long-term measures for ozone maintenance that require further analysis in 2011/1012;
- Potential measures that may be valuable for ozone attainment and maintenance but are lower priority due to implementation challenges and timing of benefits, but should not be removed entirely from consideration.

Section III of this report summarizes the assessment of identified measures, while individual assessments for each of the measures is included in Attachment C.

Additionally, an "Ozone SIP Measure Selection Goals and Criteria" subcommittee was created to identify and define the overall goals and decision-making criteria for including the control measures in the SIP. This subcommittee developed 10 goals and criteria for use when the RAQC begins to select strategies for inclusion in the Ozone SIP. These are listed in Attachment D.

d. **Additional Key 2010 RAQC Activities**

Elements of the usual and customary air quality planning processes such as development of stationary source inventories, air quality modeling, and associated air pollution control strategies continued concurrently. The RAQC continued to work closely with its partners on these efforts so that these complementary efforts meet at the appropriate juncture to result in development and submittal of the SIP, to the maximum extent practicable.

**Ozone SIP Planning: The General Challenge Before the RAQC**

As Colorado’s population, vehicle use and industrial activity grow, and as EPA tightens the 8 hour ozone (smog) standard, maintaining compliance with this federal health-based standard (first established in 1997) has been a continuing challenge. The Denver/North Front Range region fell out of compliance with the standard during the summer of 2007 and EPA officially designated the region “nonattainment” in November 2007. In December 2008, the AQCC approved a new ozone attainment plan. This plan was
framed and developed by the RAQC, with extensive input from stakeholders and the CDPHE Air Pollution Control Division. The plan is pending approval from EPA in early 2011.

In 2008, EPA lowered the 8-hour ozone standard to 0.075 parts per million (ppm). New EPA Administrator Jackson reconsidered EPA’s 2008 standard and in 2010 proposed a further tightening of this standard to a range between 0.060 - 0.070 ppm. EPA was originally slated to promulgate the new standard in August 2010, but EPA recently announced promulgation of the new standard has been delayed until July 31, 2011 so the Administrator can obtain further input and clarification from EPA’s science advisors.

Regardless of what the new EPA standard is, meeting it will require unprecedented efforts, not only for Colorado, but throughout the United States. These will have to include consideration of strategies to reduce emissions of ozone precursors from stationary sources, the transportation sector, and other source categories.

**Ozone Modeling in 2010**

RAQC, CDPHE and its technical consultants continued ozone modeling work in 2010. The consultants prepared a revised modeling analysis for the year 2020 based on baseline conditions and strategies on the books or anticipated by 2020. The consultants also performed various scenario analyses to determine potential ozone reductions from reductions in emissions from various source categories. The analyses indicated that currently anticipated strategies will not be sufficient to reach the levels of EPA’s new ozone standard range and additional emission reductions will be needed.

At the request of the RAQC Board, RAQC and CDPHE staff also convened a meeting of modeling experts to review, discuss and question various aspects of the ozone modeling platform and overall strategy and assumptions; and make recommendations for areas of improvement. Attachment E contains a memo summarizing that meeting and identifying agreed upon next steps to be taken in 2011.

Finally, in 2010 RAQC and CDPHE secured funding to pursue additional modeling investigations and perform the modeling analyses that will be necessary for the upcoming Ozone SIP. CDPHE secured $200,000 in state funding to support modeling analyses in 2010/11, while DRCOG and CDOT will provide $387,000 in federal transportation funds to support the SIP modeling in 2011 and 2012.

e. **Transitioning from the 2010 to 2011 Scope of Work**

As seen from the above summary of RAQC activities in 2010, the newly constituted RAQC has been focused on understanding the nature and extent of the region’s ozone issue and investigating those ozone management opportunities associated with transportation and land use. The RAQC has made considerable progress addressing these strategies and advancing their consideration as potential ozone control strategies. More work will continue on these strategies in 2011.

Attachment F contains a meeting framework for 2011 which maintains momentum on existing work. It also supports the RAQC’s evaluation of stationary and area source strategies which are also important elements of an Ozone SIP. While many of these strategies have been identified and considered to some extent in the past and/or have been applied in other areas, they require a fresh look because of the anticipated stringency of the new ozone standard. RAQC and CDPHE will prepare additional high-level
assessments for these strategies and the RAQC Board will follow a similar process as in 2010 to review and identify required further analysis.

Other areas that will receive new attention in 2011 include those of energy efficiency and its role in air quality planning and the relationship between public health protection and the built environment. RAQC and CDPHE, with help from EPA, will assess the range of energy efficiency strategies and determine potential emission reductions that could be realized from expanded implementation of such efforts. An important consideration will be to ascertain how such measures can be included in the Ozone SIP. By the end of 2011, the meeting framework has the RAQC completing an initial list of ozone control strategies for inclusion in the Ozone SIP, as well as a list of strategies that will be mentioned in the SIP to lower the emissions baseline and thus the “distance” the region has to go to demonstrate compliance with the new ozone standard.

f. **Update on EPA's Anticipated Announcement of a New, More Stringent Ozone Standard and Ozone SIP Development Timeline**

When EPA proposed tightening the ozone standard within the range of 0.060 - 0.070 ppm in January 2010, the Agency anticipated promulgating the final standard by August 2010, with nonattainment designations following in August 2011 and SIPs due from states by the end of 2013. Based on this schedule, the RAQC outlined a SIP development timeline (see g. below).

However, EPA recently announced a delay in the final issuance of the 8-hour ozone standard until "no later than July 31, 2011". In making this announcement, EPA stated that the agency is asking the Clean Air Science Advisory Committee (CASAC) for further interpretation of the epidemiological and clinical studies they used to make their (0.060 - 0.070 ppm) recommendation, EPA also said that the agency will review CASAC’s input before selecting and announcing the new standard and associated implementation guidance. Additionally, EPA stated that it will select a standard within the 0.060 - 0.070 ppm range which CASAC indicated would be protective of public health.

While the following ozone SIP development schedule may be effected by EPA's recent announcement, it is unlikely that a delay will fundamentally influence the RAQC's 2010 work progress or its proposed 2011 work plan because the ozone nonattainment area is currently exceeding 0.070 ppm; the least restrictive of the new standard's proposed range. RAQC will watch these developments carefully, paying particular attention to EPA's final ozone standard implementation guidance and make adjustments to the timeline below accordingly.

g. **Current Ozone SIP Development Timeline**

**2010**

- EPA proposes range of revised 8-hour standard in January
- RAQC is introduced to and discusses wide range of possible emission reduction measures
- RAQC receives updates/progress reports on various ongoing supporting analyses, assessments and evaluations (e.g. modeling, fuels options, paints/solvents options, other VOC options, large NOx sources options)
- EPA promulgates revised 8-hour ozone standard and implementation rule in August (*now delayed until July 2011*)
2011

- RAQC further evaluates and begins refining ozone SIP emission reduction measures
- RAQC initiates development of proposed ozone SIP
- EPA finalizes nonattainment designations and classifications in August

2012

- RAQC completes proposed Ozone SIP with supporting technical information
- RAQC and CDPHE Air Pollution Control Division, submit (by August) proposed Ozone SIP to AQCC for consideration
- AQCC takes action (by December) on Ozone SIP

2013

- Generally Assembly conducts Legislative Review of SIP by May 2013 (C.R.S. 27-7-133)
- Governor submits ozone SIP to EPA following Legislative review
- EPA requires receipt of SIP no later than December 2013
II. Preliminary Ozone Management Strategy Assessments

At the direction of the RAQC and RAQC Subcommittees, RAQC and CDPHE staff worked with subject matter experts and available studies, information and data to develop preliminary high-level assessments of potential strategies for reducing ozone precursors. Subject matter experts included staff from the following agencies: Colorado Department of Transportation (CDOT), Department of Local Affairs (DOLA), Denver Regional Council of Governments (DRCOG), the Regional Transportation District (RTD), the North Front Range Metropolitan Planning Organization (NFRMPO), the Metro Mayor’s Caucus, local governments and industry. Each assessment was discussed within the RAQC subcommittees and modified based on direction from the subcommittee members (all of whom are also members of the RAQC Board – see list below).

The RAQC Board decided upon this approach because the Board realized that a robust and effective evaluation of all potential ozone SIP measures required extensive and time-consuming preparation. They identified a necessary first step via the preliminary assessments; which was to develop a "high level" or "back of the envelope" sense of how, the extent to which, and when a particular strategy might be used to demonstrate ozone attainment. To this end, each assessment briefly evaluated the following for each strategy:

- National and local experience as an air pollution control strategy;
- The air quality benefits and associated costs;
- When further analysis might be needed to determine whether the strategy could be selected to be included in the ozone SIP (e.g. whether and to what extent EPA would accept and offer SIP credit for it);
- Likelihood that the strategy could be implemented in time for inclusion in the ozone SIP, taking into consideration what mechanism (regulation, legislative change, etc.) would have to be in place to do so and what authorities exist for doing so today; and
- Co-benefits beyond ozone reductions.

As mentioned, RAQC Board members volunteered to one of three subcommittees.

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<thead>
<tr>
<th>Fuels and Motor Vehicles</th>
<th>Transportation Pricing</th>
<th>Alternative Transportation and Land Use</th>
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<td>Jep Seman, Chair</td>
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<td>Elise Jones, Chair</td>
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<td>Richard Long</td>
<td>Debra Baskett</td>
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In addition, select CDPHE and RAQC staff participated in every subcommittee meeting to maintain continuity and keep the work moving forward. Upon completion of the assessments, the appropriate subcommittee reviewed each strategy. Each subcommittee reported regularly at the RAQC’s Board meetings.

Within this section, the strategies are summarized and then detailed in the appropriate table. The detailed assessments are contained in Attachment C.

a. **Fuels and Motor Vehicles**

Motor vehicles and their associated fuels are the critical to the American economy. Unfortunately, they are also a major source of criteria and greenhouse gases emissions. The goal of the subcommittee was to investigate cleaner vehicles and alternative fuels to reduce emissions from this sector.

The Fuels and Motor Vehicles Subcommittee met four times between August 2010 and November 2010. The group investigated petroleum based fuels, alternative fuels, improvements to current programs and technologies including:

- **Reformulated Gasoline (RFG):** RFG is blended to reduce smog-forming and toxic pollutants principally by lowering fuel evaporation rates. The Board will consider industry input on this strategy in 2011.
- **7.0 Reid Vapor Pressure (RVP) Gasoline:** The RVP of gasoline is a measure of its volatility. Higher RVP gasoline is more volatile meaning it has a greater propensity to evaporate. Lowering the required RVP from the current 7.8 standard to 7.0 (with a 1 pound per square inch (psi) ethanol waiver throughout the nonattainment area) will reduce VOC evaporative emissions. The Board will consider industry input on this strategy in 2011.
- **Eliminate Ethanol Waiver:** The current EPA nonattainment area summertime fuel specification is 7.8 RVP with a waiver allowing for ethanol blended fuels to have a 1 psi increase in RVP. This waiver allows ethanol to be blended at 10% volume with regular specification gasoline (i.e., 7.8 RVP) resulting in E10 fuel being produced with a RVP of 8.8. The Board will consider industry input on this strategy in 2011.
- **Eliminate Ethanol Blending During the Summertime Ozone Season:** End ethanol (E10) blending during summer ozone season. Blending 10% ethanol with gasoline raises the RVP of the gasoline by approximately 1 psi. Eliminating ethanol blending during the summer season would reduce the RVP of gasoline in the nonattainment area thereby lowering evaporative VOC and NOx emissions and increasing CO. The Board will consider industry input on this strategy in 2011.
- **Expand the Use of Alternative Fuels in Governmental and Private Fleets:** Alternative fuels such as compressed natural gas (CNG), liquefied natural gas (LNG), biodiesel, 85% ethanol blended with gasoline (E85), and hybrid and electric technologies are used to reduce criteria emissions, toxic pollutants and greenhouse gases. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.
- **Electrification of Vehicle Fleet:** The conversion of the light-duty gasoline vehicle fleet to electric will reduce criteria emissions, toxic pollutants and greenhouse gases. This strategy uses tax credits/rebates to promote the purchase of electric powered vehicles in governmental and corporate fleets and personal vehicles. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.
• **Fleet Fuel Use Reduction:** This strategy focuses on measures to eliminate excessive idling and associated fuel use. This strategy would address both diesel and gasoline powered vehicles. Potential idling reduction strategies could vary from voluntary education programs, to mandatory and enforceable programs, to subsidized equipment retrofit programs for heavy duty vehicles and school buses. The Board decided to table the strategy as a SIP measure and pursue voluntary efforts.

• **I/M Program Enhancements**
  o **More Stringent Pass/Fail Standards:** Reduce vehicle emissions testing pass/fail criteria within the Vehicle Inspection and Maintenance (I/M) Program to increase the benefit from the program. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.
  o **Evaporative Emission Testing Via High-Emitter Remote Sensing:** Roadside remote sensing technology is currently used to identify vehicles with emissions problems in the Denver area. Using roadside remote sensing technology to identify high evaporative emitters of volatile organic compounds (VOC) may increase the benefit from the I/M program. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.
  o **On Board Diagnostics (OBD) Testing:** On-board diagnostic (OBD) testing uses information from the vehicle’s computer to predict vehicle operating and emissions problems. Addition of an OBD test may increase the benefit from the program. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.
  o **Remote Sensing Based High-Emitter Program:** Roadside remote sensing technology is currently used in a voluntary program to identify vehicles with emissions problems in the Denver area. This strategy could either replace the current I/M program with a program that utilizes only remote sensing to identify vehicles with high emissions or include remote sensing as a supplement to the current I/M program. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.

• **Cash for Clunkers:** A cash for clunkers program would identify older, higher polluting vehicles for purchase and permanent retirement. The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.

• **Diesel Retrosits:** Older diesel vehicles have higher emissions than newer diesel vehicles. Diesel retrofits use different technologies to reduce emissions from these older vehicles. The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.

• **Truck Stop Electrification:** Truck stop electrification (TSE) can be installed at area truck stops so that cab cooling and heating is provided by a unit that is inserted into the window of the vehicle so that the engine does not need to idle. The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.

• **Signal Timing and Coordination:** Signal timing is the process of making traffic signals work together as opposed to independently. This process reduces emissions on certain corridors by reducing vehicle wait times. The Board decided to continue evaluation of this strategy through investigation of Phoenix’s program.

• **Eco-Driving Education:** Eco-driving programs are designed to educate drivers in techniques (i.e., avoiding rapid acceleration, reducing speeds, etc.) that can reduce gas consumption and emissions. These programs can take the form of direct driver education in a classroom,
tracking employee driving through technology or as a public awareness campaign. The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.
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<tr>
<th>Measure</th>
<th>Description of Measure</th>
<th>Experience in Colorado/Other Areas</th>
<th>Existing Authority or Needed Approvals</th>
<th>Implementation/SIP Measure Feasibility</th>
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<tr>
<td>Reformulated Gasoline (RFG)</td>
<td>RFG is blended to reduce smog-forming and toxic pollutants principally by lowering fuel evaporation rates.</td>
<td>Approximately 17 states have opted into the federal RFG program.</td>
<td>The Governor must petition EPA to develop RFG for attainment purposes. No legislative approval is required because this strategy is technically not part of the SIP.</td>
<td>Benefits are accounted for through emissions and atmospheric modeling to demonstrate attainment in the SIP.</td>
<td>Evaluate benefits using EPA’s required Motor Vehicle Emissions Simulator (MOVES) model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011.</td>
</tr>
<tr>
<td><strong>7.0 Reid Vapor Pressure (RVP) Gasoline</strong></td>
<td>The RVP of gasoline is a measure of its volatility. Higher RVP gasoline is more volatile meaning it has a greater propensity to evaporate. Lowering the required RVP from the current 7.8 standard to 7.0 (with a 1 pound per square inch (psi) ethanol waiver throughout the nonattainment area) will reduce VOC evaporative emissions.</td>
<td>Five areas (i.e., Atlanta, Birmingham, El Paso, Detroit and Kansas City) currently require 7.0 RVP gasoline.</td>
<td>The AQCC currently has regulatory authority to establish a 7.0 RVP fuel standard.</td>
<td>The State must implement this strategy as part of a SIP and demonstrate it is necessary to achieve attainment of the NAAQS. EPA can approve this if it finds no other measures bring about timely compliance.</td>
<td>Evaluate benefits using EPA’s MOVES model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011.</td>
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<td>Eliminate Ethanol Waiver</td>
<td>The current EPA nonattainment area summertime fuel specification is 7.8 RVP with a waiver allowing for ethanol blended fuels to have a 1 psi increase in RVP. This waiver allows ethanol to be blended at 10% volume with regular specification gasoline (i.e., 7.8 RVP) resulting in E10 fuel being produced with a RVP of 8.8.</td>
<td>Colorado has been using the national RVP required fuel with the 1 psi summertime waiver for E10 blended fuels since 1991. Further investigation is required to determine if other areas have eliminated the ethanol waiver.</td>
<td>Removal of the waiver requires the Governor to petition EPA requesting elimination of the waiver. The petition must document the waiver increases air pollution.</td>
<td>SIP credit can be calculated and verified with MOVES modeling. Enforceability is assured via the Governor’s petition and EPA action to approve the waiver elimination.</td>
<td>Evaluate benefits using EPA’s MOVES model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011.</td>
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<td>Eliminate Ethanol Blending During the Summer Ozone Season</td>
<td>End ethanol (E10) blending during summer ozone season. Blending 10% ethanol with gasoline raises the RVP of the gasoline by approximately 1 psi. Eliminating ethanol blending during the summer season would reduce the RVP of gasoline in the nonattainment area thereby lowering evaporative VOC and NOx emissions and increasing CO.</td>
<td>EPA has rejected a waiver from the Renewable Fuels Standard (RFS) filed by Texas. Further investigation is required to determine if other areas have attempted to eliminate ethanol in summertime fuel blending.</td>
<td>Authority to implement this measure must be investigated.</td>
<td>A determination of whether the State can ban ethanol usage under federal law is required. If this is possible, a mandatory program could receive SIP credit.</td>
<td>Evaluate benefits using EPA’s MOVES model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011. Evaluate feasibility in view of federal (RFS).</td>
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<td>Expand Use of Alternative Fuels in Governmental and Private Fleets</td>
<td>Alternative fuels such as compressed natural gas (CNG), liquefied natural gas (LNG), biodiesel, 85% ethanol blended with gasoline (E85), and hybrid and electric technologies are used to reduce criteria emissions, toxic pollutants and greenhouse gases.</td>
<td>Governor Ritter issued an Executive Order requiring state fleets to reduce petroleum usage by 25% by 2012. From 1994 – 2002 Colorado Regulation Number 17 required fleets to use alternative fuels. A number of states have implemented mandatory and voluntary programs.</td>
<td>Regulatory and/or statutory provisions would be needed to implement a mandatory program.</td>
<td>Current gas/electric hybrid vehicles and natural gas vehicles are certified to the same criteria emission standards as gasoline vehicles. States cannot take credit based on estimates of future purchases of advanced technology vehicles without a mandate that ensures these vehicles will be purchased. There may be SIP credit available for purely electric vehicles. At this point the potential for obtaining SIP credit is unclear.</td>
<td>Analysis of vehicle/alternative fuels penetration under various scenarios to quantify nonattainment area emissions benefits.</td>
<td>Presented to the RAQC in September 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td><strong>Electrification of Vehicle Fleet</strong></td>
<td>The conversion of the light-duty gasoline vehicle fleet to electric will reduce criteria emissions, toxic pollutants and greenhouse gases. This strategy uses tax credits/rebates to promote the purchase of electric powered vehicles in governmental and corporate fleets and personal vehicles.</td>
<td>No known efforts require mandatory introduction of electric vehicles.</td>
<td>Regulatory and/or statutory provisions would be needed to implement a mandatory program.</td>
<td>Emissions benefits could be realized with this measure and they could be quantified through EPA’s MOVES model. However, regional SIP credit would have to be based on vehicle penetration which would be dependent on incentives. Colorado would also need to require that a certain portion of the fleet be electric in order to meet EPA guidance for taking credit for such a program.</td>
<td>Significant additional air quality and cost analysis is necessary to predict the timing and extent of replacement of gasoline vehicles with electric vehicles. Analysis for assessing additional emissions from the generation of power needed to recharge the electric vehicles.</td>
<td>Presented to the RAQC in September 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>Fleet Fuel Use Reduction</td>
<td>This strategy focuses on measures to eliminate excessive idling and associated fuel use. This strategy would address both diesel and gasoline powered vehicles. Potential idling reduction strategies could vary from voluntary education programs, to mandatory and enforceable programs, to subsidized equipment retrofit programs for heavy duty vehicles and school buses.</td>
<td>The City and County of Denver and the Town of Aspen have idling ordinances in place.</td>
<td>Regulatory and/or statutory provisions would be needed to implement a mandatory program.</td>
<td>A mandatory program with an enforcement mechanism would likely be eligible for SIP credit.</td>
<td>Evaluation of existing programs in other states to determine idling program types and associated benefits and costs, as well as how SIP creditable they are/could be.</td>
<td>Presented to the RAQC in September 2010. The Board decided to table the strategy as a SIP measure and pursue voluntary efforts.</td>
</tr>
<tr>
<td>I/M Program Enhancements – More Stringent Pass/Fail Standards</td>
<td>Reduce vehicle emissions testing pass/fail criteria within the Vehicle Inspection and Maintenance (I/M) Program to increase the benefit from the program.</td>
<td>The I/M Program is currently in place in Colorado. Reducing pass/fail criteria would be a regulatory change to the existing program.</td>
<td>AQCC has the authority to adopt tighter emissions standards.</td>
<td>This strategy could be implemented and included in the SIP.</td>
<td>APCD currently performing analyses MOVES modeling Cost analysis</td>
<td>Presented to the RAQC in December 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<tr>
<td>I/M Program Enhancements – Evaporative Emission Testing via High Emitter Remote Sensing</td>
<td>Roadside remote sensing technology is currently used to identify vehicles with emissions problems in the Denver area. Using roadside remote sensing technology to identify high evaporative emitters of volatile organic compounds (VOC) may increase the benefit from the I/M program.</td>
<td>Pilot studies are currently in operation in Colorado.</td>
<td>AQCC has the authority to adopt an evaporative emissions check in the I/M Program.</td>
<td>Currently, EPA does not provide SIP credit for this strategy. Colorado must demonstrate this is an effective control option to EPA to be included in the SIP.</td>
<td>Significant additional analysis on the costs and benefits based on the current pilot program by CDPHE/RAQC.</td>
<td>Presented to the RAQC in December 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>I/M Program Enhancements – On Board Diagnostics (OBD) Testing</td>
<td>On-board diagnostic (OBD) testing uses information from the vehicle’s computer to predict vehicle operating and emissions problems. Addition of an OBD test may increase the benefit from the program.</td>
<td>Currently, Colorado requires OBD testing for data gathering purposes.</td>
<td>AQCC has the authority to adopt regulatory requirements for an OBD based I/M Program or to require an OBD test to supplement the current I/M240 test.</td>
<td>A program using OBD testing as either a replacement or a supplement could be implemented and included in the SIP.</td>
<td>Additional analysis of the disparity between modeled and actual emissions benefits between I/M240 testing and OBD. Cost analysis Analysis of program structure</td>
<td>Presented to the RAQC in December 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>Remote Sensing Based High-Emitter Program</td>
<td>Roadside remote sensing technology is currently used in a voluntary program to identify vehicles with emissions problems in the Denver area. This strategy could either replace the current I/M program with a program that utilizes only remote sensing to identify vehicles with high emissions or include remote sensing as a supplement to the current I/M program.</td>
<td>Colorado has been investigating a remote sensing based high-emitter program since 2003.</td>
<td>The AQCC adopted a pilot remote sensing based high-emitter program and has the authority to adopt a full-scale program.</td>
<td>Currently, EPA does not provide additional SIP credit for this strategy. Colorado must demonstrate this is an effective control option to EPA to be included in the SIP.</td>
<td>APCD is currently in the process of analyzing results from the pilot program. Cost analysis</td>
<td>The Board tabled this measure as a replacement for the current I/M program but directs staff to continue evaluating the strategy as a supplemental program with incentives.</td>
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<tr>
<td>Cash for Clunkers</td>
<td>A cash for clunkers program would identify older, higher polluting vehicles for purchase and permanent retirement.</td>
<td>The RAQC/CDPHE are currently operating a voluntary cash for clunkers program with SEP funds.</td>
<td>A mandatory program would require legislative action to fund the program and establish eligibility requirements.</td>
<td>A mandatory program with a dedicated source of funding could be included in the SIP.</td>
<td>Program eligibility requirements would need to be developed to analyze costs and benefits.</td>
<td>The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.</td>
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<tr>
<td>Measure</td>
<td>Description of Measure</td>
<td>Experience in Colorado/Other Areas</td>
<td>Existing Authority or Needed Approvals</td>
<td>Implementation/SIP Measure Feasibility</td>
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<td>Board Recommendation and Next Steps</td>
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<td>Diesel Retrofits</td>
<td>Older diesel vehicles have higher emissions than newer diesel vehicles. Diesel retrofits use different technologies to reduce emissions from these older vehicles.</td>
<td>Colorado currently has a robust voluntary diesel retrofit program through the RAQC, CDPHE, the City and County of Denver, school districts and local governments. Other states have mandatory programs in place.</td>
<td>A mandatory program would require legislative approval and regulatory development by the AQCC.</td>
<td>EPA has guidance on taking SIP credit for these programs. California has a major diesel retrofit program ($120M) included in their SIP.</td>
<td>Significant additional development of this strategy to identify what sectors would be required to install retrofits is needed. Without a program framework it is impossible to determine program costs and benefits.</td>
<td>The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.</td>
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<td>Truck Stop Electrification</td>
<td>Truck stop electrification (TSE) can be installed at area truck stops so that cab cooling and heating is provided by a unit that is inserted into the window of the vehicle so that the engine does not need to idle.</td>
<td>Colorado currently has approximately 20 TSE spaces in the state.</td>
<td>A mandatory program would require legislative approval and regulatory development by the AQCC.</td>
<td>There are no known programs included in SIPs. However, EPA has guidance on taking SIP credit for these programs.</td>
<td>Evaluation of EPA guidance for taking SIP credit. Additional analysis of the power plant emissions required to provide TSE services.</td>
<td>The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.</td>
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<td>Signal Timing and Coordination</td>
<td>Signal timing is the process of making traffic signals work together as opposed to independently. This process reduces emissions on certain corridors by reducing vehicle wait times.</td>
<td>DRCOG has a Regional Traffic Signal System Improvement Program (TSSIP) that identifies critical corridors for improvement. Other areas in the country have similar efforts in place.</td>
<td>This program is in place and operated by DRCOG.</td>
<td>Emissions reductions can be calculated for DRCOG’s program. At this time, DRCOG’s models do not have the sophistication to translate these benefits to a regional level that would be required for a SIP. However, Phoenix has included this in their SIP. Their methodology is being investigated.</td>
<td>Evaluation of Phoenix’s SIP methodology.</td>
<td>The Board decided to continue evaluation of this strategy through investigation of Phoenix’s program.</td>
</tr>
<tr>
<td>Eco-Driving Education</td>
<td>Eco-driving programs are designed to educate drivers in techniques (i.e., avoiding rapid acceleration, reducing speeds, etc.) that can reduce gas consumption and emissions. These programs can take the form of direct driver education in a classroom, tracking employee driving through technology or as a public awareness campaign.</td>
<td>There are a number of programs in existence and they are common in fleet operations. Both the City and County of Denver and Encana Oil &amp; Gas have programs that focus on improving driver behavior.</td>
<td>Legislative action and regulatory development would be required to implement a mandatory program.</td>
<td>There is no demonstrated ability to take SIP credit for this measure. There are no known eco-driving programs included in SIPS.</td>
<td>Additional analysis of potential emissions reductions.</td>
<td>The Board tabled this strategy as a SIP measure and directs staff to continue pursuing voluntary efforts.</td>
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b. Transportation Pricing

Transportation pricing sends a cost signal to motorists. By adding a visible, incremental cost to driving a vehicle, motorists are more likely to reduce or combine trips, and/or use alternative transportation. The goal of the RAQC analysis was to investigate pricing strategies that have the potential to reduce vehicle miles traveled and improve air quality. Additional co-benefits were identified including reduced congestion, increased quality of life, and reduced greenhouse gas emissions (GHG). A thoughtful review was done of available pricing strategies.

The Transportation Pricing Subcommittee met three times between August 2010 and September 2010. The group investigated five pricing strategies including:

- **Fuel Tax Pricing Strategies:** Fuel tax pricing strategies would increase the gasoline tax to reduce vehicle miles traveled (VMT) and generate revenue. The current state gas tax is $0.22/gallon and the federal gas tax is $0.184/gallon for passenger vehicles.

- **Transportation Facility Pricing:** Transportation facility pricing strategies are designed to charge motorists for using certain travel facilities, in order to cause them to choose travel options other than a single occupant vehicle, thereby reducing VMT, congestion and air emissions. Revenues could be used to fund alternative transportation infrastructure and reduce congestion.

- **Mileage Based Fees:** Mileage-based fees charge drivers based on how many miles they drive, sometimes referred to as a Vehicle Miles Traveled (VMT) fee. Periodic odometer readings (automatic through transponders or manual through inspection) would be the basis for determining the level of fees a driver must pay.

- **Pay As You Drive Insurance:** Mandatory PAYD insurance charges drivers their insurance premium costs based in part on how many miles their vehicles are driven in a given year. Drivers have the opportunity to save money by driving fewer miles and practicing safe driving habits.

- **Priced Parking:** Parking pricing strategies include those designed to either (1) increase the cost of driving a single occupancy vehicle by charging for parking, or (2) increase the use of alternative transportation in lieu of parking (ex: parking cash-out: where an employer may offer cash, or a transit pass instead of free parking).

Upon review of the strategies by the subcommittee the strategies were forwarded to the Board. The Board directed staff to continue analyzing all pricing strategies for potential inclusion in the SIP.
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<td><strong>Fuel Tax Pricing Strategies</strong></td>
<td>Fuel tax pricing strategies would increase the gasoline tax to reduce vehicle miles traveled (VMT) and generate revenue. The current state gas tax is $0.22/gallon and the federal gas tax is $0.184/gallon for passenger vehicles.</td>
<td>Gas tax currently used in Colorado for revenue generation. It has not been used or evaluated to reduce VMT.</td>
<td>State legislation needed</td>
<td>With aggressive legislative action, could be included in SIP</td>
<td>Run pricing alternatives through CDOT’s revenue generation model</td>
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<tr>
<td><strong>Transportation Facility Pricing</strong></td>
<td>Transportation facility pricing strategies are designed to charge motorists for using certain travel facilities, in order to cause them to choose travel options other than a single occupant vehicle, thereby reducing VMT, congestion and air emissions. Revenues could be used to fund alternative transportation infrastructure and reduce congestion.</td>
<td>Authority to price facilities currently exists for the State of Colorado, Regional Public Highway Authorities, and the private sector. The pricing of Interstate facilities is limited to new lanes.</td>
<td>Approval from localities impacted</td>
<td>Requires approval from local governments that are impacted</td>
<td>Analysis of pricing strategies and impact</td>
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<tr>
<td><strong>Mileage Based Fees</strong></td>
<td>Mileage-based fees charge drivers based on how many miles they drive, sometimes referred to as a Vehicle Miles Traveled (VMT) fee. Periodic odometer readings (automatic through transponders or manual through inspection) would be the basis for determining the level of fees a driver must pay.</td>
<td>Mileage-based fees are currently not in use in Colorado or anywhere in the United States. They have been evaluated by a number of states and CDOT has a mileage-based fees research project forthcoming.</td>
<td>State legislation needed</td>
<td>CDOT’s pilot will not be complete until 2015; implementation is dependent on the results of that study.</td>
<td>Review results of CDOT’s study</td>
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<td>Pay-as-You-Drive Insurance</td>
<td>Mandatory PAYD insurance charges drivers their insurance premium costs based in part on how many miles their vehicles are driven in a given year. Drivers have the opportunity to save money by driving fewer miles and practicing safe driving habits.</td>
<td>PAYD insurance is currently available in currently available (voluntarily) in Colorado through several insurance companies. No states have mandated PAYD insurance, but much research on the impacts of PAYD insurance has been done.</td>
<td>State legislation needed</td>
<td>With aggressive legislative action, could be included in SIP</td>
<td>Evaluation of VMT reduction potential</td>
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<td>Included in baseline modeling</td>
<td>Analysis of legal feasibility of implementation</td>
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<td>Analysis of whether SIP credit is available</td>
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<td>Priced Parking</td>
<td>Parking pricing strategies include those designed to either (1) increase the cost of driving a single occupancy vehicle by charging for parking, or (2) increase the use of alternative transportation in lieu of parking (ex: parking cash-out: where an employer may offer cash, or a transit pass instead of free parking).</td>
<td>The pricing of parking is common throughout the Denver metro, typically where demand for parking exceeds supply. There are no US examples of mandatory priced parking.</td>
<td>Currently done voluntarily through localities and the private sector. Mandatory program would require state legislation.</td>
<td>Unlikely to be implemented in short/mid term</td>
<td>Analysis of legal feasibility of implementation</td>
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<td>Potential for pilot pricing program</td>
<td>Analysis of implementation steps and costs</td>
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<td>Unlikely to be included as mandatory program in SIP</td>
<td>Evaluation of VMT reduction potential</td>
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c. **Alternative Transportation and Land Use**

The built environment influences people’s travel choices. The amount of density, mixed use, distance to transit, accessibility to employment centers, and aesthetics of the built environment have a profound impact on the viability of alternative transportation options. The Alternative Transportation and Land Use Subcommittee looked at both the built environment as well as alternative transportation options that help reduce vehicle miles traveled (VMT), make alternative modes more viable (walking, biking, transit, etc), and improve air quality.

The Alternative Transportation and Land Use Subcommittee met seven times between August 2010 and December 2010. The group investigated twenty innovative strategies including:

- **Expand Transportation Demand Management (TDM) Programs:** The expansion of TDM programs would focus on reducing demand for single occupancy vehicle trips by encouraging the use of alternative forms of transportation such as carpooling, vanpooling, bicycling, teleworking, use/expansion of RTD’s Eco Pass program, compressed work weeks or any employer-based program that encourages the use of alternative transportation for commuting purposes.

- **Reduce Speed Limit:** This strategy requires lowering of the speed limit through statutory authority for highways in the ozone nonattainment area.

- **Combined Land Use Strategies to Increase Development Densities, Mixed Use, and Connectivity to Transportation Choices**
  - **Urban Growth Boundaries:** UGB’s are established to manage growth within a geographic area. They can increase density of in urban development.
  - **Regional Transportation Plan Selection Criteria:** Regional transportation planning must be conducted by all recipients of USDOT funds. (ex: DRCOG’s Regional Transportation Plan and Transportation Improvement Program) and can effect land use development patterns. DRCOG uses scoring criteria in the transportation project selection process to incentivize growth in urban centers.
  - **Corridor Planning:** Corridor plans are generally completed by localities, MPOs, or the state DOT to plan for multi-modal improvements along a designated corridor. Plans may include access, frontage, design elements, vegetation, lighting. The plan for a specific corridor effects the subsequent investment along that corridor and can effect demand whether people choose to drive or use alternative transportation.
  - **Local Land Use Tools/Policies to Improve Air Quality:** Local land use regulations include a number of code provisions designed to guide development. Where and how development is effected in code varies from locality to locality.
  - **Transit-Oriented Development:** Transit-oriented development encourages a mix of land uses around transit that offer multi-modal connectivity between transit and employment, retail, residential, and recreational uses. Achieving TOD requires collaboration between RTD, localities, businesses, developers, and users.
  - **Financial/Economic Tools/Policies to Improve Air Quality:** Local governments can use a variety of financial and fiscal tools to create incentives for certain types of development that will reduce VMT and trip generation and therefore improve air quality. Fiscal tools may include: Impact fees to fund alternative transportation, reduced property taxes/fees to encourage sustainable redevelopment, grants to promote sustainable redevelopment, Tax Increment Financing to subsidize sustainable
development and community improvements, and Industrial Revenue Bonds to promote sustainable development.

- **Revenue Sharing:** Revenue sharing programs allocate a part of a locality’s tax income to other localities. A formula is used to allocate the money.

- **Community Land Trusts (for both Preservation of Open Space, and the Provision of Affordable Housing/Development):** Community Land Trusts (CLT) can be used to achieve different goals (preserving open space/working lands, providing affordable housing, etc). CLTs are private non-profit organizations that buy and hold land permanently, preventing market forces from causing prices to rise.

- **Purchase/Transfer of Development Rights (PDR/TDR/Conservation Easements):** Purchase of Development Rights (PDR) and/or Transfer of Development Rights (TDR) programs are created to promote higher densities development while reducing the development potential in rural areas. They offer financially competitive options for development (or not developing) a property.

- **Full Build-Out of FasTracks, Including Bus Rapid Transit (BRT), Commuter Rail, Light Rail, Bus, Transit, and HOV Infrastructure:** The full build out of FasTracks is currently included in the baseline modeling assumptions for DRCOG’s Regional Transportation Plan and subsequent air quality conformity modeling.

- **Evaluate RTD Fare Structure to Increase Demand:** Transit fares (and subsequent increases/decreases) have an effect on a traveler’s choice to take transit. Fare structures are generally related to revenue generation, fare-box recovery laws, and market analysis.

- **Increase Transit Service Levels to Increase Demand:** This strategy would increase transit service levels to induce demand for transit and reduce vehicular trips and subsequent emissions.

- **Strategic Management of Park and Ride Facilities/Capacity:** This strategy would involve optimization of park and ride facilities in terms of the number of spaces and subsequent pricing/regulatory policies used to manage the demand for parking.

- **Bus and Light Rail Station Planning:** This strategy would optimize station location, facility placement, connectivity, and access to transit services. How, when, and where transit stations are located effects a traveler’s choice to use transit.

- **Real Time Traveler Information:** Real-Time Travel Information (RTTI) for this paper’s purpose is related to transit operations. RTTI provides travelers with information on transit schedules, delays/cancellations, and headways (when the next transit vehicle will arrive at a given stop). A number of dissemination methods exist including: telephone, internet, in-vehicle, hand-held devices, and field devices (ex: electronic display boards with arrival/departure information).

- **Bike/Pedestrian Facilities:** This strategy looks at the creation of bicycle and pedestrian facilities to improve air quality.

- **Car Sharing Programs:** Car-sharing programs allow people to have on-demand access to a shared fleet of vehicles on an as-needed basis.

- **Neighborhood Electric Vehicles:** This strategy would increase the use of Neighborhood Electric Vehicles (NEV) in the Denver region. NEVs are battery electric vehicles that are generally limited to local roads (typically 25 mph or less).

- **Parking Supply Management (Residential, Commercial, Retail, etc.):** Parking supply varies from public (on street) to private (surface lots, residential garages, etc). The supply of parking makes travel by automobile possible. This strategy looks at how parking supply effects vehicle travel, while in turn effects air quality.
• **Changes to State Land Board Mission/Policies to Reduce Sprawl and Associated Emissions:** Changes to State Land Board mission/policies/decisions to reduce contribution to sprawl, VMT increases and associated emissions.

• **Employer Travel-Reduction Programs:** Employer trip reduction programs or employee commute options as they are sometimes called encourage employers to effect how their employees commute to work, when they work and where they work. The primary purpose of these programs is to reducing vehicle miles traveled (VMT), reduce congestion, and make alternative transportation more viable.

• **Linking Personal Behavior and Societal/Environmental Costs:** Linking personal behavior and environmental/societal costs connects the dots between citizens, their personal behaviors and effects to the environment, specifically how transportation and land use choices effect air quality. The focus of this strategy is to develop the public will for sustainable behavior change that will ultimately decrease VMT and improve air quality.

Upon review of the strategies by the subcommittee the following strategies were forwarded to Board with a recommendation for further analysis and potential inclusion in the SIP:

- Expand TDM;
- Reduce Speed Limit;
- Combined Land Use Strategies (see above for full list);
- Full Build-Out of FasTracks;
- RTD Fare Structure;
- Increased Transit Service Levels;
- Bike/Pedestrian Facilities;
- Car-Sharing;
- Neighborhood Electric Vehicles;
- Parking Supply Management; and
- Changes to State Land Board Mission/Policies.
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<th>Air Emission Reduction Tools</th>
<th>Description of Use</th>
<th>Desired Result</th>
<th>Application level</th>
<th>Implementation Approach</th>
<th>Pursue for Future Analysis</th>
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<tr>
<td>Expand Transportation Demand Management (TDM) Programs</td>
<td>The expansion of TDM programs would focus on reducing demand for single occupancy vehicle trips by encouraging the use of alternative forms of transportation such as carpooling, vanpooling, bicycling, teleworking, use/expansion of RTD’s Eco Pass program, compressed work weeks or any employer-based program that encourages the use of alternative transportation for commuting purposes.</td>
<td>Transportation Demand Management Programs are common throughout the Denver region. Examples of such programs include the Denver Regional Council of Governments’ (DRCOG) “RideArrangers” program and Boulder’s “Driven to Drive Less” campaign.</td>
<td>Currently being implemented voluntarily</td>
<td>Unlikely to be included as mandatory program in SIP Potential as a Voluntary Mobile Emission Source Program (VMEP)</td>
<td>Analysis of long term VMT changes from individual programs Additional analysis of program costs Better cost/benefit analysis Analysis of predictive reductions vs. actual reductions</td>
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<td>Reduce Speed Limit</td>
<td>This strategy requires lowering of the speed limit through statutory authority for highways in the ozone nonattainment area. We anticipate that the speed limit would be lowered to a maximum of 55 mph in this analysis and that the reduced speed limit could apply equally to trucks and cars, or could be applied differentially.</td>
<td>Speed limits are currently used throughout the state of Colorado, but are not adjusted to optimize traffic flow for air quality purposes. Other states (Texas, Tennessee) have used speed limit variations to improve air quality.</td>
<td>The state legislature, CDOT, local authorities have the authority to set speed limits within the state.</td>
<td>Could be included in SIP Included in baseline modeling</td>
<td>Analysis of the emission benefits of speed limit changes (modeling) Cost analysis associated with changing speed limits Analysis of safety considerations associated with slower speeds</td>
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<td>Combined land use strategies to increase development densities, mixed use, and connectivity to transportation choices. (Includes all those below)</td>
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<td><strong>Urban Growth Boundary</strong></td>
<td>UGB’s are established to manage growth within a geographic area. They can increase density of urban development. (ex: Oregon, Washington, and Tennessee)</td>
<td>Densification of development</td>
<td>Urbanized area</td>
<td>Voluntary or mandatory</td>
<td>YES. Need analysis of how existing UGB’s along Front Range have managed growth (eg: Boulder, Weld Counties, DRCOG). Discussed during 10/26 Subcommittee Meeting</td>
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<td><strong>Regional Transportation Plan Selection Criteria</strong></td>
<td>Regional transportation planning must be conducted by all recipients of USDOT funds. (ex: DRCOG’s Regional Transportation Plan and Transportation Improvement Program) and can effect land use development patterns. DRCOG uses scoring criteria in the transportation project selection process to incentivize growth in urban centers. For example, a project will get x points if it is in a designated urban center, has multi-modal access, or other criteria, depending on the funding pool.</td>
<td>Densification of development in urban areas, improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable</td>
<td>Urbanized area</td>
<td>Incentive</td>
<td>YES. Need to evaluate how RTP and TIP scoring criteria changes could be strengthened to effectively reduce VMT and associated air emissions. Discussed during 10/26 Subcommittee Meeting</td>
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<td>Corridor Planning</td>
<td>Corridor plans are generally completed by localities, MPOs, or the state DOT to plan for multi-modal improvements along a designated corridor. Plans may include access, frontage, design elements, vegetation, lighting. The plan for a specific corridor effects the subsequent investment along that corridor and can effect demand whether people choose to drive or use alternative transportation. (ex: CDOT’s I-70 Mountain Corridor Plan) Collaborative transit corridor planning is underway along RTD’s western corridor in coordination with FasTracks.</td>
<td>Improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Urban and rural areas</td>
<td>State and regional requirement</td>
<td>YES. Need to evaluate how Corridor Planning can effect VMT and associated air emissions through multi-modal planning and provision of alternative transportation. Discussed during 10/26 Subcommittee Meeting</td>
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<tr>
<td>Local Land Use Tools/Policies to Improve Air Quality</td>
<td>Local land use regulations include a number of code provisions designed to guide development. Where and how development is effected in code varies from locality to locality. For example, includes the optimization of zoning code, design and subdivision regulations, parking requirements, planned unit development (PUD), Traditional Neighborhood Design, etc.</td>
<td>Densification of development while promoting diversity of uses, improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Local Level</td>
<td>Voluntary</td>
<td>YES. Analysis of air quality impacts of local land use tools. This re-grouping was discussed during the 11/12 Subcommittee Meeting Dissemination by RAQC as best practices to improve air quality.</td>
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<td>Transit-Oriented Development</td>
<td>Transit-oriented development encourages a mix of land uses around transit that offer multi-modal connectivity between transit and employment, retail, residential, and recreational uses. Achieving TOD requires collaboration between RTD, localities, businesses, developers, and users. (ex: Englewood’s City Center)</td>
<td>Densification of development around transit stops, improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Urban and rural areas</td>
<td>Voluntary</td>
<td>YES. The subcommittee believes additional analysis of potential VMT benefits of neighborhood-scale TOD linked to local bus stations (as opposed to FasTracks) is warranted because the benefits of this more localized tool have not been determined and such TOD projects are underway around the region. This will complement what we know about FasTracks- related TOD and provide a better sense of how this tool might result measurable VMT and air emissions regionally and certain localities. Discussed during 10/26 Subcommittee Meeting</td>
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<tr>
<td>Financial/ Economic Tools/Policies to Improve Air Quality</td>
<td>Local governments can use a variety of financial and fiscal tools to create incentives for certain types of development that will reduce VMT and trip generation and therefore improve air quality. Fiscal tools may include: Impact fees to fund alternative transportation, reduced property taxes/fees to encourage sustainable redevelopment, grants to promote sustainable redevelopment, Tax Increment Financing to subsidize sustainable development and community improvements, and Industrial Revenue Bonds to promote sustainable development. Economic development planning activities such as business incubators, innovative leasing agreements, and Business Improvement Districts can also be used to promote sustainable development.</td>
<td>Provide financial economic incentives to promote increased density, diversification of use, destination accessibility and design that makes alternative transportation options more attractive/viable.</td>
<td>Local Level</td>
<td>Voluntary or mandatory</td>
<td>YES. Analysis of how employing financial and economic development incentive tools can ultimately drive air quality benefits. Discussed during the 11/23 Subcommittee Meeting</td>
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| Revenue Sharing              | Revenue sharing programs allocate a part of a locality’s tax income to other localities. A formula is used to allocate the money. (Ex: State of Maine’s Municipal Revenue Sharing program)                                         | By sharing revenue among localities, there is less competition to bring in/retain businesses for tax revenue; this can effect the density and diversification of use seen in development. | Local Level       | Mandatory                | YES. The Board identified revenue sharing as a potential tool for influencing the built environment and its subsequent effect on air quality.  
Discussed at 12/3 Board Meeting.                                                                                   |
<table>
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<tr>
<th>Air Emission Reduction Tools</th>
<th>Description of Use</th>
<th>Desired Result</th>
<th>Application level</th>
<th>Implementation Approach</th>
<th>Pursue for Future Analysis</th>
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<tr>
<td><strong>Purchase/Transfer of Development Rights (PDR/TDR/Conservation easements)</strong></td>
<td>Purchase of Development Rights (PDR) and/or Transfer of Development Rights (TDR) programs are created to promote higher density development while reducing the development potential in rural areas. They offer financially competitive options for development (or not developing) a property. For example, with PDR, a developer may want to develop more densely, so it purchases the development rights from a property owner. That property owner can no longer develop the parcel (or as much) as allowed previously, unless it purchases development rights. (ex: Adams County TDR Program)</td>
<td>Increase density through targeting growth to key areas.</td>
<td>Local or regional level</td>
<td>Voluntary</td>
<td><strong>YES.</strong> Determine how this tool can be used to drive the 5 D's that can lead to decreased VMT. Discussed during November 23 Subcommittee Meeting</td>
</tr>
<tr>
<td><strong>Full Build Out of FasTracks</strong></td>
<td>The full build out of FasTracks is currently included in the baseline modeling assumptions for DRCOG’s Regional Transportation Plan and subsequent air quality conformity modeling. FasTracks is a $6.5 billion dollar, program to build 122 miles of new commuter and light rail, 18 miles of bus rapid transit service, 21,000 new parking spaces and enhanced bus service for easy, convenient bus/rail connections.</td>
<td>Increase the use of RTD services throughout region and reduce the use of single occupancy vehicles.</td>
<td>Regional level</td>
<td>Voluntary</td>
<td><strong>YES.</strong> Evaluate air quality impact of FasTracks and continue to monitor funding levels and any project changes. Discussed during December 17 Subcommittee Meeting</td>
</tr>
<tr>
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<td>Evaluate RTD Fare Structure</td>
<td>Transit fares (and subsequent increases/decreases) have an effect on a traveler’s choice to take transit. Fare structures are generally related to revenue generation, fare-box recovery laws, and market analysis.</td>
<td>Increase demand for transit services and reduce single occupancy vehicle trips.</td>
<td>Regional level</td>
<td>Voluntary</td>
<td><strong>YES.</strong> Evaluate travel demand impacts of RTD fare structure and pursue further analysis of air quality impacts. Discussed during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td>Increase Transit Service Levels</td>
<td>This strategy would increase transit service levels to induce demand for transit and reduce vehicular trips and subsequent emissions. Examples of increased service may include: less time between transit headways (bus every 10 minutes as opposed to every 30 minutes), more bus routes, and more service during non-peak times (evening, weekends, etc).</td>
<td>Increase demand for transit services and reduce single occupancy vehicle trips.</td>
<td>Regional level</td>
<td>Voluntary</td>
<td><strong>YES.</strong> Evaluate travel demand impacts of RTD service level changes and pursue further analysis of air quality impacts. Discussed during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td>Strategic Management of Park and Ride Facilities/Capacity</td>
<td>This strategy would involve optimization of park and ride facilities in terms of the number of spaces and subsequent pricing/regulatory policies used to manage the demand for parking.</td>
<td>Increase demand for transit services and reduce single occupancy vehicle trips.</td>
<td>Regional level</td>
<td>Voluntary</td>
<td><strong>NO.</strong> The subcommittee chose to pursue this measure as an educational and outreach program, highlighting best practices. Discussed during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td>Bus and Light Rail Station Planning</td>
<td>This strategy would optimize station location, facility placement, connectivity, and access to transit services. How, when, and where transit stations are located affects a traveler’s choice to use transit. For example, if a station only has one entry/exit point and little pedestrian access, the difficulty getting to the station may prohibit individuals from using it.</td>
<td>Increase demand for transit services and reduce single occupancy vehicle trips.</td>
<td>Regional level</td>
<td>Voluntary</td>
<td><strong>NO.</strong> The subcommittee chose to pursue this measure as an educational and outreach program, highlighting best practices. Discussed during December 17 Subcommittee Meeting</td>
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<tr>
<td><strong>Real Time Traveler Information</strong></td>
<td>Real-Time Travel Information (RTTI) for this paper's purpose is related to transit operations. RTTI provides travelers with information on transit schedules, delays/cancellations, and headways (when the next transit vehicle will arrive at a given stop). A number of dissemination methods exist including telephone, internet, in-vehicle, hand-held devices, and field devices (ex: electronic display boards with arrival/departure information).</td>
<td>Increase demand for transit services and reduce single occupancy vehicle trips.</td>
<td>Regional level</td>
<td>Voluntary</td>
<td><strong>NO.</strong> The subcommittee chose to pursue this measure as an educational and outreach program, highlighting best practices. Discussed during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td><strong>Bike/Pedestrian Facilities (Including Bike Sharing)</strong></td>
<td>This strategy looks at the creation of bicycle and pedestrian facilities to improve air quality. Examples include: multi-use trails, bike trails, bike lanes, shared lanes, sidewalks, and bike sharing programs.</td>
<td>Increase travel by bicycle and/or walking through the provision of bike/ped. infrastructure.</td>
<td>Regional and local level</td>
<td>Voluntary</td>
<td><strong>YES.</strong> Evaluate the travel demand impacts of bike/ped infrastructure and pursue further analysis of air quality impacts. Discussed during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td><strong>Car Sharing Programs</strong></td>
<td>Car-sharing programs allow people to have on-demand access to a shared fleet of vehicles on an as-needed basis. Usage charges are assessed at an hourly and/or mileage rate. In addition some car-share organizations charge a refundable deposit and/or a low annual membership fee. These fees typically cover all costs associated with vehicle usage, including insurance, maintenance, parking, and gas.</td>
<td>Increase the use of car-sharing programs which will result in lower VMT and fewer emissions.</td>
<td>Regional and local level</td>
<td>Voluntary</td>
<td><strong>YES.</strong> Additional analysis on the impact of car sharing in the region (reduction in vehicle ownership, VMT, etc). Pursue modeling of car sharing as appropriate. Discussed during December 17 Subcommittee Meeting</td>
</tr>
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<td>Neighborhood Electric Vehicles</td>
<td>This strategy would increase the use of Neighborhood Electric Vehicles (NEV) in the Denver region. NEVs are battery electric vehicles that are generally limited to local roads (typically 25 mph or less). A NEV battery pack recharges by plugging into a standard outlet and does not produce direct tailpipe emissions, they typically have a 30 mile range before needing a recharge.</td>
<td>Increase use of NEVs and reduce use of gasoline powered vehicles for short trips.</td>
<td>Local level</td>
<td>Voluntary</td>
<td>YES. Additional analysis needed of NEV mode share impact on emissions. Discuss during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td>Parking Supply Management</td>
<td>Parking supply varies from public (on street) to private (surface lots, residential garages, etc). The supply of parking makes travel by automobile possible. This strategy looks at how parking effects vehicle travel, while in turn affects air quality. It begins to explore the next steps in evaluating the management of parking supply and its effect regional air quality.</td>
<td>Manage the supply of parking to reduce demand for single occupancy vehicle travel.</td>
<td>Local and regional level</td>
<td>Voluntary</td>
<td>YES. Quantify emission benefits of parking supply and pursue further analysis of co-benefits. Discuss during December 17 Subcommittee Meeting</td>
</tr>
<tr>
<td>Changes to State Land Board Mission/Policies to Reduce Sprawl and Associated Emissions</td>
<td>Changes to State Land Board mission/policies/decisions to reduce contribution to sprawl, VMT increases and associated emissions.</td>
<td>Coordinate changes to SLB mission/policies to reduce sprawl that results from SLB decision/policy making.</td>
<td>State level</td>
<td>Voluntary or Mandatory</td>
<td>YES. Analysis of SLB decisions and subsequent effects on built environment, pursue further analysis of legal barriers. Discuss during December 17 Subcommittee Meeting</td>
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<tr>
<td>Employer Travel-Reduction Programs</td>
<td>Employer Trip Reduction programs or Employee Commute Options as they are sometimes called encourage employers to affect how their employees commute to work, when they work and where they work. The primary purpose of these programs is to reducing vehicle miles traveled (VMT), reduce congestion, and make alternative transportation more viable.</td>
<td>Reduce the demand for single-occupancy vehicle trips to employer sites.</td>
<td>Regional or local level</td>
<td>Mandatory</td>
<td>NO. Pursue as a voluntary program, interwoven with TDM strategy listed above. The subcommittee chose to not pursue this strategy as a mandatory measure. Discuss during December 17 Subcommittee Meeting</td>
</tr>
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<tr>
<td>Linking Personal Behavior and Societal/Environmental costs</td>
<td>Linking personal behavior and environmental/societal costs connects the dots between citizens, their personal behaviors and effects to the environment, specifically how transportation and land use choices effect air quality. The focus of this strategy is to develop the public will for sustainable behavior change that will ultimately decrease VMT and improve air quality.</td>
<td>Reduce the demand for single-occupancy vehicle trips.</td>
<td>Regional or local level</td>
<td>Voluntary</td>
<td>NO. The subcommittee chose not to analyze this strategy further, but rather consider as part of education and outreach work being done by the RAQC and others. Discussed during December 17 Subcommittee Meeting</td>
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III. Further Analysis

During the course of their evaluation of potential ozone control measures, the RAQC subcommittees identified further analysis that will be need to evaluate measures more fully for possible inclusion in the Ozone State Implementation Plan. The areas of further analysis are presented for each measure in the following table. The amount of analysis is extensive and staff proposes that the RAQC discuss the analytical needs and prioritize the measures for the further analysis.
### Part A: Measures Recommended For Further Technical, Policy and Legal Analysis

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<th>Measure</th>
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| **Reformulated Gasoline (RFG)** | – Complete Fuels Report  
– Receive industry presentation on report during 1st quarter 2011 RAQC meeting  
– Estimate emissions reduction w/MOVES  
– Include in preliminary control scenario analysis using atmospheric chemistry modeling | – RAQC  
– Industry  
– CDPHE  
– Consultant(s) |
| **7.0 Reid Vapor Pressure (RVP) Gasoline** | – Complete Fuels Report  
– Receive industry presentation on report during 1st quarter 2011 RAQC meeting  
– Estimate emissions reduction w/MOVES  
– Include in preliminary control scenario analysis using atmospheric chemistry modeling  
– Assess cost of implementation to State | – RAQC  
– Industry  
– CDPHE  
– Consultant(s) |
| **Eliminate Ethanol Waiver** | – Complete Fuels Report  
– Receive industry presentation on report during 1st quarter 2011 RAQC meeting  
– Estimate emissions reduction w/MOVES  
– Include in preliminary control scenario analysis using atmospheric chemistry modeling | – RAQC  
– Industry  
– CDPHE  
– Consultant(s) |

1 NOTE: Staff’s of the CDPHE, CDOT, CDPHE and RAQC will meet in January to discuss the “division of labor” for these tasks and where consultants will be needed. During the February meeting we will present the RAQC Board with suggested work priorities and a schedule for accomplishing them, as well as where additional funds might be needed to hire consultants. We recommend that the RAQC Board be prepared to identify 2010 priorities during the January meeting to help staff’s analysis.
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| **Eliminate Ethanol Blending During the Summer Ozone Season** | – Receive industry presentation during 1st quarter 2011 RAQC meeting  
– Analyze legal issues to determine if State can eliminate ethanol usage under federal law; and, if so, what the legal mechanism is for enacting such a ban under Colorado law.  
– Estimate emissions reduction w/MOVES  
– Include in preliminary control scenario analysis using atmospheric chemistry modeling | – RAQC  
– Industry  
– CDPHE  
– Consultant(s) |
| **Expand Use of Alternative Fuels in Governmental and Private Fleets** | – Perform analysis of fleet makeup in N/A area  
– Identify eligible public and private fleets  
– Develop program structure  
– Determine eligible fuels  
– Determine current fuels penetration  
– Determine potential fuels penetration based on fleet analysis  
– Perform cost analysis  
– Determine emissions benefits through MOVES  
– Determine if SIP credit is possible  
– Develop statutory language and/or regulatory requirements  
– Receive industry presentation/comment during 2nd quarter 2011 RAQC Meeting | – CDPHE  
– RAQC  
– Consultants  
– Industry |
| **Electrification of Vehicle Fleet** | – Perform analysis of fleet makeup  
– Determine availability of electric vehicles in Denver/Colorado market  
– Develop program structure  
– Develop penetration scenarios  
– Determine emissions benefits through MOVES  
– Perform cost analysis  
– Develop necessary statutory and/or regulatory requirements | – CDPHE  
– RAQC  
– Consultants |
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| **I/M Program Enhancements:**               | - Finalize remote sensing pilot study analysis  
- Implement evaporative emissions pilot study  
- Implement OBD pilot study  
- Perform MOVES modeling on all strategies  
- Analyze differences between modeled and actual emissions benefits between I/M 240 testing and OBD and discuss with RAQC during 2nd quarter 2011 RAQC Meeting  
- Develop cost analyses  
- Develop regulatory requirements                                                                 | - CDPHE  
- RAQC |
| **Signal Timing and Coordination**           | - Update emissions reduction benefit calculation with latest MOVES emissions factors and assumptions                                                                                                    | - RAQC  
- DRCOG |
| **Fuel Tax Pricing Strategies**              | - Create scope and objectives for studying fuel tax pricing alternatives  
- Run CDOT’s revenue generation model  
- Analyze ability to pay (pricing burden on users)  
- Assess legal feasibility/legal barriers of mandatory program  
- Run travel demand models to estimate potential VMT reduction  
- Perform MOVES modeling to estimate emission reduction                                                                 | - CDOT  
- DRCOG  
- NFRMPO  
- RAQC  
- CDPHE  
- Consultant(s) |
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| Transportation Facility Pricing | - Identify scope and objectives for studying transportation facility pricing alternatives (e.g. which corridors to study and analyze and why; and which pricing strategies/alternatives to study/analyze and why)  
                           | - Establish methodology for modeling (micro/macro, elasticities, etc)  
                           | - Run travel demand models to assess potential VMT reduction  
                           | - Perform MOVES modeling to estimate emission reduction  
                           | - Analyze ability to pay (pricing burden on users)  
                           | - Assess legal feasibility/barriers of mandatory program |  
                           |                                                                                     | CDOT  
                           |                                                                                     | DRCOG  
                           |                                                                                     | NFRMPO  
                           |                                                                                     | Consultant(s)  
                           |                                                                                     | RAQC  
                           |                                                                                     | CDPHE |
| Mileage Based Fees          | - Monitor/Review/Report ramifications on SIP planning of CDOT’s research study and resulting recommendations | CDOT  
                           |                                                                                     | CDOT Consultant  
                           |                                                                                     | RAQC  
                           |                                                                                     | CDPHE |
| Pay-as-You-Drive Insurance  | - Meet/discuss possible scope, objectives and program components with insurance industry  
                           | - Run travel demand models to assess potential VMT reduction  
                           | - Assess legal feasibility/barriers of mandatory program  
                           | - Perform MOVES modeling to estimate emission reduction  
                           | - Analyze ability to pay (pricing burden on users) | State Insurance Commissioner  
                           |                                                                                     | Insurance Companies  
                           |                                                                                     | DRCOG  
                           |                                                                                     | NFRMPO  
                           |                                                                                     | RAQC  
                           |                                                                                     | CDPHE  
                           |                                                                                     | Consultant(s) |
| Priced Parking              | - Develop potential pilot program  
                           | - Run travel demand models to assess potential VMT reduction on regional scale  
                           | - Perform MOVES modeling to estimate emission reduction  
                           | - Assess legal feasibility/barriers of mandatory program | DRCOG  
                           |                                                                                     | NFRMPO  
                           |                                                                                     | Local Government (pilot)  
                           |                                                                                     | RAQC  
                           |                                                                                     | CDPHE  
<pre><code>                       |                                                                                     | Consultant(s) |
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| Expand Transportation Demand Management (TDM) Programs | − Determine methodology for estimating costs, benefits and tracking  
− Estimate emissions reductions with technical analysis and/or modeling in accordance with VMEP guidance                                                                 | − DRCOG  
− RAQC  
− NFRMPO  
− CDPHE  
− TMOs/TMAs  
− Consultant(s) |
| Reduce Speed Limit                           | − Develop scope of speed limit reduction options  
− Analyze cost & safety considerations of proposed speed limit reduction options  
− Run travel demand model to estimate VMT changes (if any) of speed limit options  
− Estimate emissions reduction w/MOVES  
− Model air quality impacts of preliminary control scenarios | − CDOT  
− CDPHE  
− DRCOG  
− RAQC  
− Consultant |
| Combined land use strategies to increase development densities, mixed use, and connectivity to transportation choices. |                                                                                                                                                                                                                  |                                       |
| Urban Growth Boundary                        | − Evaluate existing UGBs in N/A area, how they differ, how they effect VMT growth and what changes could be considered to make them reduce additional VMT, including:  
− Perform additional land use modeling, as needed  
− Run travel demand model to assess potential VMT reduction  
− Perform MOVES modeling to estimate emission reductions  
− Evaluate UGB components in place elsewhere that might be appropriate for the Denver region | − DRCOG  
− NFRMPO  
− RAQC  
− CDPHE  
− Consultant(s) |
| Regional Transportation Plan Selection Criteria | − Review current DRCOG RTP/TIP project selection scoring criteria for air quality benefits and identify (if any) additional criteria that could be employed to increase air quality benefits  
− Do the same for NFRMPO | − DRCOG  
− NFRMPO  
− RAQC  
− CDOT  
− CDPHE |
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| **Corridor Planning**                       | - Evaluate corridor planning underway in Denver region and which identify corridors to focus on and why  
- For selected corridors evaluate affect on built environment, employment, public health, air quality and other issues as needed  
- Perform any additional land use scenario modeling, as needed  
- Run travel demand model to assess VMT reduction potential  
- Perform MOVES modeling to estimate emission reductions | - DRCOG  
- NFRMPO  
- CDOT  
- RTD  
- RAQC  
- CDPHE |
| **Local Land Use Tools/Policies to Improve Air Quality** | - Assess air quality impacts of local land use regulations  
  - Detailed analysis of built environment and associated VMT and air quality impacts  
  - Review of land use tools to optimize built environment w/ goal of improved air quality  
  - Assess co-benefits of local land use  
  - Identify which local land use policies/regulations are best suited to improve air quality  
  - Develop best practice guide and outreach program to educate localities on land use measures to improve air quality | - DRCOG  
- NFRMPO  
- CDOT  
- CDPHE  
- DOLA  
- RAQC  
- Consultant(s) |
| **Transit-oriented Development**            | - Review potential VMT and air quality impacts of TOD existing in the region  
- Review RTD’s TOD planning for local bus service  
- Perform any additional land use scenario modeling, as needed  
- Run travel demand model to assess VMT reduction potential  
- Perform MOVES modeling to estimate emission reductions | - DRCOG  
- RTD  
- RAQC  
- CDPHE  
- NFRMPO |
| **Financial/Economic Tools/Policies to Improve Air Quality** | - Analyze how tools and policies are formed/operated/institutionalized and by whom  
- Evaluate how tools/policies effect the built environment, VMT and air quality  
- Develop best practice guide and outreach program to educate localities on tools/policies to improve air quality and advance co-benefits | - DRCOG  
- NFRMPO  
- CDOT  
- DOLA  
- Consultant(s)  
- RAQC  
- CDPHE |
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| Local Tax/Revenue Sharing Structure          | – Evaluate why current local tax structure contributes to a more sprawling built environment, greater VMT, higher emissions and reduced public health  
– Analyze whether and how local tax reform using “revenue sharing” can alter the built environment and offer corresponding air quality/public health benefits, without compromising local/municipal economic health  
– Perform additional land use modeling analysis, as needed  
– Run travel demand model to assess potential VMT reduction, as needed  
– Perform MOVES modeling to estimate emission reductions, as needed | – DRCOG  
– NFRMPO  
– DOLA  
– CML  
– RAQC  
– CDPHE  
– Consultant(s)                                                                                                                                                                                                                               |
| Community land trusts                        | (for both the preservation of open space, and the provision of affordable housing/development)  
– Evaluate how and why Community land trusts are formed/operated/institutionalized and by whom  
– Evaluate how CLTs can affect the built environment and air quality  
– Identify where CLTs exist in Colorado and elsewhere and how they might be expanded to achieve air quality and other land use goals.  
– Perform any additional land use modeling, as needed  
– Run travel demand model to assess VMT reduction potential, as needed  
– Perform MOVES modeling to estimate emission reductions, as needed | – RAQC  
– GOCO  
– CDPHE  
– DRCOG  
– NFRMPO  
– Nature Conservancy/Trust for Public Land  
– Consultants                                                                                                                                                                                                                                         |
| Purchase/Transfer of Development Rights      | (PDR/TDR/Conservation easements)  
– Evaluate how these tools are formed/operated/institutionalized; and by whom  
– Evaluate how CLTs can affect the built environment and air quality  
– Identify where they exist in Colorado and elsewhere and how they might be expanded to achieve air quality and other land use goals. Perform any additional land use modeling, as needed  
– Run travel demand model to assess VMT reduction potential)  
– Perform MOVES modeling to estimate emission reductions | – DRCOT  
– NFRMPO  
– RAQC  
– CDPHE  
– Consultant(s)                                                                                                                                                                                                                               |
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| **Full build-out of FasTracks, including Bus Rapid Transit (BRT), commuter rail, light rail, bus, transit, and HOV infrastructure** | – Evaluate build-out scenarios (as needed) and run travel demand model to quantify changes to VMT and travel behavior  
– Perform any additional land use modeling  
– Perform MOVES modeling to estimate emission reductions | RAQC  
RTD  
DRCOG  
NFRMPO  
CDPHE |
| **Increase transit service levels to increase demand**                 | – Evaluate/determine service level alternatives for additional analysis  
– Run travel demand model to assess VMT reduction potential  
– Perform MOVES modeling to estimate emission reductions | RAQC  
RTD  
DRCOG  
NFRMPO  
CDPHE  
Transit Advocates |
| **Evaluate RTD fare structure to increase demand**                    | – Evaluate/determine pricing/fare structure alternatives for additional analysis  
– Run travel demand model to assess VMT reduction potential  
– Perform MOVES modeling to estimate emission reductions | RAQC  
RTD  
DRCOG  
NFRMPO  
CDPHE  
Transit Advocates |
| **Bike/pedestrian facilities**                                        | – Evaluate bike/pedestrian network and travel demand modeling capabilities  
– Run travel demand model to assess VMT reduction potential  
– Perform any additional land use modeling, as needed  
– Perform MOVES modeling to estimate emission reductions | RAQC  
DRCOG  
NFRMPO  
Local Governments  
CDPHE |
| **Car-sharing programs**                                              | – Evaluate car sharing program, market penetration, and travel behavior changes resulting from car-sharing programs.  
– Run travel demand model to assess VMT reduction potential, as needed  
– Perform MOVES modeling to estimate emission reductions, as needed | RAQC  
DRCOG  
NFRMPO  
CDPHE  
Car-share organizations |

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</table>
| Neighborhood electric vehicles (NEV)                                    | – Evaluate NEV market penetration rate, automobile fleet percentages, and alternative assumptions for NEV trip making (route, speed, # of vehicles, etc)  
– Run travel demand model to assess VMT reduction potential, as needed  
– Perform MOVES modeling to estimate emission reductions, as needed | – RAQC  
– DRCOG  
– Local Governments  
– NFRMPO  
– CDPHE  
– NEV Industry |
| Parking supply management (residential, commercial, retail, etc.)       | – Evaluate parking supply management’s impact on travel behavior, develop assumptions and alternative analysis.  
– Run travel demand model to assess VMT reduction potential, as needed  
– Perform any additional land use modeling, as needed  
– Perform MOVES modeling to estimate emission reductions, as needed | – RAQC  
– Local governments  
– Developers  
– DRCOG  
– NFRMPO  
– CDPHE |
| Changes to State Land Board mission/policies/decisions to reduce sprawl and associated emissions | – Meet with SLB staff  
– Evaluate how SLB policy effects development  
– Run travel demand model to assess VMT reduction potential, as needed  
– Perform any additional land use modeling, as needed  
– Perform MOVES modeling to estimate emission reductions, as needed | – RAQC  
– SLB  
– DRCOG  
– NFRMPO  
– CDPHE  
– Consultant(s) |
<table>
<thead>
<tr>
<th>Measure</th>
<th>Next Steps</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce Fuel Use in Fleet Vehicles</td>
<td>RAQC staff to continue developing educational materials to reduce fleet fuel use through the ‘Engines Off’ program. The program currently penetrates the Denver metro area. CDPHE and CDOT are investigating efforts to create a statewide educational program.</td>
<td>RAQC, CDPHE, CDOT, City and County of Denver, Partner fleets</td>
</tr>
<tr>
<td>Cash for Clunkers</td>
<td>RAQC staff to complete current cash for clunkers program. At this time, there is no funding to continue this effort. The RAQC will be seeking additional funds in the future for this effort.</td>
<td>RAQC, CDPHE, Industry</td>
</tr>
<tr>
<td>Diesel Retrofits</td>
<td>RAQC and CDPHE staff will continue expansion of its diesel retrofit program with area public and private fleets. At this time, the RAQC has funding for this effort through the beginning of 2012. CDPHE will continue to retrofit school buses outside the Denver metro area.</td>
<td>RAQC, CDPHE, Partner fleets</td>
</tr>
<tr>
<td>Truck Stop Electrification</td>
<td>Truck stop electrification is not being pursued at this time due to the costs needed to build the infrastructure. Currently, cheaper on-board units designed to eliminate idling are available.</td>
<td></td>
</tr>
<tr>
<td>Eco-Driving</td>
<td>The RAQC is seeking funding for an eco-driving pilot program. The RAQC has contacted CDPHE to investigate possible supplemental environmental project (SEP) funding.</td>
<td>RAQC, CDPHE, Industry</td>
</tr>
<tr>
<td>Priced Parking Pilot</td>
<td>RAQC staff will work with local governments to provide outreach and education on the VMT reduction potential of pricing parking facilities.</td>
<td>RAQC, Local governments</td>
</tr>
</tbody>
</table>

2 This table contains measures designated by subcommittee members as strategies not to be included in the SIP but had merit to be implemented as voluntary outreach efforts.
<table>
<thead>
<tr>
<th>Measure</th>
<th>Next Steps</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDM</td>
<td>– The RAQC will meet with DRCOG/Ridearrangers staff and TMOs/TMAs to determine scope, feasibility, funding for a region-wide program. This includes employer travel reduction programs. Report on these efforts due by end of 2011</td>
<td>– RAQC</td>
</tr>
<tr>
<td>Local Land Use Tools</td>
<td>– RAQC staff will work with local governments to provide outreach and educational resources on how the built environment influences air quality. This outreach will also include best practices for land use codes that improve air quality. Report on these efforts due by end of 2011</td>
<td>– RAQC</td>
</tr>
<tr>
<td>Strategic Management of Park and Ride facilities/capacity</td>
<td>– The RAQC will work with RTD to support best practice information on the management of park and ride facilities. Report on these efforts due by end of 2011</td>
<td>– RAQC</td>
</tr>
<tr>
<td>Bus and Light Rail Station Planning</td>
<td>– The RAQC will work with RTD to support best practice information on bus and light rail station planning. Report on these efforts due by end of 2011</td>
<td>– RAQC</td>
</tr>
<tr>
<td>Real Time Traveler Information</td>
<td>– The RAQC will work with RTD to support best practice information on real time traveler information. Report on these efforts due by end of 2011</td>
<td>– RAQC</td>
</tr>
<tr>
<td>Linking personal behavior and societal/environmental costs</td>
<td>– RAQC staff will continue to educate local governments and provide outreach and educational resources on how personal behavior is linked to societal/environmental costs through the OzoneAware campaign (or others). Report on these efforts due by end of 2011</td>
<td>– RAQC</td>
</tr>
</tbody>
</table>
IV. Attachments

Attachment A – Executive Order
Attachment B – 2010 Meeting Framework
Attachment C – Preliminary Assessments
Attachment D – RAQC Ozone SIP Strategies: Selection Goals and Criteria
Attachment E – August 16, 2010 Modeling Meeting Memo
Attachment F – 2011 Meeting Framework
Attachment G – Comprehensive List Stationary and Area Sources to be Evaluated in 2011
Attachment A – Executive Order
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EXECUTIVE ORDER

Recreating and Reauthorizing the Denver Metropolitan Area Regional Air Quality Council

Pursuant to the authority vested in the Office of the Governor of the State of Colorado and, in particular, pursuant to Article IV, section 2 of the Colorado Constitution, I, Bill Ritter, Jr., Governor of the State of Colorado, hereby issue this Executive Order authorizing the Regional Air Quality Council as the lead air quality planning agency for the Denver Metropolitan Area.

1. Background and Purpose

Quality of life in Colorado is closely tied to environmental quality, including air quality. While Colorado has made considerable progress in addressing air quality issues, we face new challenges associated with population growth and tightening environmental standards. Communities in the Denver Metropolitan Area and the North Front Range continue to experience elevated ambient concentrations of ozone that pose risks to human health, especially to children and other vulnerable populations. Reducing regional haze is an ongoing effort, while reducing levels of nitrogen deposition in Rocky Mountain National Park and meeting the greenhouse gas reduction goals established in Executive Order D 004 08 present new challenges.

To accomplish the goals of meeting tighter ozone standards, reducing regional haze, reducing nitrogen deposition within Rocky Mountain National Park, and meeting Colorado’s greenhouse gas reduction goal, we must adopt measures to reduce emissions of ozone precursors from stationary sources, the transportation sector, and other sources. Doing so requires evaluation of emissions sources, atmospheric fate and dispersion, and technically and economically feasible emissions reduction measures available for stationary sources and the transportation sector. In addition, these efforts require close coordination between the Colorado Department of Public Health and Environment (“CDPHE”), the Colorado Department of Transportation (“CDOT”), and the many local governments and transportation planning regions affected.

The Governor of the State of Colorado, pursuant to the federal Clean Air Act, 42 U.S.C. § 7504, is authorized to designate a lead agency for air quality planning with the responsibility to prepare air quality plans for the region to demonstrate and ensure long-
term compliance with federal air quality standards. The Regional Air Quality Council ("Council") has been an important actor in the development of strategies to improve air quality and coordinate air quality planning initiatives for the greater Denver Metropolitan Area. This Executive Order recreates, reauthorizes and directs the Council to engage in a coordinated process with CDPHE, CDOT, and local government and transportation agencies to develop and report on the options to further reduce emissions from vehicles, reduce vehicle miles traveled and other measures that yield emission reductions from the transportation sector. In addition, the Executive Order directs the Council to continue with their ongoing duty to develop and propose revisions to the State Implementation Plan in compliance with the requirements of the Clean Air Act.

2. Council Designated

The Regional Air Quality Council ("Council") is the hereby designated as the lead air quality planning agency for the Denver metropolitan area in its status as a non-profit Colorado corporation. The Council shall perform only those duties and functions specifically designated in this Executive Order.

3. Roles and Coordination with Other Entities

A. Role of the Council

The Council has proved to be an important component in the State of Colorado’s development of strategies to improve air quality and coordinate air quality planning initiatives for the greater Denver Metropolitan Area. The Council recently completed action, in conjunction with the North Front Range Transportation and Air Quality Planning Council, on a set of measures designed to bring the Front Range Ozone Nonattainment Area into compliance with the 0.08 parts per million 8-hour National Ambient Air Quality Standard for ozone.

It is likely that even with the measures recently proposed by the Council to attain the 0.08 ppm ozone standard, the Denver and North Front Range areas will be unable to demonstrate attainment of the 0.075 ppm standard unless the State of Colorado adopts additional measures to reduce emissions of ozone precursors from stationary sources, the transportation sector, and from other source categories. Additional emission reductions will be required of stationary sources under the requirements of the regional haze program and the plan to reduce nitrogen deposition in Rocky Mountain National Park. CDPHE will lead and coordinate the development of the emission reduction strategies for stationary sources that will work to improve ambient ozone concentrations, regional haze and decrease nitrogen deposition at Rocky Mountain National Park. However, further emission reductions may be needed from the transportation sector to bring the area into compliance with the latest federal ozone standard and to ensure progress toward accomplishment of the Colorado Climate Action Plan’s goals.
Denver metropolitan and North Front Range local governments, the State of Colorado, businesses, and others will need to find ways to reduce emissions from the transportation sector that may include reductions in emissions from vehicles, reductions in vehicle miles traveled, or adoption of other measures that yield emissions reductions from this sector. Developing options that may be considered will require innovation, creativity, and collaboration among a wide variety of entities. The Council will make an excellent host for focusing these discussions.

Focusing on transportation related air quality issues will require broad coordination among many levels of government, working with the private sector. In particular, an investigation of whether feasible and acceptable strategies exist to address emissions from the transportation sector will require close and thoughtful coordination with the Denver Regional Council of Governments, which has significant experience and expertise in land use planning and transportation planning. The North Front Range Transportation and Air Quality Planning Council will be an integral partner in these discussions, and ultimately the Pikes Peak Area Council of Governments and the city and county of Pueblo will need to be consulted, since any strategies that ultimately might be recommended in the Denver and North Front range area must consider the polices being pursued by those other local governments. The Council shall lead the discussions of transportation related air quality issues and provide for the broad coordination and opportunity for public involvement that is necessary to address the issue.

B. Role of CDPHE

   The Department of Public Health and Environment shall play a lead role, in coordination with Council staff, in technical matters such as developing emissions inventories, conducting air dispersion modeling, and evaluating potential emissions reduction strategies.

4. Mission and Duties

A. The Council shall serve as the lead planning agency for air quality that forwards to the Air Quality Control Commission proposed amendments to the state implementation plan to address attainment and maintenance requirements for the metropolitan area under the Clean Air Act.

B. CDPHE, in coordination with Council staff, shall have the lead responsibility for developing air quality assessments and air quality improvement strategies and shall address the development of ozone management strategies, to the extent possible, in a fashion coordinated with the development of related air quality strategies to address issues such as regional haze and nitrogen deposition in Rocky Mountain National Park.
C. The Council shall work with CDPHE and appropriate agencies in evaluating and developing strategies for completing required amendments to the state implementation plan.

D. The Council shall, in coordination with CDPHE, receive regular briefings on the status of air quality in the metropolitan area as well as plans to reduce emissions and to improve air quality.

E. The Council, in coordination with CDOT, shall convene discussions with the Denver Regional Council of Governments, the North Front Range Transportation and Air Quality Planning Council, affected municipal and county governments, transit agencies and others, as appropriate. These discussion shall form part of the broad coordination effort to identify and discuss strategies that might be available to reduce aggregate emissions of ozone precursors and greenhouse gases from the transportation sector in anticipation that emissions reductions may be required from this sector to demonstrate attainment of the 0.075 ppm ozone standard, or any revisions that may occur to it, as well as the Colorado Climate Action Plan. The Council shall seek out information and briefings from local governments and other organizations from the region, the State and the country to identify and discuss strategies that have been successfully adopted and implemented or strategies that are being studied, in the event that such strategies may be applicable in Colorado.

F. The Council shall report to the Office of the Governor its plan for the coordination of discussions regarding the identification of emission reduction strategy options for the transportation sector prior to conducting such discussions and shall report to the Office of the Governor on the results once the effort is complete.

G. The Council shall be responsible for developing and administering public education and outreach programs regarding air quality and air pollution prevention and control in the Denver metropolitan area. Council material shall include discussions of the public health and environmental benefits as well as the cost effectiveness of providing good air quality in the region.

H. The Council shall serve as an education resource on regional air quality issues to the elected city and county officials in the Denver metropolitan area and shall provide support to the North Front Range Transportation & Air Quality Planning Council as appropriate.

I. The Council may participate in rulemaking proceedings where appropriate and consistent with the rules and procedures of the regulatory body involved in the proceeding.

J. The Council shall continue its ongoing efforts to reduce vehicle tailpipe emissions through the Repair Your Air Campaign and diesel retrofit programs.
5. Structure and Powers

A. The Council shall adopt its own by-laws, consistent with the terms of this executive order. The Council shall adopt a meeting schedule that facilitates its work. The Council shall keep a record of its proceedings, which shall be open to public inspections. No final policy decision or formal action and no action approving contract calling for payment of money shall be adopted or approved at any executive session. The council shall conduct its meetings pursuant to the Colorado Sunshine Law, C.R.S. §§ 24-6-401, 24-6-402.

B. The Council may operate in ad hoc subcommittees, working groups, or such other arrangements as may be useful for efficient and effective functioning. However, all final policy actions must be approved by the Council as a whole.

C. The Council shall rely on CDPHE as its primary source of technical expertise, but may, upon a simple majority vote, contract with other agencies or vendors for additional technical data to assist in achieving its air quality planning mission.

D. The Council shall have the power to retain a staff and hire consultants as appropriate; enter into contracts; receive and expend funds; purchase goods and services; lease space; and perform all necessary management and administrative functions.

E. A simple majority vote of the Council is sufficient to determine the recruitment, hiring, termination and evaluation of the staff and consultants of the Council.

F. A quorum shall consist of a majority of the Council members.

6. Membership and Organization

The Council shall consist of no fewer than twenty-one members to be appointed as follows:

A. No fewer than 6 representatives of local governments in the Denver metropolitan region;

B. At least 1 representative of the following:

1. Denver Regional Council of Governments;
2. local government representative from the North Front Range Metropolitan Area
3. representative of entities that are or have stationary sources;
4. representative of automotive-related businesses;
5. representative of the region's transportation management agencies
6. representative of the general business community
7. individual with transit expertise;
8. member of the public with appropriate transportation experience;
9. member of the public with appropriate land use planning experience;
10. member of the public to represent the conservation community;
11. member of the public to represent the broad public interest;
12. a citizen at large.

C. The Executive Directors of the following departments: CDPHE, CDOT, and the Department of Local Affairs. Each Executive Director may designate an alternate to serve in his place. Said alternates may vote on issues before the Council.

D. The Governor shall appoint one member of the Council to serve as chair of the Council.

E. Appointees shall serve at the pleasure of the Governor.

7. Directive

This Executive order shall supersede all preceding Executive Orders pertaining to the Metropolitan Air Quality Planning Council and the Regional Air Quality Council.

8. Duration

This Executive Order shall continue in existence until April 30, 2011, unless it is either terminated or extended beyond that date by Executive Order of the Governor.

Given under my hand and the Executive Seal of the State of Colorado, this 23rd day of March, 2009.

Bill Ritter, Jr.
Governor
Attachment B – 2010 Meeting Framework

Key Assumptions:

- Meeting Frequency: Monthly
- Meeting Length: 3 hours from 9 am-12 pm
- Meeting Time Slot: 1st Friday of the Month, except for:
  - January meeting scheduled for Thursday, January 28
  - April meeting scheduled for Thursday, April 1
  - July meeting scheduled for Friday, July 9
  - September meeting scheduled for Wednesday, September 8
- With the exception of meetings involving out of town participants, meeting design components may change, based on RAQC member preferences and progress-to-date evaluating and discussing topics/issues
- 2010 work will lay the groundwork for the 2011-2013 ozone SIP control measure selection process
- Each meeting will include time for public comment and other business, as necessary

Meeting 1: January 28, 2010 – Laying the Foundation

- Introduction of RAQC Members/key staff
- Remarks by Jim Martin, Martha Rudolph and Andy Spielman
- Keynote Presentation by Fred Hansen, Director of Tri-Met, Portland, Oregon
- Discussion of Proposed 2010 RAQC Board Meeting Framework and Key Questions for RAQC Consideration Moving Forward
- Remarks by Governor Ritter

Meeting 2: March 5, 2010 – The View from Air Quality Managers: Progress to Date and Future Directions

- **Purpose:** To address the foundation for future air quality management decisions, touching on multi-state, state-wide and front-range regional factors/considerations.
- **Proposed Discussion Topics:**
  - Institutional framework for managing air quality in Colorado
  - Tools and methodologies used for predicting air quality levels and future impacts
  - Air quality status, efforts to date to manage air quality and projected magnitude of challenges ahead
  - Emission source apportionment and other factors influencing air quality planning
  - Positioning the front range to respond to national air quality and climate initiatives
  - Introduce NOx strategies and Regional Haze strategy requirements
Meeting 3: April 1, 2010 – The View from Beyond Government Air Quality Managers: Additional Perspective on Air Quality and Related Planning Initiatives

- Facilitated Discussion on Regional Air Quality Management, Including Past Experiences, Roles and Upcoming Challenges and Opportunities
- Perspectives could include those from:
  - Local and Regional Government Planning
  - Transportation
  - Business
  - Public Interest/Health
  - Academic

Meeting 4: May 7, 2010: Discussion of transportation control measures, alternative transportation choices, “sustainable” land use plans and other strategies for achieving emissions reductions

Facilitated discussion topics could include:

- Front Range transportation planning efforts, including DRCOG “sustainability” scenarios
- Transportation and congestion mitigation choices and associated realities
- “Sustainability” measures and related benefits/co-benefits (e.g., health, quality of life, housing, etc loc)
- Transit-oriented Development practice and air quality planning options/realities

Meeting 5: June 4, 2010 – Regional Air Quality Planning Approaches Considered Elsewhere in the US

How Transportation, Land Use and Housing/Built Environment Considerations Can Influence Help Regional Air Quality Initiatives

Note: This meeting would be a special meeting proposed to be co-hosted by the RAQC, DRCOG, NFRMPO and the Metro Mayor’s Caucus, with representatives from these and other groups invited to attend and participate in a discussion with a panel of regional leaders from around the Country having experience tackling issues related to air quality, transportation and land use. It would be sponsored and facilitated by the Governor’s Institute. The timeframe for this meeting will be 9-3 and lunch will be served. Guest Participants will be named in early 2010.

Discussion Topics could include:

- Understanding and working with public opinion and communicating need for action
- Measures used/considered for reducing vehicle emissions and vehicle miles traveled
- Private sector involvement in air quality planning involving transportation and land use
- Local government involvement in air quality planning involving transportation and land use
- Experience with finding broad local support for VMT reduction strategies
- Strategies for gaining EPA acceptance of innovative solutions
- Lessons learned
Meeting 6: July 9, 2010 – Taking Stock and Providing Direction to Staff; Update of Federal Regional Haze Control Strategy Direction

• What RAQC Members Have Heard, Discussed To Date and Discussion/Confirmation of Next Steps
  ▪ A facilitated discussion by Governor’s Institute staff on opportunities, challenges and next steps, based on June Meeting and associated research.
  ▪ RAQC member roundtable discussion of views and impressions of previous four RAQC meetings
  ▪ Possible staff assignments on areas for evaluation and analysis
  ▪ Discussion of possible adjustments to future meeting emphases
  ▪ Discussion of establishing RAQC member subcommittees
• Update on Federal Regional Haze NOx emission control strategy direction and regulatory/SIP direction

Meeting 7: August 6, 2010 – Discussion of Stationary Source Emission Reduction Strategies

• Discussion of stationary source contribution to front range ozone levels
• Options, magnitude, costs, benefits/co-benefits of reducing emissions from stationary air emission sources
• Update on evaluation of benefits, impacts and technical feasibility of adopting California paints/solvents regulations in Colorado

Meeting 8: September 8, 2010 - Discussion of Alternative Fuels and Automotive-Related Emission Reduction Strategies

• Discussion of contribution of motor vehicle fleet and fuels to front range air quality emission levels
• Options, magnitude, costs, benefits/co benefits of reducing emissions from the fleet (not including reducing VMT)
• Update on ongoing evaluation of potential motor vehicle fuels ozone reduction strategies

Meeting 9: October 1, 2010 – A Point of View from the Region’s Businesses: Opportunities and Challenges Associated with Possible Approaches to Reducing VMT

• Discussion on the pros and cons of pursuing air quality management options designed to reduce VMT.
• Possible perspectives from real estate developers, manufacturing companies, etc

Meeting 10: November 5, 2010 – A Point of View from the Region’s Public & Environmental Interests: Opportunities and Challenges with Possible Approaches to Reducing VMT and Distribution of Preliminary Draft 2010 RAQC Progress Report

• Discussion topics could include the pros and cons of pursuing air quality management options designed to reduce VMT
• Possible perspective from health, environmental, sustainability/livability energy conservation representatives
Meeting 11: December 3, 2010 – Discussion of draft 2010 RAQC Progress Report, Roundtable discussion of next steps, preferences, future meeting, activities

- RAQC Discussion of draft 2010 RAQC Progress Report capturing ideas, options, positions, messages, issues discussed to date and recommended changes to staff
- RAQC discussion of future meetings and next steps
- Possible scheduling of additional December meeting to approve 2010 RAQC Progress Report
Attachment C – Preliminary Assessments
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Compilation of 2010 Assessments

Preliminary “High-Level” Evaluation Tool
for Supporting Initial Prioritization of Ozone Reduction Measures

For Discussion Purposes Only
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A. Motor Vehicle and Fuels Measures

Table A: Overview of Strategies Analyzed

Detailed Assessment for the following strategies:

**Fuels**
A1. Reformulated Gasoline
A2. 7.0 RVP Gasoline
A3. Eliminate Ethanol Waiver
A4. Eliminate Ethanol Blending during Ozone Season
Table A-1: Gasoline Fuels Options – Cost Benefit Summary
A5. Expanded Use of Alternative Fuels in Governmental and Private Fleets
A6. Electrification of Vehicle Fleet
A7. Fleet Fuel use Reduction

**Motor Vehicle**
A8. I/M Program Enhancements - More Stringent Pass/Fail Standards
A10. I/M Program Enhancements - On Board Diagnostic (OBD) Testing
A11. Remote Sensing Based High Emitter Program
A12. Cash for Clunkers
A13. Diesel Retrofits
A14. Truck Stop Electrification
A15. Signal Timing and Coordination
A16. Eco-Driving Education
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# Regional Air Quality Council | Fuels and Motor Vehicles Subcommittee | Overview of Strategies Analyzed

## TABLE A

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<tr>
<th>Measure</th>
<th>Description of Measure</th>
<th>Experience in Colorado/Other Areas</th>
<th>Existing Authority or Needed Approvals</th>
<th>Implementation/SIP Measure Feasibility</th>
<th>Additional Analysis Needed</th>
<th>Board Recommendation and Next Steps</th>
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<tr>
<td><strong>Reformulated Gasoline (RFG)</strong></td>
<td>RFG is blended to reduce smog-forming and toxic pollutants principally by lowering fuel evaporation rates.</td>
<td>Approximately 17 states have opted into the federal RFG program.</td>
<td>The Governor must petition EPA to develop RFG for attainment purposes. No legislative approval is required because this strategy is technically not part of the SIP.</td>
<td>Benefits are accounted for through emissions and atmospheric modeling to demonstrate attainment in the SIP.</td>
<td>Evaluate benefits using EPA's required Motor Vehicle Emissions Simulator (MOVES) model. Atmospheric modeling Determine Colorado's administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011.</td>
</tr>
<tr>
<td><strong>7.0 Reid Vapor Pressure (RVP) Gasoline</strong></td>
<td>The RVP of gasoline is a measure of its volatility. Higher RVP gasoline is more volatile meaning it has a greater propensity to evaporate. Lowering the required RVP from the current 7.8 standard to 7.0 (with a 1 pound per square inch (psi) ethanol waiver throughout the nonattainment area) will reduce VOC evaporative emissions.</td>
<td>Five areas (i.e., Atlanta, Birmingham, El Paso, Detroit and Kansas City) currently require 7.0 RVP gasoline.</td>
<td>The AQCC currently has regulatory authority to establish a 7.0 RVP fuel standard.</td>
<td>The State must implement this strategy as part of a SIP and demonstrate it is necessary to achieve attainment of the NAAQS. EPA can approve this if it finds no other measures bring about timely compliance.</td>
<td>Evaluate benefits using EPA's MOVES model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011.</td>
</tr>
<tr>
<td>Measure</td>
<td>Description of Measure</td>
<td>Experience in Colorado/Other Areas</td>
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<tr>
<td>Eliminate Ethanol Waiver</td>
<td>The current EPA nonattainment area summertime fuel specification is 7.8 RVP with a waiver allowing for ethanol blended fuels to have a 1 psi increase in RVP. This waiver allows ethanol to be blended at 10% volume with regular specification gasoline (i.e., 7.8 RVP) resulting in E10 fuel being produced with a RVP of 8.8.</td>
<td>Colorado has been using the national RVP required fuel with the 1 psi summertime waiver for E10 blended fuels since 1991. Further investigation is required to determine if other areas have eliminated the ethanol waiver.</td>
<td>Removal of the waiver requires the Governor to petition EPA requesting elimination of the waiver. The petition must document the waiver increases air pollution.</td>
<td>SIP credit can be calculated and verified with MOVES modeling. Enforceability is assured via the Governor’s petition and EPA action to approve the waiver elimination.</td>
<td>Evaluate benefits using EPA’s MOVES model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011.</td>
</tr>
<tr>
<td>Eliminate Ethanol Blending During the Summer Ozone Season</td>
<td>End ethanol (E10) blending during summer ozone season. Blending 10% ethanol with gasoline raises the RVP of the gasoline by approximately 1 psi. Eliminating ethanol blending during the summer season would reduce the RVP of gasoline in the nonattainment area thereby lowering evaporative VOC and NOx emissions and increasing CO.</td>
<td>EPA has rejected a waiver from the Renewable Fuels Standard (RFS) filed by Texas. Further investigation is required to determine if other areas have attempted to eliminate ethanol in summertime fuel blending.</td>
<td>Authority to implement this measure must be investigated.</td>
<td>A determination of whether the State can ban ethanol usage under federal law is required. If this is possible, a mandatory program could receive SIP credit.</td>
<td>Evaluate benefits using EPA’s MOVES model. Atmospheric modeling Determine Colorado’s administrative costs to enforce this strategy.</td>
<td>-Presented to the RAQC in September 2010. The Board will consider industry input on this strategy in 2011. -Evaluate feasibility in view of federal (RFS).</td>
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<td>Expand Use of Alternative Fuels in Governmental and Private Fleets</td>
<td>Alternative fuels such as compressed natural gas (CNG), liquefied natural gas (LNG), biodiesel, 85% ethanol blended with gasoline (E85), and hybrid and electric technologies are used to reduce criteria emissions, toxic pollutants and greenhouse gases.</td>
<td>Governor Ritter issued an Executive Order requiring state fleets to reduce petroleum usage by 25% by 2012. From 1994 – 2002 Colorado Regulation Number 17 required fleets to use alternative fuels. A number of states have implemented mandatory and voluntary programs.</td>
<td>Regulatory and/or statutory provisions would be needed to implement a mandatory program.</td>
<td>Current gas/electric hybrid vehicles and natural gas vehicles are certified to the same criteria emission standards as gasoline vehicles. States cannot take credit based on estimates of future purchases of advanced technology vehicles without a mandate that ensures these vehicles will be purchased. There may be SIP credit available for purely electric vehicles. At this point the potential for obtaining SIP credit is unclear.</td>
<td>Analysis of vehicle/alternative fuels penetration under various scenarios to quantify nonattainment area emissions benefits.</td>
<td>Presented to the RAQC in September 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>Electrification of Vehicle Fleet</td>
<td>The conversion of the light-duty gasoline vehicle fleet to electric will reduce criteria emissions, toxic pollutants and greenhouse gases. This strategy uses tax credits/rebates to promote the purchase of electric powered vehicles in governmental and corporate fleets and personal vehicles.</td>
<td>No known efforts require mandatory introduction of electric vehicles.</td>
<td>Regulatory and/or statutory provisions would be needed to implement a mandatory program. Emissions benefits could be realized with this measure and they could be quantified through. EPA’s MOVES model. However, regional SIP credit would have to be based on vehicle penetration which would be dependent on incentives. Colorado would also need to require that a certain portion of the fleet be electric in order to meet EPA guidance for taking credit for such a program.</td>
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<td>Presented to the RAQC in September 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>Fleet Fuel Use Reduction</td>
<td>This strategy focuses on measures to eliminate excessive idling and associated fuel use. This strategy would address both diesel and gasoline powered vehicles. Potential idling reduction strategies could vary from voluntary education programs, to mandatory and enforceable programs, to subsidized equipment retrofit programs for heavy duty vehicles and school buses.</td>
<td>The City and County of Denver and the Town of Aspen have idling ordinances in place.</td>
<td>Regulatory and/or statutory provisions would be needed to implement a mandatory program.</td>
<td>A mandatory program with an enforcement mechanism would likely be eligible for SIP credit.</td>
<td>Evaluation of existing programs in other states to determine idling program types and associated benefits and costs, as well as how SIP creditable they are/could be.</td>
<td>Presented to the RAQC in September 2010. The Board decided to table the strategy as a SIP measure and pursue voluntary efforts.</td>
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<tr>
<td>I/M Program Enhancements – More Stringent Pass/Fail Standards</td>
<td>Reduce vehicle emissions testing pass/fail criteria within the Vehicle Inspection and Maintenance (I/M) Program to increase the benefit from the program.</td>
<td>The I/M Program is currently in place in Colorado. Reducing pass/fail criteria would be a regulatory change to the existing program.</td>
<td>AQCC has the authority to adopt tighter emissions standards.</td>
<td>This strategy could be implemented and included in the SIP.</td>
<td>APCD currently performing analyses MOVES modeling Cost analysis</td>
<td>Presented to the RAQC in December 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
</tr>
<tr>
<td>I/M Program Enhancements – Evaporative Emission Testing via High Emitter Remote Sensing</td>
<td>Roadside remote sensing technology is currently used to identify vehicles with emissions problems in the Denver area. Using roadside remote sensing technology to identify high evaporative emitters of volatile organic compounds (VOC) may increase the benefit from the I/M program.</td>
<td>Pilot studies are currently in operation in Colorado.</td>
<td>AQCC has the authority to adopt an evaporative emissions check in the I/M Program.</td>
<td>Currently, EPA does not provide SIP credit for this strategy. Colorado must demonstrate this is an effective control option to EPA to be included in the SIP.</td>
<td>Significant additional analysis on the costs and benefits based on the current pilot program by CDPHE/RAQC.</td>
<td>Presented to the RAQC in December 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>I/M Program Enhancements – On Board Diagnostics (OBD) Testing</td>
<td>On-board diagnostic (OBD) testing uses information from the vehicle’s computer to predict vehicle operating and emissions problems. Addition of an OBD test may increase the benefit from the program.</td>
<td>Currently, Colorado requires OBD testing for data gathering purposes.</td>
<td>AQCC has the authority to adopt regulatory requirements for an OBD based I/M Program or to require an OBD test to supplement the current I/M240 test.</td>
<td>A program using OBD testing as either a replacement or a supplement could be implemented and included in the SIP.</td>
<td>Additional analysis of the disparity between modeled and actual emissions benefits between I/M240 testing and OBD. Cost analysis Analysis of program structure</td>
<td>Presented to the RAQC in December 2010. The Board directs staff to continue evaluation of this strategy as a mandatory measure for potential inclusion in the SIP.</td>
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<td>Remote Sensing Based High-Emitter Program</td>
<td>Roadside remote sensing technology is currently used in a voluntary program to identify vehicles with emissions problems in the Denver area. This strategy could either replace the current I/M Program with a program that utilizes only remote sensing to identify vehicles with high emissions or include remote sensing as a supplement to the current I/M program.</td>
<td>Colorado has been investigating a remote sensing based high-emitter program since 2003.</td>
<td>The AQCC adopted a pilot remote sensing based high-emitter program and has the authority to adopt a full-scale program.</td>
<td>Currently, EPA does not provide additional SIP credit for this strategy. Colorado must demonstrate this is an effective control option to EPA to be included in the SIP.</td>
<td>APCD is currently in the process of analyzing results from the pilot program. Cost analysis</td>
<td>The Board tabled this measure as a replacement for the current I/M program but continue evaluating the strategy as a supplemental program with incentives.</td>
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<td>Cash for Clunkers</td>
<td>A cash for clunkers program would identify older, higher polluting vehicles for purchase and permanent retirement.</td>
<td>The RAQC/CDPHE are currently operating a voluntary cash for clunkers program with SEP funds.</td>
<td>A mandatory program would require legislative action to fund the program and establish eligibility requirements.</td>
<td>A mandatory program with a dedicated source of funding could be included in the SIP.</td>
<td>Program eligibility requirements would need to be developed to analyze costs and benefits.</td>
<td>The Board tabled this strategy as a SIP measure but to continue pursuing voluntary efforts.</td>
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<td>Diesel Retrofits</td>
<td>Older diesel vehicles have higher emissions than newer diesel vehicles. Diesel retrofits use different technologies to reduce emissions from these older vehicles.</td>
<td>Colorado currently has a robust voluntary diesel retrofit program through the RAQC, CDPHE, the City and County of Denver, school districts and local governments. Other states have mandatory programs in place.</td>
<td>A mandatory program would require legislative approval and regulatory development by the AQCC.</td>
<td>EPA has guidance on taking SIP credit for these programs. California has a major diesel retrofit program ($120M) included in their SIP.</td>
<td>Significant additional development of this strategy to identify what sectors would be required to install retrofits is needed. Without a program framework it is impossible to determine program costs and benefits.</td>
<td>The Board tabled this strategy as a SIP measure but to continue pursuing voluntary efforts.</td>
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<td>Truck Stop Electrification</td>
<td>Truck stop electrification (TSE) can be installed at area truck stops so that cab cooling and heating is provided by a unit that is inserted into the window of the vehicle so that the engine does not need to idle.</td>
<td>Colorado currently has approximately 20 TSE spaces in the state.</td>
<td>A mandatory program would require legislative approval and regulatory development by the AQCC.</td>
<td>There are no known programs included in SIPs. However, EPA has guidance on taking SIP credit for these programs.</td>
<td>Evaluation of EPA guidance for taking SIP credit. Additional analysis of the power plant emissions required to provide TSE services.</td>
<td>The Board tabled this strategy as a SIP measure and directed staff to continue pursuing voluntary efforts.</td>
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<td><strong>Signal Timing and Coordination</strong></td>
<td>Signal timing is the process of making traffic signals work together as opposed to independently. This process reduces emissions on certain corridors by reducing vehicle wait times.</td>
<td>DRCOG has a Regional Traffic Signal System Improvement Program (TSSIP) that identifies critical corridors for improvement. Other areas in the country have similar efforts in place.</td>
<td>This program is in place and operated by DRCOG.</td>
<td>Emissions reductions can be calculated for DRCOG’s program. At this time, DRCOG’s models do not have the sophistication to translate these benefits to a regional level that would be required for a SIP. However, Phoenix has included this in their SIP. Their methodology is being investigated.</td>
<td>Evaluation of Phoenix’s SIP methodology.</td>
<td>The Board decided to continue evaluation of this strategy through investigation of Phoenix’s program.</td>
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<td><strong>Eco-Driving Education</strong></td>
<td>Eco-driving programs are designed to educate drivers in techniques (i.e., avoiding rapid acceleration, reducing speeds, etc.) that can reduce gas consumption and emissions. These programs can take the form of direct driver education in a classroom, tracking employee driving through technology or as a public awareness campaign.</td>
<td>There are a number of programs in existence and they are common in fleet operations. Both the City and County of Denver and Encana Oil &amp; Gas have programs that focus on improving driver behavior.</td>
<td>Legislative action and regulatory development would be required to implement a mandatory program.</td>
<td>There is no demonstrated ability to take SIP credit for this measure. There are no known eco-driving programs included in SIPs.</td>
<td>Additional analysis of potential emissions reductions.</td>
<td>The Board tabled this strategy as a SIP measure but to continue pursuing voluntary efforts.</td>
</tr>
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</table>
A1. Reformulated Gasoline (RFG)

Measure type: Fuels - Gasoline

Measure description:

RFG is gas blended to reduce smog-forming and toxic pollutants (principally by lowering fuel evaporation rates). The Clean Air Act requires that RFG be used in cities with the worst smog pollution to reduce harmful emissions that cause ground-level ozone. A state may petition EPA to require RFG as part of efforts to meet the ozone standard.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The benefits below are compared to the current base summertime fuel specification of 7.8 RVP with a 1 psi RVP waiver:
- Mostly on road mobile source benefits, but some off-road benefits as well
- Approx. 15 TPD VOCs (w/potential small NOx benefits) total reduction based on 13 tpd on-road and 2 tpd non-road emissions reductions
- Reduction of 15 tpd represents around 11% reduction of total (on-road and non-road) transportation-related VOC emissions contributing to ozone

Preliminary sense of anticipated costs and economic impact:

The RAQC/CDPHE commissioned a fuels study in the fall of 2009 to assess the market impacts of four proposed fuel options, the costs incurred to make the designated fuels and how a particular fuel specification might impact the sourcing and availability of summertime fuel for the Denver/North Front Range Market.

- Based on Costs from final Fuels Study (03/04/11):
  - Range of Refinery Costs:
    - Capital – 0.7-5 cents/gallon (cpg)
    - Operating/Maintenance – 0.05-4 cpg
    - Lost product – 3.6-17 cpg
  - Capital Costs: estimated at $710 Million
  - Market Costs:
    - During initial years of RFG program, region would likely experience a pass through of total incremental refining cost increase to consumer, estimated at 13-26 cpg (based on volume of major providers).
    - Supply tightening in the early years could lead to some additional costs to consumers over and above refinery costs.
    - In later years, when the market is potentially oversupplied the market price could be less than the refining costs of the major providers.
Additional technical analysis/input needed to refine benefits/costs estimates:

- Obtain feedback on fuels study/independent analysis from refining industry
- Evaluate benefits using EPA required MOVES model, as well as atmospheric model

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

- Authority exists under the Federal Clean Air Act because region is nonattainment for ozone
- Governor must petition EPA to develop RFG for attainment purposes; no legislative approval needed since RFG is not part of the SIP, rather it is a federal program (see below)
- Implementation feasibility high; approximately 17 states have opted-in to the federal RFG program, so pursuing this does not raise issues with EPA regarding quantifiability, enforceability etc.
- EPA implements program, but likely process would be for the RAQC and AQCC to consider pursuing RFG and recommend to Governor

Demonstrated ability to take "SIP Credit" for the measure:

- Yes. Measure not technically part of the SIP, rather associated benefits are accounted for via modeling to demonstrate attainment via the SIP.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

- High likelihood, assuming commitment to pursue RFG is made within about one year so that predicted 5 year technical lead in begins in 2011 and assuming EPA provides reasonable flexibility from requirement that the RFG enters the fuels market within 1 year of the Governor’s petition requesting to use it for attainment purposes.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Possible slight air toxics, but these benefits are most likely to be realized by other federal mobile source regulations
- No GHG benefits

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Depending on where EPA sets the ozone standard, how many states pursue RFG, associated market supply and demand considerations, industry's need for uniformity, and whether the EPA pushes for a federal change in fuel standards, the cost/benefits of this measure could vary.
A2. 7.0 RVP Gasoline

Measure type: Fuels - Gasoline

Measure description:

Summertime fuel standard w/ 1 psi ethanol waiver throughout the DMA/NFR NAA. The RVP of a gasoline is a measure of its volatility. Higher RVP gasoline is more volatile meaning it has a greater propensity to evaporate. Lowering the required RVP from the current 7.8 standard to 7.0 will reduce VOC evaporative emissions.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The benefits below are compared to the current base summertime fuel specification of 7.8 RVP with a 1 psi RVP waiver:
  - Approximately 7 TPD reduction in VOC from On-Road Mobile Emissions in 2015 (about 6% of On-road VOC)
  - Approximately 1 TPD reduction in VOC from Non-Road Mobile Emissions in 2015 (tractors, lawn mowers etc.)

Preliminary sense of anticipated costs and economic impact:

The RAQC/CDPHE commissioned a fuels study in the fall of 2009 to assess the market impacts of four proposed fuel options, the costs incurred to make the designated fuels and how a particular fuel specification might impact the sourcing and availability of summertime fuel for the Denver/North Front Range Market.

- Based on Costs from final Fuels Study (03/04/11):
  - Refinery Costs: (capital, operating and light end loss) between 9 cents per gal. (cpg) and 13 cpg based on volume of major providers,
  - Refinery Capital Investment: estimated at approximately $250 Million
  - Market costs: The Colorado Front Range market will likely experience a decline in available gasoline supply due to the light end loss and the fact some refiners may shift gasoline to other markets to avoid the capital costs of more stringent fuel specifications. This supply tightening could lead to some additional market costs to consumers over and above refinery costs. Past experience indicates market premiums of 2 to 21 cpg have been paid for 7.0 RVP fuels in Detroit and Kansas City depending on local market conditions.

Additional technical analysis/input needed to refine benefits/costs estimates:

- Reductions based on MOBILE6 and Non-Road Model analysis for 2015. Analysis needs to be conducted using MOVES mobile sources emissions model, which will be used in SIP. Impact of MOVES on fuel options analysis is uncertain.
- Assessment of Colorado’s administrative costs to implement and enforce
Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

- The AQCC currently has regulatory authority to establish a 7.0 RVP fuel standard.
- State must implement as part of a SIP; effective date dependent on SIP approval date.
- State must demonstrate that strategy is necessary to achieve attainment of NAAQS.
- EPA can approve if it finds that no other measures that would bring about timely compliance exist or that other measures exist but such measures are unreasonable or impracticable.
- Implementation of strategy cannot cause supply or distribution in interruptions or have significant adverse effect on fuel producibility.
- Implementation of 7.0 RVP would be a State responsibility in the NAA.

Demonstrated ability to take "SIP Credit" for the measure:

- Using EPA mobile source emissions models (MOVES) properly ensures that SIP credit can be calculated and verified. Appropriate rulemaking ensures enforceability.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

- Refiners will require approximately 3-4 years to implement capabilities to produce 7.0 RVP w/ethanol waiver after regulatory requirement established. So measure could likely be in place in time SIP inclusion.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Potential gasoline supply loss due to light end rejection and choices by some refiners to shift to other markets
- Current 7.8 RVP fuel is oversupplied to NAA with overflow occurring to nearby attainment market areas. Higher cost product (7.0 RVP) relative to 9.0 RVP allowed in attainment market area, will cause refiners to minimize production of 7.0 RVP for NAA only and add storage tanks (costs) to accommodate both 9.0 and 7.0 RVP.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Five other areas (Atlanta, Birmingham, El Paso, Detroit and Kansas City) currently require 7.0 RVP gasoline.
- Implementation by state would add to States administrative costs.
A3. Eliminate Ethanol Waiver

**Measure type:** Fuels - Ethanol

**Measure description:**

The current EPA DMA/NFR NAA summertime fuel specification is 7.8 Reid Vapor Pressure (RVP) with a waiver allowing for ethanol blended fuels (E10) to have a 1 pound per square inch (psi) increase in RVP. Specifically, this waiver allows ethanol to be blended at 10% volume with regular specification (7.8 RVP) gasoline, effectively resulting in E10 fuel being produced with a RVP of 8.8. Eliminating the waiver would mean that refiners would have to meet the applicable RVP requirement regardless of whether they blended ethanol or not.

Eliminating the waiver could either be done while retaining the current 7.8 RVP specification, or in connection with a reduction of the RVP specification to 7.0 to achieve even greater emission reduction benefits. Elimination of the waiver would require the refiners to either eliminate ethanol blending or make lower RVP conventional gasoline blendstock to accommodate the 1 psi increase resulting from 10% ethanol blending. Given current federal renewable fuel standards, continued blending of 10% ethanol is likely effectively mandated at least in the near term. Accordingly, elimination of the waiver will likely result in lowering the RVP of conventional gasoline blendstock from the current 7.8 RVP to either 6.8 RVP, or 6.0 RVP if the elimination of the waiver was done in conjunction with the lowering of the RVP specification to 7.0.

This strategy has been analyzed assuming use of a lower RVP conventional gasoline blendstock to accommodate the 1 psi increase resulting from 10% ethanol blending because the federal renewable fuel standards have mandated the use of ethanol at this time.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

The benefits below are compared to the currently effective summertime (June 1 to September 15) fuel specification of 7.8 RVP with a 1 psi RVP waiver and based on Mobile 6.2 modeling for the year 2015:

- Eliminating the 1 psi waiver assuming a summer time fuels specification of 7.8 RVP would result in approximately a 9 tpd reduction of VOCs for total on road and non-road engines.
- Eliminating the 1 psi waiver assuming a summertime fuels specification of 7.0 RVP would result in approximately a 15 tpd reduction of VOCs for on road and non-road engines.
A reduction of 9 tpd represents a reduction of approximately 7% of the transportation related VOCs in the NAA. A reduction of 15 tpd represents around 12% reduction of total (on-road and non-road) transportation-related VOC emissions in the non-attainment area in 2015.

Preliminary sense of anticipated costs and economic impact:

The RAQC/CDPHE commissioned a fuels study in the fall of 2009, designed to build off of a similar study commissioned by the refining industry. This study, in a preliminary draft phase, assesses the market impacts of four proposed fuel options, the costs associated with making the designated fuels, and how a particular fuel specification might impact the sources and market availability of summertime fuel in the Denver/North Front Range.

- Based on Costs from preliminary final Fuels Study (03/04/11):
  - 7.8 RVP w/o waiver (6.8 RVP blendstock + 10% ethanol)
    - Costs to refiners (capital, operating and light end loss)
      - Capital – 0.7 to 2.2 cents per gallon (cpg)
      - Operating - 0 to 2 cpg
      - Lost product – 9 to 10 cpg
    - Cost to consumer compared to current baseline could range from 10-14 cpg (based on volume of major providers) plus an additional premium depending on the market and supply.
  - 7.0 RVP w/o waiver (6.0 RVP blendstock + 10% ethanol)
    - Costs to refiners (capital, operating and light end loss) on
      - Capital – 0.7 to 4.4 cpg
      - Operating - 0 to 3 cpg
      - Lost product – 1 to 18 cpg
    - Cost to consumer compared to current baseline could range from 2-24 cpg (based on volume of major providers) plus an additional premium depending on the market and supply.

Additional technical analysis/input needed to refine benefits/costs estimates:

- Emissions estimates will need to be updated using EPA’s new emissions model (MOVES) before this measure can be considered for SIP purposes, which will ultimately be used in the SIP analysis.
- Additional input and analysis of associated costs requested of and provided by the refining industry.
- Photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

- Removal of the waiver requires that the Governor petition EPA requesting elimination of the waiver. The petition must document that the waiver increases air pollution.
- Elimination of the waiver will be effective date one year after receipt of petition. EPA may extend the effective date of the waiver elimination if it determines that elimination of the waiver would result in insufficient supply of gasoline.
Demonstrated ability to take "SIP Credit" for the measure:

- SIP credit can be calculated and verified provided that EPA's most current mobile source emissions models (MOVES) are employed
- Enforceability is assured via the petition and EPA action to approve the waiver elimination

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?)

High likelihood, assuming commitment to pursue measure is made within one year so that predicted 3-4 years needed for refiners to modify operations can occur.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

No greenhouse gas benefits.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

The cost and benefit numbers listed above are based on the assumption that eliminating the ethanol waiver will result in refiners lowering RVP, not eliminating ethanol blending during the summer season. If, based on input from refiners, it appears that some or all refiners will try meet the strategy by eliminating summertime ethanol blending, a new cost and benefit analysis would be needed, as well as a consideration of additional policy consideration regarding the elimination of ethanol blending in the summer.
A4. Eliminate Ethanol Blending during Summer Ozone Season

**Measure type:** Fuels - Ethanol

**Measure description:**

Prohibits ethanol (E10) blending during summer ozone season June 1-September 15. Because blending 10% ethanol with gasoline raises the RVP of the gasoline by approximately 1 pound, eliminating ethanol blending during the summer season would reduce the RVP of gasoline in the non-attainment area thereby lowering evaporative VOC emissions. Eliminating ethanol would also lower NO\textsubscript{x} emissions in non-road vehicles and increase CO emissions in on-road and non-road vehicles.

**Preliminary sense of anticipated air quality benefits (e.g. NO\textsubscript{x}/VOC reductions? Potential reduction amount?):**

Based on Mobile 6.2 modeling for 2015 eliminating ethanol in gasoline during the summer months would:

- Reduce VOC emissions for on-road and non-road vehicles by approximately 6 tpd.
- Reduce NO\textsubscript{x} emissions from non-road vehicles by approximately 2 tons per day.
- Increase CO emissions by approximately 206 tpd. However, while CO emissions are technically an ozone precursor, their reactivity is significantly lower (6 tpd VOC – (206 tpd/60))
- Accounting for the lower reactivity of CO the total modeled VOC emissions reduction benefit from this strategy in 2015 is approximately 2.6 tons per day (VOC+1/60CO).
- The projected VOC reduction of 6 tpd from this measure represents an approximately 5% reduction of the total (on-road and non-road) transportation related VOC in the non-attainment area. The projected NO\textsubscript{x} reduction of 2 tpd is approximately a 2% reduction of total transportation NO\textsubscript{x} in the NAA, and the CO increase of 206 tpd is approximately a 14% increase in transportation related CO.
- Based on previous sensitivity modeling during the EAC SIP process (2004) and the recent SIP process (2008) for the years 2007 and 2010, respectively, elimination of the ethanol waiver resulting in no change in 2007 to a slight (0.1 ppb) increase in ozone concentrations in 2010.

**Preliminary sense of anticipated costs and economic impacts:**

The RAQC/CDPHE commissioned a fuels study in the fall of 2009, designed to build off of a similar study commissioned by the refining industry. This study, in a preliminary draft phase, assessed the market impacts of four proposed fuel options, the costs associated with making the designated fuels, and how a particular fuel specification might impact the sources and market availability of summertime fuel in the Denver/North Front Range. Based on Costs from the final Fuels Study (03/04/11):

- Cost to ethanol producers in lost sales could range between $1.68 to $2.45/gallon.
• Cost increase to consumer could be approximately 2-7 cpg due to the ethanol tax credit and generally lower spot price for ethanol compared to conventional gasoline going forward, although prices do fluctuate.
• The Colorado ethanol industry spends approximately $225 million annually producing 10MBD of corn ethanol, which includes approximately $100 million annually in corn purchases.

Additional technical analysis/input needed to refine benefits/costs estimates:

• Emissions estimates will need to be updated using EPA’s new emissions model (MOVES) before this measure can be considered for SIP purposes, which will ultimately be used in the SIP analysis.
• Additional input and analysis of associated costs requested of and provided by the refining industry and other interested parties.
• Photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Based on analysis from the Colorado Department of Public Health and Environment, banning ethanol is not a legally viable option in light of the federal RFS mandate. Although the Energy Independence and Security Act does provide EPA with waiver authority, the standards for granting such a waiver were set exceptionally high and include:
  o Inadequate domestic supply
  o Implementation would severely harm the economy or environment of state, a region or the United States.

Neither the domestic supply nor the severe economic harm conditions apply in terms of the reasons for seeking a waiver. In 2008, EPA rejected the State of Texas’ request for a waiver based on an argument of increased ozone concentration. In this light, an ethanol ban or waiver is not considered a viable alternative for implementation.

Demonstrated ability to take "SIP Credit" for the measure:

A mandatory program could receive SIP credit since it is enforceable and could be modeled using the EPA mobile source emissions model.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

A mandatory program, if there is authority to establish one, could possibly be effective as soon as an AQCC rulemaking is completed. However, the impact of the supply of motor fuel, the RFS and RINs issues would take time to sort out.
Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Based on a life cycle analysis, the EPA believes that an expanded use of renewable fuels (ethanol) would provide significant reductions in green house gases. Accordingly, banning ethanol during the summer months would increase GHG emissions.
- Elimination of ethanol in gasoline would increase CO emissions by 206 tpd.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- The American Jobs Creation Act of 2004 encourages ethanol use via tax incentives of 51 cents per gallon (cpg).
- The RFS rules require any party that produces gasoline, including blenders that produce gasoline from blendstocks, to sell a set and increasing percentage of renewable fuels annually. Banning ethanol in the summer may make it difficult, if not impossible for refiners serving the Denver market to meet RFS requirements in upcoming years.
- Eliminating ethanol from the supply equation could decrease the supply of motor fuel in the Denver/North Front Range market.
- Elimination of ethanol in gasoline would negatively impact the agricultural and ethanol production industries in Colorado, which has a current production capacity of 10 MBPD, and planned additional capacity of 16 MBPD. If planned capacity is built this would meet Colorado’s ethanol needs through 2017.
<table>
<thead>
<tr>
<th>Strategy</th>
<th>Estimated Emission Reduction** (tons per day)</th>
<th>Estimated Refinery Cost Impact***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VOC</td>
<td>CO</td>
</tr>
<tr>
<td>Federal Reformulated Gasoline</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>7.0 RVP Gasoline (with current ethanol waiver)</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td>Eliminate Ethanol Waiver*</td>
<td>7.8 RVP</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>7.0 RVP</td>
<td>15</td>
</tr>
<tr>
<td>Eliminate Ethanol (E10) Blending during Ozone Season</td>
<td>6</td>
<td>+206 (increase)</td>
</tr>
</tbody>
</table>

*Assumes E10 is still blended and RVP standard is met with lower RVP blend stock
** Reduction compared to current 7.8 RVP gasoline with current ethanol waiver based on MOBILE6.2
*** Based on volume of major suppliers
A5. Expand Use of Alternative Fuels in Governmental and Private Fleets  
(CNG, LNG, biodiesel, E85, hybrid, electric, etc.)

Measure type: Fuels

Measure description:

Alternative fuels are used to reduce criteria emissions, toxic pollutants and greenhouse gases. Currently, many governmental organizations are seeking funding to purchase vehicles, implement fueling infrastructure and educating the public about alternative fuel benefits. Many private vehicle owners are also utilizing alternative fuels (including gas industry operators in Weld County, as presented and discussed during a recent RAQC meeting). Since many of these fuels are already being used the strategies listed here are focused on expanding the use of these fuels in the region's gasoline and diesel fleets.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The transition to alternative fuel use can reduce criteria pollutants and greenhouse gases. State fleets are already using alternative fuels on a limited basis under Colorado’s Climate Action Plan and some local governments are using these fuels under their own "greening government" initiatives. Broader adoption of these fuels can increase the associated air quality benefit. Table 1 below shows the estimated reductions in tons per day (tpd) per 1,000 vehicles per alternative fuel type.

| Table 1 – Estimated Emissions Reductions by Fuel Type |
|-----------------|---|---|---|---|---|
|                  | VOC | NOx | CO  | PM  | CO2  |
| 1,000 CNG Vehicles (tpd) | 0.005 | 0.000 | 0.090 | 0.000 | 2.808 |
| 1,000 Electric Vehicles (tpd) | 0.049 | 0.001 | 0.449 | 0.000 | 13.370 |
| 1,000 E85 Vehicles (tpd) | 0.009 | 0.001 | 0.081 | 0.000 | 2.273 |
| 1,000 Hybrid Electric Vehicles (tpd) | 0.045 | 0.001 | 0.341 | 0.000 | 6.551 |
| 1,000 HDDV B20 (tpd) | 0.089 | 1.091 | 0.660 | 0.022 | 18.245 |

These estimates were developed using percentage emissions reductions from the Department of Energy’s Advanced Fuels and Advanced Vehicles Data Center and EPA gasoline powered emissions factors. The biodiesel emissions reductions were developed from EPA’s Diesel Emissions Quantifier.

While these numbers represent reasonable emission reduction numbers for the various fuels, actual reductions will depend on the new vehicle standards applicable to particular alternative fuel vehicles. Overall, emission reductions within the nonattainment area will ultimately be driven by the market penetration of the various alternative fuel vehicles identified.
Preliminary sense of anticipated costs and economic impact:

Estimated costs alternative fuels costs are listed below in the graph on a gasoline/diesel per gallon equivalent. The gasoline/diesel per gallon equivalent (GGE) is the amount of alternative fuel it takes to equal the energy content of one gallon of gasoline or diesel fuel.

There are a range of costs associated with the fuels discussed above that include the estimated light-duty vehicle cost differential and estimated cost of infrastructure. The vehicle cost differentials are actual costs for light-duty vehicles from various sources. The infrastructure costs are estimates.

Industry estimates a dedicated CNG fueling station will cost $500,000 - $1.5M based on the fuel volumes. The $1.5M cost is for a new dedicated fueling station built under a canopy with four hoses to handle large volumes of fuel. CNG vehicle cost differentials are up to $10,000 per light duty vehicle.

Costs for electrical infrastructure are up to $8,000 per charging station. These costs were developed from a City of Thornton electrification project. This cost includes installing the proper wiring and charging stations in a parking lot at a local government. For home charging the electrical equipment cost can be very low if the time to charge the vehicle is not of concern. At this time, estimated light duty vehicle differential costs are $7,000 - $14,000.

The E85 infrastructure is approximately $10,000 to convert an existing gasoline pump to E85. This cost estimate is different than the above costs because it is utilizing an existing fueling facility and converting existing infrastructure. This information is from the Colorado Corn Growers Association that is assisting the Governor’s Energy Office in developing E85 infrastructure. Heavy-duty vehicles have highly varied costs based on the vehicle type and are not included here. To install a brand new variable blend pump the cost could be up to $40,000. There is no vehicle cost differential for E85 flex fuel compliant vehicles.

Hybrid vehicles require no infrastructure expenditures. However, the light duty vehicle cost differential is approximately $5,000 per vehicle.
Additional technical analysis/input needed to refine benefits/costs estimates:

Analysis of vehicle/alternative fuels penetration under various scenarios to quantify nonattainment area emissions benefits. This would include a detailed examination of the emission reductions from the actual alternative fueled vehicles available or likely to be available, as well as a calculation of emission reductions under various fleet penetration scenarios. Given the uncertainty of these issues, significantly different costs and benefits than those identified above could be expected depending on which assumptions are used. This analysis could be completed in 2011 depending on funding.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

In 1994 a mandatory alternative fuels program was developed for the Carbon Monoxide SIP. The Legislature mandated this program in 1994. The AQCC then adopted Regulation #17 to implement the program. It required fleets of 10 or more vehicles to have a proportion of their vehicles (10%) fueled by alternative fuels. In 2002, the Legislature removed legislative authority for the program and the AQCC removed Regulation 17 from the SIP due to program ineffectiveness. Currently there is no legal authority to mandate alternative fueled vehicles. Regulatory or statutory provisions would be needed to implement a mandatory program (we are currently researching whether any other states have mandatory programs).

Currently, State of Colorado fleets are required to reduce petroleum usage by 25% by 2012, pursuant to a Governor's Executive Order evolving from the Colorado Climate Action Plan. Also under this Order, the Governor's Biofuels Coalition is expanding the E85 fueling infrastructure.

Many states have tax exemptions, credits and grants for ethanol and biodiesel. A number of states across the country have biofuels mandates in place including Minnesota, Oregon, Washington, Pennsylvania, New Mexico and Louisiana. These states require a certain percentage of diesel fuel sold in the state to be blended with biodiesel. This is usually in the 2% - 20% range.

Demonstrated ability to take "SIP Credit" for the measure:

Current gas/electric hybrid vehicles and natural gas vehicles are certified to the same criteria emission standards as gasoline vehicles and do not receive separate treatment in calculations for SIPs. Plug-in gas/electric hybrids may have lower criteria pollutant emissions than other gasoline vehicles but EPA does not have estimates of those benefits that would be acceptable for a SIP analysis. States cannot take credit in SIPs based on estimates of future purchases of advanced technology vehicles without a mandate that ensures that such vehicles will be cleaner and that they will be purchased. There may be SIP credit available for purely electric vehicles. At this point the potential for obtaining SIP credit is extremely unclear. We would need to explore with EPA.
Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

A voluntary program can be in-place for CNG, E85 and biodiesel in the short-term. However, a mandatory program could take longer due to the legislation required to implement the program and ensuring there is proper infrastructure in place. To implement a long-term project, the past Regulation 17 model could be revisited. Data would need to be gathered and the issues encountered under Regulation 17 would need to be investigated. Any long term benefit would depend on fleet turnover.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

These fuels have lower greenhouse gas emissions. Other benefits include economic gains for Weld County and the Western Slope, which depend on the oil and gas industry for revenues and related economic benefits. Economic benefits will also be realized in rural areas based on the demand for feed stocks to produce renewable fuels. These fuels could reduce reliance on foreign petroleum.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

Currently, the natural gas industry has formed a partnership between Noble, Anadarko, Encana, Williams and Bill Barrett. The industry is working on co-evolving the infrastructure and vehicles needed to grow the market and implement CNG/LNG as a viable transportation fuel.

The industry is currently in the planning and development stage. The Colorado Oil & Gas Association (COGA) and the industry are developing a five year plan investigating natural gas opportunities. The natural gas industry is approaching fleets to install infrastructure. They are starting with governmental fleets and oil & gas service provider fleets. Weld County has funding for a fueling facility.

The industry is also working with the Big 3 to provide OEM vehicles. Honda’s CNG Civic has been the primary fleet vehicle in the past. It is estimated there are approximately 100 CNG Civics on the road in the Front Range. The industry has approached the Big 3 to lobby for a wider range of OEM vehicles. GM is releasing a CNG van in 2011 and maybe a bi-fuel pick up truck in the future.

Many of these fuels do not have the energy content equivalent of gasoline and diesel fuels, thereby reducing the driving range and desirability for some fleets. However, focusing such a program on those fleets which operate solely within the region (e.g. gas industry fleet vehicles, waste haulers, etc.) may be a better option. Natural gas is good for fleets that have smaller areas of operation and are close to refueling infrastructure (i.e., Denver International Airport). Many fleets have experience with these fuels with varied experience.
A6. Electrification of Vehicle Fleet

Measure type: Fuels

Measure description:

The conversion of the light-duty gasoline vehicle fleet to electric will reduce criteria emissions, toxic pollutants and greenhouse gases. This strategy uses tax credits/rebates to promote the purchase of electric powered vehicles in governmental and corporate fleets and personal vehicles. Currently, many governmental organizations are seeking funding to purchase vehicles, implement fueling infrastructure and educate the public about electric vehicle benefits and tax credits/rebates.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

These vehicles do not emit air pollutants. However, there are associated indirect emissions attributable to the power plants that generate the electricity used by these vehicles. Overall direct emission benefits will depend on the extent to which gasoline vehicles are retired and replaced. When the air quality benefits of HB1365 are determined, we will have a better sense of the direct and indirect air quality benefits of this measure. Furthermore, the market penetration of renewables as an energy source will also affect overall emission benefits.

Preliminary sense of anticipated costs and economic impact:

Based on the current release of initial pricing on the Chevy VOLT and Nissan LEAF the estimated vehicle cost differential is $7,000 - $14,000. Estimated costs from a City of Thornton electrification project indicate infrastructure costs of up to $8,000 per plug-in. Other direct costs are the recharging costs to the consumer which are estimated at $0.61 gallon of gasoline equivalents (GGE). This effort could also include costs for a large public education campaign aimed at purchasers of new vehicles and fleet owners. Other indirect costs could include power grid and generation modifications.

Additional technical analysis/input needed to refine benefits/cost estimates:

Significant additional air quality and cost analysis is necessary to predict the timing and extent of replacement of gasoline vehicles with electric vehicles. Analysis will also be necessary for assessing additional emissions from the generation of power needed to operate the electric vehicles.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

In the short-term implementation feasibility on a large scale is limited because there are no vehicles available and there is no fueling infrastructure. However, HB1331 will generate interest in this measure because it provides a 75% tax credit/rebate for the cost differential between an electric and similar non-electric vehicle. HB1331 expires in 2016. Federal tax credits/rebates
are being investigated. Currently there is no legal instrument in place to mandate a transition to electric vehicles.

**Demonstrated ability to take "SIP Credit" for the measure:**

Emissions benefits could be realized with this measure and they could be quantified through EPA's mobile source modeling. However, regional SIP credit would have to be based on vehicle penetration which, currently and without a mandate, would be dependent on incentives. Colorado would also need to require that a certain portion of the fleet be electric in order to meet EPA guidance for taking credit for such a program. It is not clear what credit EPA would give for an incentive program. Clarification from EPA in the near future would be essential.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

It is not likely significant implementation and the resulting benefit could be achieved in time for the SIP. An effort of a scale necessary to realize significant benefits would take years. Such an effort would also be dependent upon incentives or a mandate utilized to promote fleet turnover to increase the penetration of electric vehicles. Nonetheless, long term air quality benefits could be significant depending on a host of factors to be determined; potentially assisting in a successful ozone standard maintenance strategy.

**Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):**

Benefits are highly influenced on whether and to what extent coal, natural gas or renewables will be used to recharge electric vehicles. CO2 benefits could be realized through this effort. In addition, this could reduce the reliance on foreign petroleum.

**Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):**

The Union of Concerned Scientists and others indicate electric vehicles will be a ‘niche’ market for the foreseeable future since manufacturers are just beginning to make cars and infrastructure is just being installed and is still expensive. Other issues to overcome include the time it would take to charge vehicles at public fueling stations. Another issue is that many homes do not have attached garages to plug vehicles in. Depending on the voltage requirements, some homes may not have the proper electrical supply. There are also grid capacity and electric generating unit emissions implications. The emissions increases from power plants are primarily SO2 and fine particulates. From the research, many of these issues are being addressed through technological solutions.
A7. Fleet Fuel Use Reduction

**Measure type:** Fuels

**Measure description:**

This strategy focuses on measures to eliminate excessive idling and associated fuel use. This strategy would address both diesel and gasoline powered vehicles in fleets and personal vehicles. Potential idling reduction strategies could vary from voluntary education programs, to mandatory and enforceable programs, to subsidized equipment retrofit programs for heavy duty vehicles and school buses. If a mandatory program is not feasible voluntary efforts to reduce idling are still an important strategy to pursue.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

This measure reduces criteria emissions, air toxics and greenhouse gases. The table below shows the estimated hours of idling that occur for light-duty gasoline powered vehicles, heavy-duty diesel vehicles and school buses. The gasoline, heavy duty and school bus annual idle hours are from the Lowering Emissions and Particulate (LEaP) website sponsored by a leading idle reduction equipment manufacturer. The emissions reductions use factors from EPA’s 1998 Emissions Fact Sheet. Due to the age of the data, 2005 data from the Center for Alternative Fuels, Engines and Emissions (CAFEE) from West Virginia University was consulted to ensure the 1998 factors were still valid. The table shows that heavy duty diesel vehicles have the highest amount of idling. These high idle hours are to provide for heat/cool while the driver sleeps.

<table>
<thead>
<tr>
<th></th>
<th>Gasoline Vehicle Idling</th>
<th>Heavy Duty Diesel Idling</th>
<th>School Bus Idling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Idle Hours</td>
<td>30</td>
<td>2,412</td>
<td>181</td>
</tr>
<tr>
<td>Annual 10% Reduction</td>
<td>3</td>
<td>241.2</td>
<td>18.1</td>
</tr>
<tr>
<td>VOC Reduction (pounds per vehicle)</td>
<td>0.11</td>
<td>6.64</td>
<td>0.50</td>
</tr>
<tr>
<td>CO Reduction (pounds per vehicle)</td>
<td>1.51</td>
<td>49.94</td>
<td>3.75</td>
</tr>
<tr>
<td>NOx Reduction (pounds per vehicle)</td>
<td>0.03</td>
<td>29.22</td>
<td>2.19</td>
</tr>
<tr>
<td>PM Reduction (pounds per vehicle)</td>
<td></td>
<td>1.37</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Table 2 shows the estimated daily reductions by vehicle type if 1,000 vehicles reduced their idling. Gasoline vehicles and school buses have very low emissions on a tons per day (tpd) estimate.
Table 2 – Estimated Daily Emissions Reductions by Vehicle Type per 1,000 Vehicles

<table>
<thead>
<tr>
<th></th>
<th>Gasoline Vehicle Idling</th>
<th>Heavy Duty Diesel Idling</th>
<th>School Bus Idling</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC (tpd)</td>
<td>0.00015</td>
<td>0.009</td>
<td>0.0007</td>
</tr>
<tr>
<td>CO (tpd)</td>
<td>0.00207</td>
<td>0.068</td>
<td>0.0051</td>
</tr>
<tr>
<td>NOx (tpd)</td>
<td>0.00004</td>
<td>0.040</td>
<td>0.0030</td>
</tr>
<tr>
<td>PM (tpd)</td>
<td>-</td>
<td>0.002</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

These numbers are preliminary. While reduced idling reduces air emissions, the magnitude of reductions associated with this measure will depend on how the specific idling strategy is employed and how successful it can be in reducing idling hours.

Preliminary sense of anticipated costs and economic impact:

Costs will vary depending on the strategy adopted. A voluntary approach could have low costs because there would be no enforcement component. The primary cost would be for driver training and any idle reduction equipment the fleet would purchase. A mandatory program would require additional costs for enforcing idling laws. The City and County of Denver has a program in place. Denver indicates the cost of their program is difficult to determine because the Safety Department cites idling vehicles as a part of their routine duties to reduce stolen vehicles. Court costs were eliminated by changing their ticketing procedure from a civil violation that would need to go to court to an administrative penalty that does not go to court. The only staff time expenditures are to mail these citations to motorists and the occasional site visit to discuss idling with a business that may be in violation on a complaint basis.

Additional technical analysis/input needed to refine benefits/costs estimates:

Evaluation of existing programs in other states to determine idling program types and associated benefits and costs, as well as how SIP creditable they are/could me. Also additional analysis is needed to determine the likely achievable idling hours reductions from implementing different idling reduction strategies in the region; as well as the commensurate emission reductions.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Research will need to be done to determine what authority currently exists or needs to be secured to implement a mandatory idle reduction effort. Home rule cities currently have this authority. The City and County of Denver and the City of Aspen have idling ordinances in place. A number other states have idling rules in place as well.
Demonstrated ability to take "SIP Credit" for the measure:

A mandatory program with an enforcement mechanism would likely be eligible for SIP credit.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

A mandatory program could be in place in time for SIP inclusion.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

This program would reduce greenhouse gases. In addition, fleets would save fuel and vehicle maintenance costs through this effort. Quality of life would be improved around fleet yards, schools and other areas frequented by heavy idling traffic.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

In the early 2000’s, the RAQC invited area law enforcement and code enforcement to a training session to discuss implementation of a mandatory smoking vehicle and idling vehicle enforcement program. All jurisdictions were invited to participate. Six jurisdictions attended the training. They indicated that they could not dedicate resources towards this effort due to other priorities.

Both a mandatory and voluntary effort were investigated under the previous RAQC Board. The strategy focused on reducing idling around schools, public works fleets, fast food drive thrus and railroad crossings across the state. The mandatory program was not implemented due to concerns over enforcement and cost. The voluntary program has been implemented through a partnership between the RAQC, CDPHE, the City and County of Denver and American Lung Association primarily throughout the Denver metropolitan area. CDOT is currently working with these partners to expand this effort statewide.

The primary consideration with voluntary idling programs is that as soon as the vehicle leaves the fleet yard the vehicle can idle excessively unless technology is in place to monitor vehicle idling frequency. These technologies include global positioning systems (GPS) and idle reduction preheat systems. GPS systems can track idle time and engine preheat systems can warm passenger cabins so that drivers do not idle their vehicles for warmth. At this time, the majority of preheat units are deployed on diesel vehicles but technology is available for gasoline powered vehicles now. Many of the primary idle reduction technologies are covered under the diesel retrofit strategy assessment.

The key consideration with mandatory idling laws is enforcement. Significant State or local enforcement resources may be necessary to identify and enforce against excessively idling vehicles. There resources include both law enforcement and court system resources to cite and adjudicate these cases. A number of exemptions, such as those contained in Denver's Idling Vehicles ordinance would also be provided for during extreme hot and cold weather for passenger safety considerations. Diesel vehicles also need to idle at times to operate equipment on the vehicle. Another issue that concerns many fleets is avoiding a patchwork of different local idling ordinances.
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A8. I/M Program Enhancements - More Stringent Pass/Fail Standards

Measure type: Motor Vehicles

Measure description:

The State of Colorado operates a Vehicle Inspection and Maintenance (I/M) Program in the 7-County Denver Metro Area (DMA). Commencing in late 2010, the program will be expanded to non-attainment areas within Larimer and Weld Counties. Under the program, all vehicles registered within the program area must meet established carbon monoxide (CO), nitrogen oxides (NOx) and volatile organic compounds (VOCs) pass/fail criteria. These pass/fail standards are typically referred to as “emission cutpoints.” To ensure compliance with established emission cutpoints, vehicles must undergo periodic emissions testing at the time of their registration renewal (I/M 240 testing). Vehicles that fail the tests must be repaired and pass a retest before they can be re-registered. In 2009, approximately 60,000 vehicles failed their emissions test in the Denver Metro Area. Based on DMA fail rates, approximately 15,000 vehicles from Larimer and Weld Counties are projected to fail per year upon expansion of the program to those counties.

The environmental benefit from the program is derived primarily from the emission reductions that occur when vehicles failing the initial test are repaired to ensure compliance with program requirements, with additional reductions occurring as a result of pre-inspection vehicle maintenance. While most inspected vehicles within the AIR Program area pass the established standards, those that fail contribute disproportionately to the overall emissions of the vehicle fleet.

Based on Mobile 6.2 modeling, the I/M Program in the DMA reduced ozone precursor emissions by approximately 16 tons per day in 2009 (VOC + NOx + 1/60 CO). Based on modeling for 2015, the projected benefit for the entire program area (including Larimer and Weld Counties) is approximately 18 tons per day (approximately 8 tpd VOC, 8 tpd NOx, and 2 tpd CO (120 tpd/60)).

By adopting more stringent or lower I/M program emission cutpoints, we could achieve additional emission reductions from motor vehicles through the identification and repair of more vehicles with excess emissions.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The amount of emission reductions from an I/M 240 program will vary depending on the emission cutpoints that are adopted. Recognizing that the emission levels of vehicles can only be lowered so much through maintenance and repair, the Mobile6.2 emissions model only recognizes emission cutpoints down to a certain level of stringency. Using the most stringent emission limits allowed under the model, additional benefits beyond those currently achieved by the I/M program, are as follows:
- Approximately 0.5 TPD reduction in VOC emissions from on-road vehicles (approximately 0.7% of on-road VOC)
- Approximately 0.5 TPD reduction in NOx emissions from on-road vehicles (approximately 0.7% of on-road NOx)

**Preliminary sense of anticipated costs and economic impact:**

Based on projections from 2009 actual program data, adopting the most stringent cutpoints allowed under the model will result in approximately 50,000 additional failing vehicles, and a corresponding increase in vehicle repair costs attributable to the program. Based on 2009 inspection data from the DMA program, and projecting this data out to include the expansion of the program into Larimer and Weld Counties, using the most stringent cutpoints allowed under the model would increase the cost of the program in 2009 by approximately 13 million dollars.

**Additional technical analysis/input needed to refine benefits/costs estimates:**

Emission reduction analysis needs to be conducted using the MOVES mobile source emission model since the MOVES model will need to be used for the next SIP. Additionally, actual test data from the current I/M program needs to be considered in order to validate the results, and examine the apparent disconnect between the relatively small emission reductions as calculated by the Mobile model, and the large number of additional vehicles projected to fail if the new emission cutpoints were adopted. Finally, additional analysis is needed to more accurately predict the actual costs from this proposed strategy, through a more in-depth analysis of predicted fail rates that would occur if more stringent cut-points were adopted, including analysis of actual program data from Larimer and Weld Counties rather than the projected data used for this high level assessment.

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

The AQCC has authority to adopt regulatory requirements regarding the inspection and maintenance program including the adoption of emission cutpoints. CDPHE and Department of Revenue would jointly implement and oversee the program.

**Demonstrated ability to take "SIP Credit" for the measure:**

Colorado can take SIP credit for adopting more stringent cutpoints up to the amount allowed by the approved emission model. To receive additional credit would require an extensive demonstration that the more stringent cutpoints produced greater emission reductions than is accounted for under the model.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

Colorado could adopt more stringent cutpoints in the near term. The full benefit would only be achieved, however, after the completion of a full (2 year) inspection cycle.
Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

Adopting more stringent cutpoints would improve the fuel economy of vehicles repaired under the program, thereby reducing greenhouse gas emissions, reducing fuel consumption and saving motorists money on fuel.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

While adopting more stringent cutpoints will achieve additional emission reduction benefits from the inspection and maintenance program, it will also increase the risk that vehicles without any emissions related problem will fail. In setting cutpoints, it is imperative that they are set at a level that well maintained vehicles can meet.

Measure type: Motor Vehicles

Measure description:

The State of Colorado operates a Vehicle Inspection and Maintenance (I/M) Program in the 7-County Denver Metro Area (DMA). Commencing in late 2010, the program will be expanded to non-attainment areas within Larimer and Weld Counties. Pursuant to the program, vehicles registered in the program area must meet established criteria (cutpoints) for emissions of carbon monoxide (CO), nitrogen oxides (NOx) and volatile organic compounds (VOCs). While the program requirements include a rigorous test for tailpipe emissions, with the exception of a gas cap pressure check, there is currently no testing requirements to identify vehicles with high VOC evaporative emissions emanating from vehicles’ fuel systems. With the advent of stricter new vehicle tailpipe VOC emission standards, evaporative VOC emissions have become an increasingly larger source of the overall VOC emissions from the vehicle fleet. Based on recent calculations, evaporative emissions may now represent more than 60% of all mobile source VOCs in the non-attainment area.

Identifying and requiring the repair of high evaporative emitting vehicles would help to reduce this important source of VOC emissions. Currently, however, because of technological limitations, and the time and expertise it takes to determine whether a vehicle is a high evaporative emitter, conducting an evaporative emissions test on all vehicles as part of the current I/M test is not a viable option. CDPHE is working with both EPA and the RAQC on identifying likely high evaporative emitters while they drive on the public roadways using remote sensing technology. If these efforts prove successful, remote sensing technology could be used to identify likely high emitters, which would then be required to come in for further testing. Vehicles that were confirmed as high evaporative emitters would then be required to undergo repairs to reduce their evaporative emissions.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The work to identify high evaporative emitters using remote-sensing is still very preliminary. From 2008-2009, CDPHE conducted evaporative emissions testing as part of its larger remote sensing based high emitter pilot program. As part of the program, the RAQC funded the repair of vehicles determined to have high evaporative emissions. Based on this work, CDPHE calculated that a full-scale program would reduce evaporative emissions by 0.6 tons per day through the identification and repair of vehicles with excess evaporative emissions. Further, because of limitations in the testing methods used to measure the amount of evaporative emissions reduced, this reduction figure likely underestimates the actual benefits that could be achieved from such a program.
Preliminary sense of anticipated costs and economic impacts:

CDPHE has not yet calculated the costs of a potential evaporative emission program.

Additional technical analysis/input needed to refine benefits/costs estimates:

Significant additional analysis on the potential costs and benefits of such a strategy needs to be completed.

CDPHE is currently working with EPA to refine the methodology used to identify likely high evaporative emitting vehicles using remote sensing technology. Based on this work, EPA has developed a new way to use remote sensing measurements to identify high evaporative emitting vehicles. CDPHE and the RAQC recently began using this new methodology to identify likely high evaporative emitters as part of a voluntary repair assistance program. Data generated from this repair assistance program, along with EPA and CDPHE’s ongoing study will provide significant additional information on the potential benefits of a remote sensing based high evaporative emitter program.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

The AQCC has authority to adopt regulatory requirements regarding the inspection and maintenance program, including the adoption of an evaporative emissions check. CDPHE and Department of Revenue would jointly implement and oversee the program. If adopted, such a program would be the first of its kind.

Demonstrated ability to take “SIP Credit” for the measure:

Currently, EPA does not provide SIP credit for a remote sensing evaporative emissions program. This is one of the reasons we are working with EPA to evaluate this measure as an emission control option. To receive additional credit for such a program would require extensive further demonstration of the emission reductions from such a program.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

It is unclear whether an evaporative emissions program could be include in the next ozone SIP, although we believe it would be unlikely due to the significant further evaluation currently underway.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

Adopting an evaporative emissions program would save fuel and associated money.
Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

Based on preliminary work, use of remote sensing devices to identify high evaporative emission vehicles, could potentially develop into a significant strategy to reduce VOC emissions. Given the current state of our knowledge, however, such reductions remain very speculative.
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A10. I/M Program Enhancements-On Board Diagnostic (OBD) Testing

Measure type: Motor Vehicles

Measure description:

The State of Colorado operates a Vehicle Inspection and Maintenance (I/M) Program in the 7-County Denver Metro Area (DMA). Commencing in late 2010, the program will be expanded to non-attainment areas within Larimer and Weld Counties. This program utilizes I/M 240 testing to measure tailpipe emissions of carbon monoxide (CO), nitrogen oxides (NOx) and volatile organic compounds (VOCs). This approach allows Colorado to determine whether a vehicle is a high emitter and therefore in need of emission related repairs.

Colorado is unique. Other jurisdictions around the Country have transitioned from using I/M 240 to test vehicles to using vehicle on-board diagnostic systems (OBD). Unlike the I/M 240 test, which measures a vehicle’s actual emissions from the tailpipe, OBD testing uses information regarding a vehicle’s operation and performance, which is stored in a vehicle’s on board computer. This information is then used to evaluate vehicle emissions and determine whether repairs are needed to meet emission requirements. Currently, Colorado requires a testing contractor to conduct OBD testing, but the results from the test are advisory only and not used to fail vehicles.

The reason for Colorado’s present disinclination to transition to OBD is that we believe more accurate measurements occur using I/M 240; although we continue to evaluate this as part of efforts to further enhance Colorado’s I & M program. One future option may be to pursue greater emission reductions, by requiring pass/fail OBD testing either to supplement or to replace the current I/M 240 test.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Based on Mobile 6.2 modeling for 2015, the projected benefit for the I/M program utilizing the current I/M 240 testing approach is approximately 18 tons per day (approximately 8 tpd VOC, 8 tpd NOx and 2 tpd CO (120 tpd/60).

According to the model, replacing the I/M 240 test with an OBD test, while maintaining the other elements of the current I/M program, would increase the emission reduction benefits of the program as follows:

- Approximately 2.8 TPD reduction in VOC emissions from on-road vehicles (approximately 3.5% of on-road VOC)
- Approximately 2.0 TPD reduction in NOx emissions from on-road vehicles (approximately 2.7% of on-road NOx)
OBD testing can also be used as a complement to I/M 240 testing. The Mobile 6.2 model does not recognize any emission reduction benefit from conducting dual testing, presumably based on the belief that any failing vehicles identified by an I/M 240 test would also be identified by an OBD test. Based on analyses of Colorado program data as well as studies from other jurisdictions, however, there is far from complete overlap between the failing vehicles identified by OBD testing and the vehicles identified by I/M 240 testing. Accordingly, conducting dual testing would result in the identification of more failing vehicles than either I/M 240 or OBD testing alone, and consequently achieve greater emission reductions from the repair of these vehicles than either testing system, regardless of what the model predicts. Based on an analysis of 2008 I & M program data by an independent contractor, requiring pass/fail OBD testing in conjunction with the current I/M 240 test would result in the following additional emission reductions above the current I/M program:

- Approximately 1.3 TPD reduction in VOC emissions from on-road vehicles
  (approximately 1.6% of on-road VOC)
- Approximately 2.9 TPD reduction in NOx emissions from on-road vehicles (approximately 3.9% of on-road NOx)

**Preliminary sense of anticipated costs and economic impact:**

Based on a preliminary cost analysis, APCD has calculated that replacing the current I/M 240 test with an OBD test would add approximately $5.1 million to the cost of the program, due to a significant increase in the number of failing vehicles requiring repairs. These costs would be born by vehicle owners. These costs are based on 2009 program data for the Denver Metro Area, and estimates for the soon to be started North Front Range Area.

The contractor, which analyzed the potential benefits of using OBD testing in conjunction with I/M 240 testing, calculated that such a strategy would cost approximately $4.2 million, based on 2008 data from the Denver Metro Area alone.

**Additional technical analysis/input needed to refine benefits/costs estimates:**

Additional analysis on the relative benefits of I/M 240 and OBD testing are needed. While the Mobile 6.2 model calculates significant additional benefits from OBD testing, analysis of current program data comparing vehicles failing the current I/M 240 test and vehicles that “fail” the current advisory-only OBD test indicates that OBD testing may miss between 40% and 60% of the high emitting vehicles identified by I/M 240.

Given this broad range of potential inaccuracy, it is very possible that OBD testing actually reduces emissions less than I/M 240 testing. APCD is currently conducting an extensive study on the relative merits of the two testing systems. This study will be ongoing, and is intended to provide tangible information to help inform us as to whether a switch to an OBD based system is warranted as part of the next SIP.

Emission reduction analysis needs to be conducted using the MOVES mobile source emission model since the MOVES model will need to be used for the next SIP.

Finally, additional analysis is needed to more accurately predict the actual costs from this proposed strategy, through a more in-depth analysis of predicted fail rates that would occur if
OBD testing were adopted either as a supplement to or replacement of the current I/M 240 testing. This analysis would be based on the most current program data available, including analysis of actual program data from Larimer and Weld Counties rather than the projected data used for this high level assessment.

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

The AQCC has authority to adopt regulatory requirements for an OBD based I/M program, or to require an OBD test to supplement the current I/M 240 based program emitter program. CDPHE and Department of Revenue would jointly implement and oversee the program.

**Demonstrated ability to take "SIP Credit" for the measure:**

SIP credit for an OBD based program is clearly available. Achieving additional SIP credit for a dual testing program will require an extensive demonstration that such a program would achieve additional emission reductions. Since other jurisdictions have not adopted a dual OBD I/M 240 testing program it is unclear whether EPA would grant additional credit for dual testing. Depending on the results, CDPHE's study of the relative merits of the two testing systems could form the basis for demonstrating to EPA that additional SIP credit for a dual testing system is warranted.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

A program using OBD testing as either a replacement or a supplement could be implemented for 2015.

**Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):**

Like all I/M programs, these strategies would improve the fuel economy of vehicles repaired under the program, thereby reducing greenhouse gas emissions and saving motorists money on fuel.

**Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):**

OBD testing is only available for 1996 and newer vehicles. Older vehicles are not equipped with OBD systems capable of assessing emission related problems. The benefit numbers presented above assume that 1995 and newer vehicles would be tested using the two-speed idle test that Colorado currently uses to test 1981 and older vehicles, since this is the testing package currently employed in most other jurisdictions that use OBD testing.
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A11. Remote Sensing Based High Emitter Program

Measure type: Motor Vehicles

Measure description:

Use remote sensing technology to identify high emitting vehicles as they are driven on public roadways. The program could be structured as either a supplement to the existing vehicle inspection and maintenance (I/M) program, or as a stand-alone program that replaces the existing program. From 2008 through 2009, CDPHE operated a pilot program to test the potential benefits of using remote sensing technology to identify high emitting vehicles. In September 2009, CDPHE presented emission benefit information to the AQCC based on data generated during calendar 2008. CDPHE will present data from 2009 to the AQCC during its September meeting.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The amount of emission reductions from a remote sensing based high emitter program will vary significantly depending on the selection criteria. As a general matter using a selection criteria that identifies a large number of potential high emitting vehicles will yield the greatest benefit, but will also increase the likelihood that a vehicle identified as a potential high emitter by remote sensing will in fact be clean when subjected to follow-up testing. During the pilot program, CDPHE used a variety of different selection criteria.

Based on an analysis of the various selection criteria, and using optimistic benefit calculation assumptions, CDPHE calculates a maximum benefit from a full-scale stand-alone remote sensing based high emitter program of approximately 2.6 tons per day reduction of ozone precursor emissions (VOC + NOx + 1/60CO) for 2009. This represents 16.5% of the emission benefit reduction from the current I/M program (15.9 tons per day ozone precursor reduction for 2009 based on Mobile 6.2 modeling). As an add on to the existing program, the benefit would be approximately one-third as much, or 0.9 tons per day, based on an optimistic calculation scenario.

Preliminary sense of anticipated costs and economic impact:

Costs associated with a stand-alone program include capital and operating costs of the remote sensing devices, capital and operating costs of the confirmatory test centers, the cost of repairs for motorists failing the confirmatory test, and state administrative costs. For an add-on program the costs of the remote sensing devices and to some extent the costs of the confirmatory test centers are already incurred in the cost of operating the current program.

CDPHE has not yet calculated actual costs for a full scale program, either as a stand-alone option or as an add-on to the current program.
Additional technical analysis/input needed to refine benefits/costs estimates:

If this strategy is considered a detailed cost analysis will need to be performed.

Additional analysis is needed to assess the use of remote sensing technology to identify high evaporative VOC emitting vehicles. CDPHE and EPA are currently undertaking a large study of this issue.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

The AQCC has authority to adopt regulatory requirements for a remote sensing based high emitter program. CDPHE and Department of Revenue would jointly implement and oversee the program.

Demonstrated ability to take "SIP Credit" for the measure:

Currently EPA has not approved SIP credit for remote sensing based high emitter programs anywhere in the country. It is questionable whether EPA could be convinced to approve SIP credit for a Colorado anytime in the near future.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

While a program could be implemented prior to 2015, it is unclear whether EPA would approve any SIP credit for it.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

Like all I/M programs, a remote sensing based high emitter program would improve the fuel economy of vehicles repaired under the program, thereby reducing greenhouse gas emissions and saving motorists money on fuel.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/ opportunities etc?):

A number of other jurisdictions have experimented with using remote sensing technology to identify high emitting vehicles. To date, none of these experiments has shown that remote sensing technology can generate anywhere near the amount of emission reductions obtained by traditional I/M programs that rely on periodic inspection of the entire vehicle fleet.
A12. Cash for Clunkers

**Measure type:** Motor Vehicles

**Measure description:**

‘Cash for clunkers’, also known as ‘Accelerated Vehicle Retirement’ Programs (AVR), ‘Salvage’ Programs and ‘Scrappage’ Programs have been in existence since the early 1990’s. The primary goal of an AVR program is to identify older higher-emitting vehicles to accelerate fleet turnover to newer, cleaner vehicles. The primary eligibility criteria under these programs are either a failing emissions test and/or a model year cut off.

UNOCAL Corporation implemented the first program in Southern California in 1990. The RAQC operated an AVR program from 1993 – 1994 and again in 2009 – 2010. The RAQC’s current AVR program is part of the Repair Your Air Campaign (RYAC) that first attempts to repair vehicles. If vehicles are deemed non-repairable due to cost the RAQC will salvage them. California and Texas have voluntary programs. A number of foreign countries, such as Canada, also have AVR programs.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

We developed the program benefits contained in Table 1 using the RAQC’s current AVR program. Emissions tests from salvaged vehicles are used to calculate annual baseline emissions data. Because RAQC does not test the emissions of the replacement vehicle purchased by the owner, estimates provided by CDPHE on average emissions of vehicles in the Inspection and Maintenance Program are subtracted from this baseline to get the program benefit.

To-date, the RAQC salvaged over 200 vehicles. For the purposes of comparing the benefits of this strategy to the alternative fuels strategy assessment, the RAQC has assumed that 1,000 (rather than the actual 200 vehicles) have been salvaged.

<table>
<thead>
<tr>
<th></th>
<th>VOC</th>
<th>CO</th>
<th>NOx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tons Per Day Per 1,000 Salvaged Vehicles</td>
<td>0.274</td>
<td>1.669</td>
<td>0.027</td>
</tr>
</tbody>
</table>

For the AVR program, benefits of 7 grams/mile VOC, 45 grams/mile CO and 0.7 grams/mile NOx were calculated for the over 200 vehicles salvaged under the program based on emissions testing performed at CDPHE. Because of limitations on the testing methods used to calculate emissions for the salvaged vehicles, actual reduction benefits could be higher. Another issue that impacts emissions data is that some vehicles are unsafe to test so emissions could be higher for these vehicles. Salvaged vehicles are permanently removed from area roads.
Preliminary sense of anticipated costs and economic impact:

The RAQC currently offers $1,000 per vehicle under its voluntary Repair Your Air Campaign (RYAC). California and Texas offer $1,500 - $3,500 per vehicle. Titling fees are an additional cost that must be factored into these programs. However, program income from the scrap metal from salvaged vehicles can offset some costs.

Additional technical analysis/input needed to refine benefits/costs estimates:

To further refine the benefit estimates of this program, we would need to develop program eligibility requirements. We then determine how many vehicles would be eligible for the program and estimate the associated program benefits.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

While a voluntary program needs no authority (but does need funds), a mandatory program would need legislative action not only to fund it, but also to establish program eligibility requirements. The current RAQC salvage program is funded by two supplemental environmental projects (SEPS). Larger sources of funding would be required for a mandatory program.

Demonstrated ability to take "SIP Credit" for the measure:

Only a mandatory program could receive SIP credit. There are no known mandatory programs in the United States.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

While it is conceivable that such a program could be in place in time to receive SIP credit, implementation of a salvage program would be difficult in the current economic situation because funding for it would be difficult to secure.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

The primary co-benefits of an AVR program are greenhouse gases and increased fuel economy. Quality of life is also enhanced since most vehicle eligible for these programs are older and can have other operational problems such as evaporative leaks that impact passenger health and safety issues.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

Car collectors are concerned about cash for clunkers programs because of the potential for individuals to salvage valuable collector items. However, RAQC worked with the Old Car Council of Colorado to secure their support for our current AVR project.
A13. Diesel Retrofits

Measure type: Motor Vehicles

Measure description:

A diesel retrofit is a technology or fuel that reduces emissions from older diesel vehicles. The EPA’s definition of retrofit is, “broadly defined to include any technology, device, fuel or system that, when applied to an existing diesel vehicle or engine, achieves emission reductions beyond that required by EPA regulations at the time of a vehicle or engine's certification. Retrofit technologies may include EPA verified emission control technologies and fuels and CARB-verified emission control technologies. Note that diesel technologies are verified for specific types of vehicles or engines, defined in the "applicability" sections of the EPA/CARB verified technology lists.”

The Environmental Protection Agency (EPA) has set stringent standards for newer diesel vehicles to reduce their emissions. However, these older diesel vehicles are certified under less stringent standards in the past. These vehicles are ideal candidates for diesel retrofits to reduce their emissions.

Diesel retrofits cover a wide range of technologies and vehicle types. Retrofits can be performed on heavy-duty school buses, dump trucks, refuse vehicles, construction equipment, over-the-road trucks, delivery vehicles and many other types of equipment. The primary areas of retrofit include:

- Tailpipe and engine crankcase retrofits;
- Idling reduction retrofits;
- Aerodynamic retrofits (primarily for over-the-road trucks);
- Alternative fuels;
- Engine upgrades and replacements (primarily off-road equipment); and
- Full vehicle replacements.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Using EPA’s Diesel Emissions Quantifier (DEQ), RAQC obtained a sense of the estimated emissions benefits from various vehicle types. Table 1 shows the range of these vehicle types and their associated benefits. Scenarios were developed using the DEQ and each type of vehicle was retrofitted with a tailpipe diesel oxidation catalyst (DOC) which has the lowest emissions reductions and a tailpipe diesel particulate filter (DPF) which has the highest emissions reductions. This provides a range of emissions benefits that could be expected from a diesel retrofit program.

We also considered idle reduction preheaters to show benefits from idle reduction equipment. These units provide additional benefits above the tailpipe retrofits. The DEQ does not provide idle reduction options for off-road equipment. In this case, over the road trucks retrofitted with auxiliary power units were included. Replacing engines in off-road construction equipment is another retrofit that could provide solid emissions benefits. This scenario is shown on the last line of the table.
Table 1 – Emissions Benefits Per 1,000 Vehicles Retrofitted (tpd)

<table>
<thead>
<tr>
<th></th>
<th>NOx</th>
<th>PM</th>
<th>VOC</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus DOC</td>
<td>0.000</td>
<td>0.002</td>
<td>0.016</td>
<td>0.067</td>
</tr>
<tr>
<td>Refuse Truck DOC</td>
<td>0.000</td>
<td>0.007</td>
<td>0.053</td>
<td>0.318</td>
</tr>
<tr>
<td>Off-Road DOC</td>
<td>0.000</td>
<td>0.017</td>
<td>0.048</td>
<td>0.116</td>
</tr>
<tr>
<td>Bus DPF</td>
<td>0.000</td>
<td>0.007</td>
<td>0.029</td>
<td>0.201</td>
</tr>
<tr>
<td>Refuse Truck DPF</td>
<td>0.000</td>
<td>0.030</td>
<td>0.096</td>
<td>0.955</td>
</tr>
<tr>
<td>Off-Road DPF</td>
<td>0.000</td>
<td>0.072</td>
<td>0.087</td>
<td>0.347</td>
</tr>
<tr>
<td>Bus Preheater</td>
<td>0.102</td>
<td>0.003</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Refuse Truck Preheater</td>
<td>0.170</td>
<td>0.005</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Truck with Auxiliary Power Unit</td>
<td>0.858</td>
<td>0.020</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Off-Road Engine Replacement</td>
<td>0.347</td>
<td>0.000</td>
<td>0.045</td>
<td>0.022</td>
</tr>
</tbody>
</table>

***While the DEQ does not calculate emissions benefits for these pollutants, installing pre-heaters and APUs will reduce fuel burning and thereby reduce VOC and CO emissions. If these strategies move forward, additional work is needed to calculate VOC and CO emission reductions from these strategies. Based on prior analyses of the VOC and CO emission benefits from reduced fuel burning, however, CO reductions from these strategies are likely to be similar to the NOx reductions and VOC reductions are likely to be between 10% and 20% of the NOx reductions.

The DEQ is approved for EPA grant writing but not for SIPs. The DEQ provides estimates of the emissions the area could realize from a retrofit program.

Preliminary sense of anticipated costs and economic impact:

Costs vary widely depending on the technology and the vehicle being retrofitted. Estimated costs from the scenarios discussed earlier are shown below. Engine replacements are not shown in the table due to wide variations in cost. These costs are developed from current RAQC program costs and research.

Table 2 – Retrofit Equipment Costs Per Vehicle

<table>
<thead>
<tr>
<th></th>
<th>Low Cost</th>
<th>High Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus DOC</td>
<td>$1,000</td>
<td>$1,200</td>
</tr>
<tr>
<td>Refuse Truck DOC</td>
<td>$1,000</td>
<td>$2,500</td>
</tr>
<tr>
<td>Off-Road DOC</td>
<td>$1,000</td>
<td>$3,100</td>
</tr>
<tr>
<td>Bus DPF</td>
<td>$8,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Refuse Truck DPF</td>
<td>$8,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Off-Road DPF</td>
<td>$8,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Bus Preheater</td>
<td>$1,400</td>
<td>$3,000</td>
</tr>
<tr>
<td>Refuse Truck Preheater</td>
<td>$3,000</td>
<td>$8,300</td>
</tr>
<tr>
<td>Off-Road Preheater</td>
<td>$3,000</td>
<td>$9,000</td>
</tr>
<tr>
<td>OTR APU/TSS</td>
<td>$4,000</td>
<td>$14,000</td>
</tr>
</tbody>
</table>
Table 1 and Table 2 show that a DPF get up to 4 times the PM emission benefit of a DOC at up to 10 times the cost. Based on our experience, fleets are reluctant to retrofit these advanced technologies on older vehicles that are not designed for them due to maintenance issues.

Additional technical analysis/input needed to refine benefits/costs estimates:

Additional development of this strategy is required in order to fully understand its costs and benefits. Specifically, we must determine what types of diesel vehicles reside in the Denver metropolitan area and what types of technologies can be used to reduce their emissions. EPA’s 2006 Diesel Retrofits: Quantifying and Using Their Benefits in SIPs and Conformity Guidance for State and Local Air and Transportation Agencies discusses the use of the National Mobile Inventory Model 2005 (NMIM) with MOBILE6.2 and NONROAD2005 to quantify program benefits in SIPS and conformity determinations.

Benefits from this program can be refined using the DEQ, but any measures used in a SIP would have to be modeled through an EPA approved modeling methodology.

Additional analysis would also need to include how effective other state mandatory (see below) programs might be if applied in Colorado.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Voluntary efforts to retrofit diesel vehicles are underway by the RAQC, CDPHE and the City and County of Denver as well as by private fleets using their own funding. Many states have voluntary efforts in place. There is presently no mandatory program in Colorado.

However, states including California, Illinois, New Jersey, New York and Rhode Island have mandatory programs with varying specific requirements. California’s program is the most stringent since it regulates the majority of diesel sources including transit buses, garbage trucks, long haul trucks, transport refrigeration units, stationary and portable diesel generators, port equipment, rail equipment, public utility vehicles, off-road engines, ocean going vessels, harbor craft and other private vehicles. The State has many requirements covering the regulation of these different emissions sources. For example, public agency and utility and solid waste collection vehicles must install the best available control technology (BACT) and register their vehicles with the State. The State also has a strong enforcement component to their program, which means significant funds have been allocated for enforcement. Criminal and civil penalties can be levied against fleets not complying with the State’s regulations.

A mandatory program in Colorado would require legislative approval and regulatory development by the Air Quality Control Commission. An enforcement component would need to be developed.

A funding source could be developed as a part of the program similar to California’s Diesel Retrofit Program, known as the Carl Moyer Program. This program is funded through a combination of smog check exemption fees that new vehicle owners pay, a new fee on tires and vehicle registration fees. According to the South Coast Air Quality Management District total state funding for this program is an estimated $120 million a year.
Demonstrated ability to take "SIP Credit" for the measure:

California has used diesel retrofits in their SIPS.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

A mandatory program would be required for SIP credit and could be in place for SIP inclusion, provided that the Legislature enacts a mandatory program and the AQCC adopts regulations to implement the program.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

Diesel particulate matter is a known human carcinogen. Reductions of this pollutant would increase quality of life.

Reductions of black carbon from diesel PM offers an added benefit to reducing climate change due to its high global warming potential. Black carbon is estimated to be up to 4,500 times higher than that of CO2 on a per gram of emission basis (MECA, 2009, Retrofitting Emissions Controls for Diesel Powered Vehicles).

In addition, significant fuel savings are realized by not idling the truck’s main engine. This also provides cost savings through less wear and tear on the engine.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

The RAQC has operated a voluntary diesel retrofit program since 2003 that has retrofitted many vehicles including:

- An estimated 800 diesel oxidation catalysts (DOC), 200 closed crankcase filtration (CCF) systems and 800 idle reduction preheaters on school buses;
- An estimated 100 DOCs, 50 CCFs, 100 idle reduction preheaters, and three advanced hybrid/hydraulic launch assist vehicles on public works vehicles;
- An estimated 100 DOCs, 100 CCFs and 100 idle reduction preheaters on private delivery trucks;
- An estimated 150 auxiliary power units (APU), 25 sets of aerodynamic fairings and 25 sets of low rolling resistance tires for over the road trucks; and
- Three engines for area construction companies and Denver International Airport.

All the equipment installed under the RAQC’s Diesel Retrofit Program has been verified by EPA and the California Air Resources Board to ensure that air quality benefits are realized. Benefits are being refined as the RAQC finalizes its American Reinvestment and Recovery Act (ARRA) funding. Emissions are controlled at the tailpipe by the DOCs and are active whenever the vehicle engine is operating.

Benefits associated with the idle reduction preheater and APU depend on whether the vehicle owner turning this equipment on. Vehicle owners have an incentive to use these units because they save fuel and money. Further emission reductions are realized by the aerodynamic equipment and low rolling resistance tires because they reduce aerodynamic drag and thus
lower emission levels. New engines emit less pollution through upgrades to the way the engine operates.

Certain retrofits can be installed only on certain vehicles of certain model years according to EPA and California Air Resource Board (CARB) requirements. Vehicle tampering can be enforced by EPA if vehicles are retrofitted outside these requirements. Off-road retrofits are very difficult to perform due to this issue.
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A14. Truck Stop Electrification (TSE)

Measure type: Motor Vehicles

Measure description:

The Department of Energy (DOE) and the Department of Transportation (DOT) estimate up to 5,000 truck stops offer truck parking and other services. Due to DOT mandatory rest requirements for drivers, truckers live in their vehicles for extended periods of time. They often park at area truck stops to rest and recuperate. During certain times of year, resting truckers may idle their engines to provide sleeper compartments with air conditioning, heating and electricity for appliances.

Truck stop electrification requires infrastructure development that allows truckers to "plug in" vehicles to operate necessary systems without idling the engine. In some cases, a stand-alone system is put in the window of the cab that provides heating, ventilation, and air conditioning directly to the sleeper compartment. In others, a unit on the tractor is plugged into an outlet so it can run off electricity as opposed to diesel fuel. The electrical systems are usually owned and maintained by private companies that charge an hourly fee.

As an alternative to TSE services, a stand alone diesel or battery operated auxiliary power unit (APU) can be installed on the truck. APUs are advantageous because they require no infrastructure development and they move with the vehicle. Like TSE, APUs provide the operator air conditioning, heating and electricity for appliances. These units have been a strong focus of both RAQC and CDPHE retrofit efforts.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

EPA’s Diesel Emissions Quantifier (DEQ) can be used to estimate emissions reductions for TSE. The scenario used in this analysis determines benefits if 100 spaces at area truck stops were electrified. The emissions to generate the electricity at the power plant are not included here.

| Table 1 - Estimated Benefits from TSE (tpd) |
|-------------------|---|---|---|---|
| NOx               | PM | HC | CO |
| 100               | 0.087 | 0.002 | 0.004 | 0.005 |

The DEQ is approved for EPA grant writing but not for SIPs. The DEQ provides estimates of the emissions the area could realize from a TSE program.

Preliminary sense of anticipated costs and economic impact:

EPA estimates the cost of each parking space that is electrified between $7,000 - $15,000. An ANTARES Group, Inc. 2004 study indicates that the cost for TSE services is approximately $1.50 an hour.
Additional technical analysis needed to refine benefits/costs estimates:

- Evaluation of EPA guidance for states to use to include long duration truck idling in their SIPs and Conformity needs to occur to refine benefits and cost estimates of this measure. This 2004 *Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity* describes the methodology that must be used for SIP credit.

- Additional analysis is also required to determine the additional emissions from power plants caused by the increased power demand from this measure. Implementation of HB1365 will reduce the power plant emissions associated with truck stop electrification since some area power plants would be operating on natural gas instead of coal.

**Implementation feasibility** (e.g. Who has authority? Who needs it? Who implements the measure?):

A voluntary effort would require no authority. However, a voluntary effort would provide limited emissions benefits for inclusion in a SIP. Due to the cost per space for TSE, implementation of a mandatory program would make the most sense if this strategy were to be pursued for SIP inclusion. A mandatory program would require legislative and regulatory authority.

**Demonstrated ability to take "SIP Credit" for the measure:**

EPA has guidance for taking SIP credit for a mandatory program. EPA’s 2004 *Guidance for Quantifying and Using Long Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity* details that the measure must be quantifiable, count as an emissions surplus and is federally enforceable. This last requirement requires that the emissions reductions be part of a rule or regulation.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

This measure could be in place in time for SIP inclusion. Legislative action could be taken in the next session and regulations could be developed prior to 2015 by CDPHE and the AQCC.

**Preliminary assessment of co-benefits** (e.g. other air quality, economic, quality of life, transportation etc):

Diesel particulate matter is a known human carcinogen. Reductions of this pollutant would increase quality of life.

Reductions of black carbon from diesel PM offers an added benefit to reducing climate change due to its high global warming potential. Black carbon is estimated to be up to 4,500 times higher than that of CO2 on a per gram of emission basis (MECA, 2009, Retrofitting Emissions Controls for Diesel Powered Vehicles).

In addition, significant fuel savings are realized by not idling the truck’s main engine. This also provides cost savings through less wear and tear on the engine. This cost is estimated at $0.92 per hour in the ANTARES Group, Inc. 2004 study.
Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

According to the National Renewable Energy Laboratories (NREL) there were 138 TSE sites in the United States in 2009. In a study for EPA’s Office of Transportation and Air Quality (OTAQ), researchers identified 15 corridors (shown in the map below) that were prime locations for TSE. Some states have TSE along these corridors but more must be done on a national level to link these sites.

![Map of Selected Major U.S. Truck Corridors](image)

A number of states are pursuing TSE development. However, funding for these efforts is limited. At this time, the Colorado Motor Carriers Association (CMCA) indicates there is one facility with truck stop electrification in Commerce City. The CMCA indicates that TSE has become less viable due to its higher cost compared with on-board APUs that cost half the amount of an electrified space and travel with the vehicle. According to many truckers, TSE spaces are usually full due to a lack of supply which makes on-board APUs more desirable.
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A15. Signal Timing and Coordination

**Measure type:** Motor Vehicles

**Measure description:**

Signal timing and coordination is the process of making traffic signals work together, as opposed to independently. Signal timing plans are prepared for groups of traffic signals to reduce drivers’ delay and stops as they progress through a specific traffic corridor.

Since 1989, Denver Regional Council of Governments (DRCOG's) Traffic Operations Program has been working with the Colorado Department of Transportation, RTD and local governments to coordinate traffic signals on major multijurisdictional roadways in the region, including transit signal prioritization. DRCOG administers the federally-funded “pool” project titled *Regional Traffic Signal System Improvement Program*, or TSSIP. The purpose of TSSIP is to implement cost-effective traffic signal timing and coordination improvements that reduce travel time via reduced delays and number of stops and associated harmful auto emissions within the DRCOG Transportation Management Area (TMA). The TSSIP was originally adopted in 1994 and has been updated in 1996, 1999, 2003, 2007 and August 2010 corresponding with funding authorized in the Transportation Improvement Programs (TIP).

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

In 2009, the TSSIP completed 24 signal timing projects with total emissions reductions benefits estimated at about 5 tpd of primarily Carbon Monoxide (breakout of specific pollutants has not been provided in current available documentation). The emissions reduction benefits of these 24 projects ranged from “no significant benefit” to 4 tpd of primarily CO.

**Preliminary sense of anticipated costs and economic impact:**

The August 2010 TSSIP allocated approximately $3.7 million annually from 2011 through 2016 to address regional needs. The funding breakdown for these activities, for the “typical” annual total of $3.7 million, is about $2.2 million for capital improvements; $200,000 for contingency and miscellaneous equipment purchases; about $1.1 million for signal timing and coordination; and, about $200,000 for system engineering and design.

**Additional technical analysis/input needed to refine benefits/costs estimates:**

DRCOG, CDOT, RTD and local governments working together through the TSSIP process have reviewed benefits and costs of proposed projects and prioritized projects for implementation in 2011 and annually through 2016 based on currently available funding. Through this process, projects that could be implemented with additional funding have also been identified.
Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Signal timing and coordination is currently ongoing under the authority of CDOT and local governments. DRCOG provides assistance in the development of signal timing plans that are implemented and maintained by those entities.

Demonstrated ability to take "SIP Credit" for the measure:

Emissions reduction benefits can be calculated for signal timing and coordination within a given corridor project based on improved travel time, reduced idling and more efficient vehicle operation. However, translating those benefits directly to the regional transportation model scale is still beyond the sophistication of DRCOG’s current models. In addition, traffic conditions on corridors change and evolve over time, causing benefits to deteriorate. Corridors require periodic reevaluation and adjustment to return the corridor to optimal condition in terms of signal timing and coordination. DRCOG does estimate that since inception the TSSIP has improved the travel time in the region by two to four percent.

There is no specific “SIP credit” estimated for signal timing and coordination improvements at this time in this region. Such improvements seek in essence, to increase the carrying capacity of the roadways. The roadway carrying capacities used in the regional transportation modeling are part of the baseline assumptions. DRCOG’s Traffic Operations Program seeks as a minimum to maintain the baseline assumptions of roadway capacities overtime.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Signal timing and coordination is currently ongoing through the TSSIP as noted above for the years 2011 through 2016 based on currently available funding.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

Secondary benefits expected are decreased energy consumption, increased safety, and less cut-through traffic on neighborhood streets.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

Phoenix, Southern California Association of Governments (SCAG), Northeastern (Chicago) Illinois Planning Commission (NIPC) Sacramento Area Council of Governments (SACOG), and Houston all consider some form of ITS in their transportation planning. However, only Phoenix makes a binding commitment to reduce emissions through ITS by including it in their SIP. The Phoenix SIP commits to reducing emissions by 2.2 metric tpd of VOC and 0.4 tpd of NOx through ITS development. Further follow-up with Phoenix indicated although they used a signalization/coordination project as a control measure in their SIP, they viewed it as a short term measure with a five year project life and would not consider it for use in a 10 year maintenance SIP.
Additionally, further review of the emissions reductions benefits of signalization/coordination projects indicates that previously quoted reductions above were based on early iterations of EPA’s MOBILE model for Mobile Sources and could be inflated by a factor of 10 when compared to present day MOBILE6.2 or MOVES.
A16. Eco-Directing Education

to Encourage Driving Practices that Reduce Fuel Use and Reduce Emissions

Measure type: Fuels and Motor Vehicles

Measure description:

Eco-driving programs are designed to educate drivers in techniques that can reduce gas consumption, such as avoiding rapid acceleration and braking, reducing speeds, changing gears properly, and using cruise control. These programs may also provide training on proper vehicle maintenance, such as tire pressure, wheels, motor oil, air filters, etc.

Eco-driving education programs may include direct education, where participants sit through a class with an instructor, or be more indirect – such as a public awareness campaign. Direct education may also include tracking/visual tools as part of the program to help organizations track progress, and influence driver behavior (ex: a driver can see their average speed/fuel consumption on a dash-board display, which affects their behavior). In some instances, such as in fleet operations, the tracking is used to evaluate driver behavior and may be tied to performance appraisals or linked to incentives for efficient driving.

Eco-driving programs are common with business and organizational fleets. For example, the City of Denver ran the pilot “Driving Change,” an eco-driver education pilot, in 2008. Mandatory eco-driving programs are common in Europe. In Sweden, eco-driver education is mandated under law for all individuals with driver’s licenses.1

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits would primarily come from more fuel efficient driving behaviors, but could also come from reduced VMT and traffic congestion with better trip planning/routing (for example, GPS units installed to track miles traveled and fuel consumption may produce more efficient trip planning). Air quality benefits vary based on the type of program implemented, and result in a 5 – 10% reduction in fuel usage.2

Preliminary sense of anticipated costs and economic impact:

- The cost to implement a program varies based on the scale/type of implementation. For example, implementing an eco-driving course with fleets is much less expensive than mandating eco-driver education in driver education courses.
- Additional costs may include (but are not limited to):

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- GPS tracking devices, for tracking driving behavior (ex: Tracking devices cost between $169 and $1,000/vehicle with a monthly service fee between $25 and $60/vehicle, depending on advanced functions).\(^4\)\(^5\)
- Cost for driver education (teacher training, manuals, materials, etc)
- Outreach (if program is outreach based, rather than involving direct education) which may include media (commercials, billboards, traveling displays, flyers, etc). For example, the State of Wisconsin implemented an outreach program geared toward children that involved traveling displays, a web-based training, and other promotional materials.

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Additional analysis of the emission reduction potential from such a program and variations (ex: fleet-based eco-driver education vs. driving school eco-driver education)
- Updated emissions reduction estimates using assumptions from the above analysis and EPA’s new emissions model (MOVES). Also using assumptions from the above analysis, conduct additional photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

Voluntary eco-driver education programs have occurred through the City of Denver’s fleet as well as numerous business fleets throughout the Denver metro region. For an eco-driver education program to be mandatory (for all drivers in either non-attainment area or Colorado), approval through the Colorado General Assembly is needed.

**Demonstrated ability to take "SIP Credit" for the measure:**

There currently is no clear demonstrated ability to take SIP credit for this measure. It would have to be further investigated. At this point, any air quality benefits associated with such a program would likely come through a voluntary reduction program.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

Mandatory eco-driver education could be developed and implemented in time for the SIP only with aggressive analysis and associated legislative action, occurring very quickly (analysis in time either for 2011 or 2012 legislative action). Programs may be included as voluntary measures.

**Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):**

- GHG emission benefits through reduced VMT, driving behavior, and fuel usage.
- Increased safety. Eco-driving programs promote safety in a number of ways (quick starts, leaving cars idling to warm up, rapid acceleration, etc).

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\(^4\) O’Campo, Leah. 2010. Email Correspondence. July 16, 2010
• Reduced operational costs as fleets/vehicles are maintained properly (ex: tires that are inflated properly will last longer than those that are not).

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

• Eco-driving programs are common in fleet operations, while not always identified as “eco-driving” programs; they typically focus on increasing efficiency and reducing fuel use. Programs often include GPS units for both tracking, visualization of driving behavior, and routing optimization.

• Driving Change was a program implemented through the City of Denver. It was funded by a Supplemental Environmental Project (SEP) through Encana. The program used a GPS device to track driver behavior (idling, hard starts, fuel efficiency, etc). In addition to the group of drivers that knew they were being watched, there was a control group. Those that were aware of the program had their behavior tied to job performance and the City saw a 16% improvement in fuel efficiency. City managers were able to view a web-based summary of driver behavior. The city did not see improvement with the control group.57

• Ford Motor Company has a program called “Ford Driving Skills for Life” which focuses on safety and eco-driving. The program is an outreach program with an interactive website which includes a driving simulation.8

• EcoDriven is a awareness campaign in the European Union designed to educate drivers on eco-driving principles. The program worked with car dealers, fuel stations, drivers’ associations, driving schools and municipalities to deliver the message. Individual countries can cater their marketing efforts through the program, but the overall message is the same. For example: the Easy, Rider program below.9

• Easy, Rider! Is a program in Finland, associated with EcoDriven.10

• The Energy Saving Trust is an outreach program to educate individuals on energy savings/efficiency. Through the EcoDriven program, they implemented an eco-driving outreach component.11

• Clean Air Trekkers is a program targeted at youth in Wisconsin. It is an eco-driving awareness program, funded through CMAQ dollars. The program had many interactive elements (driving simulation, Podcast, traveling exhibit) and was contracted through Discovery World Wisconsin.12 13

• Het Nieuwe Rijden, “The New Way of Driving” was a Netherlands awareness campaign based on the TV shows the Dukes of Hazard.14

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9 EcoDriven. 2010 “What is EcoDriving” http://www.ecodrive.org/Home.219.0.html
Preliminary Assessments Completed and Discussed in 2010

B. Transportation Pricing Measures

Table B: Overview of Strategies Analyzed

Detailed Assessment for the following strategies:

Pricing
B1. Fuel Tax Pricing Strategies
B2. Transportation Facility Pricing
B3. Mileage Based Fees
B4. Pay-As-You Drive Insurance
B5. Priced Parking
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### TABLE B

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description of Measure</th>
<th>Experience in Colorado/Other Areas</th>
<th>Existing Authority or Needed Approvals</th>
<th>Implementation/SIP Measure Feasibility</th>
<th>Additional Analysis Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fuel Tax Pricing Strategies</strong></td>
<td>Fuel tax pricing strategies would increase the gasoline tax to reduce vehicle miles traveled (VMT) and generate revenue. The current state gas tax is $0.22/gallon and the federal gas tax is $0.184/gallon for passenger vehicles.</td>
<td>Gas tax currently used in Colorado for revenue generation. It has not been used or evaluated to reduce VMT.</td>
<td>State legislation needed</td>
<td>With aggressive legislative action, could be included in SIP Included in baseline modeling</td>
<td>Run pricing alternatives through CDOT’s revenue generation model Evaluation of VMT reduction potential</td>
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<tr>
<td><strong>Transportation Facility Pricing</strong></td>
<td>Transportation facility pricing strategies are designed to charge motorists for using certain travel facilities, in order to cause them to choose travel options other than a single occupant vehicle, thereby reducing VMT, congestion and air emissions. Revenues could be used to fund alternative transportation infrastructure and reduce congestion.</td>
<td>Authority to price facilities currently exists for the State of Colorado, Regional Public Highway Authorities, and the private sector. The pricing of Interstate facilities is limited to new lanes.</td>
<td>Approval from localities impacted</td>
<td>Requires approval from local governments that are impacted Unlikely that measure could be in place by 2015 With aggressive action, could be included in SIP Included in baseline modeling</td>
<td>Analysis of pricing strategies and impact Analysis of implementation steps and costs Identification and evaluation of potential corridors for pricing Evaluation of VMT reduction potential</td>
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<tr>
<td><strong>Mileage Based Fees</strong></td>
<td>Mileage-based fees charge drivers based on how many miles they drive, sometimes referred to as a Vehicle Miles Traveled (VMT) fee. Periodic odometer readings (automatic through transponders or manual through inspection) would be the basis for determining the level of fees a driver must pay.</td>
<td>Mileage-based fees are currently not in use in Colorado or anywhere in the United States. They have been evaluated by a number of states and CDOT has a mileage-based fees research project forthcoming.</td>
<td>State legislation needed</td>
<td>CDOT’s pilot will not be complete until 2015, implementation is dependent on the results of this study Unlikely to be implemented in short/mid term Unlikely to be implemented in time for SIP inclusion Included in baseline modeling</td>
<td>Review results of CDOT’s study Analysis of implementation steps and costs Evaluation of VMT reduction potential</td>
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<tr>
<td>Measure</td>
<td>Description of Measure</td>
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<td>Pay-as-You-Drive Insurance</td>
<td>Mandatory PAYD insurance charges drivers their insurance premium costs based in part on how many miles their vehicles are driven in a given year. Drivers have the opportunity to save money by driving fewer miles and practicing safe driving habits.</td>
<td>PAYD insurance is currently available in currently available (voluntarily) in Colorado through several insurance companies. No states have mandated PAYD insurance, but much research on the impacts of PAYD insurance has been done.</td>
<td>State legislation needed</td>
<td>With aggressive legislative action, could be included in SIP</td>
<td>Evaluation of VMT reduction potential</td>
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<td>Included in baseline modeling</td>
<td>Analysis of legal feasibility of implementation</td>
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<td>Analysis of whether SIP credit is available</td>
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<tr>
<td>Priced Parking</td>
<td>Parking pricing strategies include those designed to either (1) increase the cost of driving a single occupancy vehicle by charging for parking, or (2) increase the use of alternative transportation in lieu of parking (ex: parking cash-out: where an employer may offer cash, or a transit pass instead of free parking).</td>
<td>The pricing of parking is common throughout the Denver metro, typically where demand for parking exceeds supply. There are no US examples of mandatory priced parking.</td>
<td>Currently done voluntarily through localities and the private sector. Mandatory program would require state legislation.</td>
<td>Unlikely to be implemented in short/mid term</td>
<td>Analysis of legal feasibility of implementation</td>
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<td>Potential for pilot pricing program</td>
<td>Analysis of implementation steps and costs</td>
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<td>Unlikely to be included as mandatory program in SIP</td>
<td>Evaluation of VMT reduction potential</td>
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<td>Included in baseline modeling</td>
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</table>
B1. Fuel Tax Pricing Strategies

Measure type: Transportation Pricing

Measure description:

Fuel tax pricing strategies would increase the gasoline tax to reduce vehicle miles traveled (VMT) and generate revenue. The current state gas tax is $0.22/gallon and the federal gas tax is $0.184/gallon for passenger vehicles.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits would occur from reduced VMT and traffic congestion. Additional benefits may also be realized from associated reduced idling, start-ups, and other ancillary emission producing activities associated with vehicle use. In order to evaluate and quantify the benefits of fuel tax pricing strategies, additional analysis would be required (see below). Nonetheless, we do know that the air quality benefits are closely tied to regional factors that affect demand elasticities, such as income and travel time/cost; and may vary in the short and long term. Further refinement of air quality benefits will also likely be obtainable using CDOT’s revenue model (see below).

Preliminary sense of anticipated costs and economic impact:

- All motorists would incur additional fuel costs. For example, if Colorado doubled the state gas tax (to $0.44/gallon), the average cost to a consumer would increase by $132 annually (assuming the average person drives 13,500 miles per year\(^{15}\), and an average fuel economy of 22.5 mpg\(^{16}\)).
- Additional cost to business due to increased transportation-related cost (e.g. direct or indirect costs for higher cost of fuel).

Additional technical analysis/input needed to refine benefits/costs estimates:

Useful evaluation of this measure would require an in-depth analysis of the following, in coordination with CDOT and CDPHE:

- Run several fuel pricing strategy scenarios using CDOT’s revenue model. This model, which is usually run for purposes other than air quality benefit predictions, can offer additional perspective on the air quality impacts of raising the gas tax (i.e. costs, driver behavior, the estimated revenue CDOT can expect given changes in fuel prices, etc.). It can also evaluate the effect of gas tax increases on driving behavior and VMT and account for other variables related to the gas tax, such as tax at the rack versus the

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\(^{15}\) FHWA, 2003. *Average Annual Miles per Driver by Age Group.* http://www.fhwa.dot.gov/ohim/onh00/bar8.htm


Transportation Pricing Strategies | Fuel Tax Pricing Strategies
Implement feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Authority to raise the gas tax would have to be provided by the Colorado General Assembly through new legislation. We would also need to confirm that TABOR does not prohibit this approach (see "Other Considerations" below).

Demonstrated ability to take "SIP Credit" for the measure:

There currently is no clear demonstrated ability to take SIP credit for this measure. It would have to be further investigated. At this point, any air quality benefits associated with such a strategy would need to be considered in the air quality baseline modeling, conducted by DRCOG, results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Fuel tax pricing strategies could be developed and implemented in time for the SIP only with aggressive analysis and associated legislative action, occurring very quickly (analysis in time either for 2011 or 2012 legislative action).

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Increase funding source, for existing transportation and alternative transportation options, via tax revenue.
- Higher fleet vehicle turnovers as organizations seek to use more fuel efficient vehicles.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- The gasoline tax is a well established funding mechanism for transportation, with the federal gasoline tax in existence since 1932.
- Some states index their gas tax to inflation, which incrementally increases the tax as inflation increases.
- This measure presents equity concerns for low-income residents because this is a regressive tax (low-income individuals pay a higher percentage of their income toward tax compared to individuals of higher income). However, revenues could be redistributed to offset potential inequities to enhance mobility options for low-income individuals.
• No other states have increased the gasoline tax for the purpose of reducing vehicle miles traveled.
• The State of Colorado Constitution requires that funds from the gas tax go into the Highway User Trust Fund (HUTF). However, there is noteworthy debate on whether the fuel pricing strategies developed for reasons such as congestion management, transit support, and air quality constitute user fees or a tax. It is not clear and could be argued either way under the Tax Payers Bill of Rights (TABOR) and needs to be more fully evaluated. If fuel pricing strategies were deemed to be a tax, adopting them would require voter approval.
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B2. Transportation Facility Pricing

Measure type: Transportation Pricing

Measure description:

Transportation facility pricing strategies are designed to charge motorists for using certain travel facilities, in order to cause them to choose travel options other than a single occupant vehicle, thereby reducing VMT, congestion and air emissions. They also are a revenue generation tool that can be used to support other transportation management strategies, such as existing road modifications for "managed (or HOV) lanes", new "managed" lanes. There are several examples of transportation facility pricing strategies. They include: cordon pricing, congestion pricing, and highway tolling. Cordon pricing establishes tolls that are paid by motorists who pass through a specific area, usually the Central Business District (CBD) or other center. Congestion pricing establishes tolls paid by motorists for using a congested facility (e.g. a particular road). Congestion pricing tolls vary by time/day and are set to achieve a desired level of service on a roadway segment. Tolls are generally used on interstate highways or other limited access roads and are tolled on a per-mile basis, fees do not vary by time of day.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits will be tied to reduced VMT and congestion; additional benefits may be realized from reduced idling, start-ups, and other ancillary emission producing activities associated with vehicle use.

A 1998 EPA study estimated that regional congestion pricing could reduce regional VMT by 0.6 – 2.6% using a $0.08 - $0.19/mile rate range (modeled for 2010).17

The best apparent method for estimating the emission or congestion reduction potential of priced facilities is to do a micro-simulation of a specific corridor. In a micro-simulation, a segment of road and surrounding area are modeled to see how specific changes affect travel (e.g. adding a managed lane to a roadway segment). In 2010, the US 36 Corridor completed such a micro-simulation using value pricing (congestion pricing) along US 36. Three scenarios were analyzed for years 2012 and 2035 along the corridor. In the simulation, two scenarios of managed lanes and one scenario of “no build” were analyzed. Overall, the managed lanes reduced VMT along the corridor, lowered travel time, and reduced fuel usage. The two scenarios had the following VMT reductions: (1) $160 Million Build: Hot lanes modeled on US 36 in both directions from Federal Blvd. to Wadsworth Parkway: 2012 VTM reductions of 0.4% (AM Peak) and 0.1% (PM Peak); 2035 VMT reductions of 0.2% (AM Peak) and VMT increase of 1.2% (PM Peak); (2) $260 Million Build: HOT lanes modeled on US 36 in both directions from Federal

Preliminary sense of anticipated costs and economic impact:

While actual cost numbers are not available without further analysis, we can offer a general sense of likely costs as follows:

- Infrastructure development (conversion of existing roadways to managed lanes, new lanes, completely new travel facilities)
- Consumer transponder costs and toll costs;
- Administrative costs;
- Cost of additional infrastructure to manage new alternative demand (i.e. light rail, bus rapid transit, bike/pedestrian facilities).

Additional technical analysis/input needed to refine benefits/costs estimates:

Useful evaluation of this measure would require an in-depth analysis of the following, in coordination with other transportation pricing strategy analyses, and DOT and CDPHE:

- Regional price points and associated elasticities to determine the extent to which transportation facility pricing approaches would affect VMT and associated emissions for both the short and long term; particularly involving tolling on new lane capacity and tolling on select existing lanes
- Selected corridors for their potential for effective use of these strategies. If RAQC wanted to pursue on expedited basis, analysis could focus on corridor most able to accommodate strategy in shortest time period.
- Updated emissions reduction estimates using assumptions from the above analysis and EPA’s new emissions model (MOVES). Also, using assumptions from the above analysis, conduct additional photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.
- Costs associated with VMT tracking: (GPS, odometer reads, other tracking devices), administrative costs, and revenue recovery estimates.
- Photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.
- Revenue generating potential and how additional revenue would be used to advance transit.
- Determine from EPA what elements of this strategy type would need to be in place and when to receive SIP-related benefits.

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Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Implementation feasibility may prove to be a major hurdle for the following reasons:
- Per Senate Bill 09-108, existing facilities may only be tolled if the have “obtained the approval of every local government that includes territory in which all of any portion of the highway segment or highway lanes upon which the user fee is to be imposed pass or that will otherwise be substantially impacted by the imposition of the user fees on the highway segment or highway lanes.” New facilities or new lanes on existing facilities may be tolled if there is concurrence from the regional planning authority (within the ozone non-attainment area that would be DRCOG, NFR, and UFR). Concurrence on tolling is often difficult.
- The High Performance Transportation Enterprise (HPTE) is authorized to implement tolls.19
- There is a limit of 10% of annual revenues that can be obtained through state or local taxes for HPTE facilities.
- Any tolling needs to be interoperable with E470, Northwest Parkway and N I-25/ US 36 HOT lanes.
- Regional Public Highway Authorities can create tolled facilities (an example of this E-470 Public Highway Authority).20
- Private entities can also create private, priced roads.
- Not sure what EPA’s views are regarding what elements of this strategy type would need to be in place and when to receive SIP-related benefits.

Demonstrated ability to take "SIP Credit" for the measure:

There currently is no clear demonstrated ability to take SIP credit for these measures. This would have to be further investigated. At this point, any air quality benefits associated with such strategies would need to be considered in the baseline modeling, conducted by DRCOG, results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Not likely that measure could be in place by 2015, unless extremely aggressive action taken as soon as possible on a particularly well-positioned tolling option. The timing of project completion depends on the individual facility type, construction timelines and funding sources.


20 C.R.S. § 43-4-806
Projects can take several years to complete, for example US 36 BRT lanes will not be completed until 2012.  

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Potential ability to fund infrastructure enhancements and transit through the fees collected from the use of that infrastructure.
- GHG emission benefits can be realized through reduced VMT, congestion and fuel usage.
- Co-benefits include increased quality of life, reduced congestion, faster travel times, and increased revenue for transportation.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- This measure presents equity concerns for low-income residents because this is a regressive tax (low-income individuals pay a higher percentage of their income toward tax compared to individuals of higher income). However, revenues could be redistributed to offset potential inequities to enhance mobility options for low-income individuals.
- Existing tolling facilities in Colorado include: E-470 (priced lanes), US36 (HOV/HOT lanes), I-25 (HOV/HOT lanes). Facility pricing is common throughout the U.S. and abroad.
- The State of Colorado has the authority to price highways through the High-Performance Transportation Enterprise (HPTE)22.
- New York City considered using CBD congestion pricing in 2007; however, the State Legislature ultimately blocked the measure from implementation.  
- Central London uses congestion pricing (£8/day or about $12/day) 24 to control demand for facilities in the central city. Since this program was implemented, the affected area has seen a daily average reduction between 65,000 and 70,000 in the number of vehicles. Traffic entering the zone is 21% lower than before the charge was implemented.  

References:


22 C.R.S. § 43-4-806


B3. Mileage-Based Fees

Measure type: Transportation Pricing

Measure description:

Drivers would be charged based on how many miles they drive, sometimes referred to as a Vehicle Miles Traveled (VMT) fee. Periodic odometer readings (automatic through transponders or manual through inspection) would be the basis for determining the level of fees a driver must pay. Mileage-based fees could be used in place of the existing gas tax (Colorado state gas tax), as more fuel efficient (or non-gasoline-powered) vehicles become more prevalent, mileage based fees provide a funding source tied to the use of facilities. Such fees would be used for to generate revenue and to reduce VMT by increasing the cost/visibility of vehicle operating costs.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

At this point and without further study, air quality benefits for this region can not be quantified. Air quality benefits would primarily be tied to reduced VMT; additional benefits may be realized from reduced idling, start-ups, and other ancillary emission producing activities associated with vehicle use. Mileage-based fees research often focuses on revenue generation and piloting technology necessary to transition to such a fee based program.

In a 1998 study, the EPA analyzed VMT reduction and associated air quality benefits offered by this strategy and determined that a mileage-based fee of $0.02/mile would reduce VMT by 4.6 – 5.6 percent.26

Preliminary sense of anticipated costs and economic impact:

Primary costs include those for implementing a transportation pricing program and those that would be incurred directly by consumers. Estimated costs of implementing the program vary based on the tracking mechanisms used. Tracking units vary in price from $5 - $50027 28 (varying from tracking at gas pumps via credit card, radio frequency transponders to advanced GPS units) and cost of infrastructure to gather VMT data varies greatly; additional infrastructure for recording VMT varies in cost from $2,500 – $25,000 per unit. The cost per mile to consumer and


commercial vehicles vary based on the fee, for example a charge of 1 cent per mile would add up to $135 annually (assuming 13,500 miles driven per year). Additional costs include administrative costs to the state for implementing and enforcing the program as well as overseeing education and public outreach.

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Review the results of CDOT’s Mileage Based User Fee (MBUF) Pilot Study Framework. This effort is exploring a scope and structure for a future “Pilot Study” that will be conducted to evaluate the feasibility and effectiveness of introducing MBUF in Colorado. It will frame the public policy discussion around MBUF, with the goal of increasing revenue in a manner which correlates roadway usage with payment. The study should take 9 – 12 months to complete.
- Pricing usage could potentially use vehicle hours traveled (VHT) rather than vehicle miles traveled (VMT). Analysis of the benefits/costs of using one metric over the other should be included.

**Additional detailed analysis needed includes:**

1. Administrative costs (including program development, enforcement, etc.)
2. Technology costs
3. Infrastructure costs
4. Consumer costs
5. VMT reduction benefits for Colorado based on an assumed cent per mile increase
6. Air Quality benefits for Colorado based on VMT reduction benefits

- Analysis of long-term VMT changes should be done including the long-term price elasticity associated with mileage-based fees (i.e. how long can we expect people to drive less?).
- Updated emissions reduction estimates using assumptions from the above analysis and EPA’s new emissions model (MOVES). Also using assumptions from the above analysis, conduct additional photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

Legislation for mileage-based fees would be required through the Colorado General Assembly. CDOT’s planned study is being conducted through its research program. State agencies currently do not have the authority to adopt mileage-based fees. There are also important considerations regarding the feasibility of this strategy as a state only strategy. Due to jurisdictional problems, it

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may make more sense for such a strategy to be advanced as a federal measure, not only for benefits to air quality, but congestion mitigation, infrastructure and transit revenue etc.

**Demonstrated ability to take "SIP Credit" for the measure:**

There currently is no clear demonstrated ability to take SIP credit for this measure. It would have to be further investigated. At this point, any air quality benefits associated with such strategies would need to be considered in the baseline modeling, conducted by DRCOG, results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

Not likely in near-term or mid-term. This appears to be a long term potential measure. CDOT’s preliminary study will not be completed until 2011 and a subsequent pilot study is not likely to be completed by 2015.

**Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):**

Potential benefits from mileage-based fees vary based on the level of deployment; *Moving Cooler* estimated GHG reductions between 1.2 – 4.4 percent.  

- Could increase funding for transportation.
- Household financial impacts will vary based on miles driven and fuel efficiency of vehicles.
- This measure presents equity concerns for low-income residents because this is a regressive tax (low-income individuals pay a higher percentage of their income toward tax compared to individuals of higher income). However, revenues could be redistributed to offset potential inequities to enhance mobility options for low-income individuals.

**Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):**

- To date, no entity in the United States or abroad has adopted mileage-based fees in practice.
- Oregon House Bill 3946 directed Oregon DOT to form a Road User Fee Task Force and create a pilot program to evaluate the replacement of the gasoline tax with a mileage-based fee. The pilot ran for 12 months beginning in April 2006. It included 299 motorists and two service stations in Portland, OR. The final report concludes mileage-based fees to be a

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viable alternative to the gasoline tax.\textsuperscript{33} Since the pilot, there has been no legislation to enact a mileage-based fee to date in the State of Oregon.

- Minnesota DOT advanced its own mileage-based pilot after being authorized to do so through the 2007 MN State Legislative Session. The pilot project was established to demonstrate technologies to support future replacement of the gas tax with a fuel-neutral mileage charge. The research/pilot project was integrated into the existing IntelliDrive research effort.\textsuperscript{34} One of the key research components of this study was the public opinion survey that emphasizes the importance of public outreach/education surrounding mileage-based fees.\textsuperscript{35} To date, Minnesota has not legislated any mileage-based fees.

- The Puget Sound Regional Council performed a pilot study with assistance of the FHWA to test mileage-based fees along congested facilities. 450 people participated in the study. The primary aims of the Traffic Choices Study were to (1) accurately describe the behavioral response to the congestion-tolling of roadways, (2) better understand issues of policy related to the Puget Sound Regional Council Traffic Choices Study implementation of road network tolling, and (3) test an integrated system of technical solutions to the problem of tolling a large network of roads without deploying substantial physical hardware on the roadside.\textsuperscript{36}

- The University of Iowa is currently in the process of testing a mileage-based road user charge to see how the public responds, the study is currently underway.\textsuperscript{37}

- The Netherlands was moving forward with a mileage-based fee tracked via GPS units, the program would charge roughly 7 cents (USD conversion) per mile.\textsuperscript{38}

- Texas Transportation Institute created a revenue model (this was a revenue study, it did not look at VMT reduction) for the state of Texas for mileage-based fees in which commercial vehicles would be charged 2.9 cents per mile and personal vehicles charged 0.95 cents per mile to produce the same level of revenue in 2010 as the state gas tax.\textsuperscript{39}


\textsuperscript{34} Minnesota Department of Transportation, 2010. \textit{Minnesota IntelliDrive/Mileage Based User Fee Program}. http://www.dot.state.mn.us/guidestar/2006_2010/intellidrive.html


\textsuperscript{37} University of Iowa, 2010. \textit{National Evaluation of a Mileage-Based Road User Charge}. http://www.roaduserstudy.org/howitworks.aspx


• Mileage-based fees, unlike the gasoline tax, do not directly incentivize fuel efficient vehicles (however, the fee could be structured to incentivize fuel efficient vehicles).
• CDOT is expecting to release a Request for Proposal for its Mileage Based Study Pilot Framework early October (see above for more details) Potential elements to be studied include: congested facilities, time of day, vehicle type, among others that will be developed further during the study. The study is expected to take 9 – 12 months. Conducting the actual Pilot Study would likely require conceptual support from the Colorado General Assembly.
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B4. Pay-As-You-Drive (PAYD) Insurance

**Measure type:** Transportation Pricing

**Measure description:**

Mandatory PAYD insurance charges drivers their insurance premium costs based in part on how many miles their vehicles are driven in a given year. Drivers have the opportunity to save money by driving fewer miles and practicing safe driving habits. Many insurance companies already factor into insurance prices the annual miles driven, such that insured individuals pay less for vehicles that are driven fewer miles per year.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

Air quality benefits would occur from reduced VMT, but additional benefits may be seen from more fuel efficient driving habits (ex: acceleration rates, most current PAYD insurance providers monitor driver acceleration/deceleration rates). The research on mandatory PAYD insurance estimates VMT reductions to be between 6.5% - 10%. 40 41 42 43 44

**Preliminary sense of anticipated costs and economic impact:**

The mechanism for tracking mileage varies, options include:

- GPS monitoring (tracks mileage, acceleration/deceleration, driving habits), cost estimate: $100 - $200/vehicle.
- Certified odometer readings (tracks mileage), cost estimate: $5 - $10/year/vehicle. 45
- Tracking mechanisms used to gather driving activity (ex: gas station monitors).


Households could save money based on the amount they drive. The Brookings Institution has projected that 63.5% of all households would save an average of $496 annually (28% off current premiums) if PAYD insurance were made mandatory.\(^{46}\)

PAYD insurance may result in fewer automobile accidents (ex: Progressive Insurance’s rate structure includes an assessment of driver behavior, drivers are incentivized for safer driving practices).\(^{47}\)

Potential costs for state to administer a mandatory program such as enforcement of such a measure.

Additional technical analysis/input needed to refine benefits/costs estimates:

More refined emission estimates would require an in-depth analysis of the following, in coordination with CDOT and CDPHE:

- Regional price points and associated elasticities to determine the extent to which a range of PAYD Insurance costs would affect VMT and associated emissions in BOTH the short and long-term.
- Research on potential legal implications of making PAYS insurance mandatory.
- Updated emissions reduction estimates using assumptions from the above analysis and EPA’s new emissions model (MOVES). Also using assumptions from the above analysis, conduct additional photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.
- Additional research to determine whether SIP credit could be take for this measure if it were to become mandatory.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Voluntary PAYD insurance is currently available in Colorado through several insurance providers. For PAYD insurance to be mandatory, legislation would need to be passed through the Colorado General Assembly.

Demonstrated ability to take "SIP Credit" for the measure:

There currently is no clear demonstrated ability to take SIP credit for this measure. Based on what we know today, it appears that any air quality benefits associated with such a strategy would have to be considered in the air quality baseline modeling, conducted by DRCOG. The results would then be fed into the DRCOG’s travel demand model to the basis for estimating emissions.


Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

PAYD insurance strategies could be developed and implemented in time for the SIP only with aggressive analysis and associated legislative action, occurring very quickly (analysis in time either for 2011 or 2012 legislative action).

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion, and fuel usage.
- Fewer traffic incidents due to lower VMT.\(^{48}\)
- Potentially fewer uninsured motorists on the road.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Many states and insurance companies currently offer voluntary PAYD insurance alternatives. Each state has different legal requirements for insurance companies and coverage and policy terms vary by state.
- No states have mandated PAYD insurance.
- There is no record of PAYD insurance included in baseline modeling as a voluntary measure.
- PAYD insurance is being evaluated and implemented voluntarily by numerous insurance companies. There is substantial ongoing research and experimentation related to identifying the usage-based data that is relevant to driving risk, practical and affordable to collect, and acceptable to consumers to use.
- PAYD insurance programs may have more impact when the cost is visible to the consumer; such when insurance is paid at the pump.
- PAYD insurance has the potential to reduce the number of uninsured motorists.\(^{49}\)


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B5. Priced Parking

**Measure type:** Transportation Pricing

**Measure description:**

The private cost of parking is often bundled into the price of retail goods/services, housing, or lease/purchase of business space. By unbundling this cost, the cost of parking becomes more visible to drivers and could influence the amount of driving, including individual trips. Most commercial and residential development provides for vehicular parking, whether it includes structured or surface parking, or is on or off-site parking. Local land use codes typically establish parking minimums (and in some cases maximums) for different types of development. For example, in Denver’s zoning code, a retail establishment must provide at least 1.25 off-street parking spaces for each 1000 sq ft of gross floor area (a 4000 sq ft shop would require 5 parking spots). Without meeting this requirements, the retail establishment has to seek a variance (approval from the local planning body) to operate in that particular location.

Parking pricing strategies include those designed to either (1) increase the cost of driving a single occupancy vehicle by charging for parking, or (2) increase the use of alternative transportation in lieu of parking (ex: parking cash-out: where an employer may offer cash, or a transit pass instead of free parking).

Parking is traditionally priced when there is high demand for parking facilities, such as central business districts (CBD), during special events, or other locations where the demand for parking exceeds the supply. On-street parking is managed by the locality, or district in which it is located. Structured/surface lots may be operated by public or private entities.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

Air quality benefits would occur from reduced VMT, but additional benefits may be seen from reduced idling, start-ups, and reduced congestion from cars driving around looking for available parking spots. Several studies have looked at the VMT reduction potential of priced parking. In *The High Cost of Free Parking*, Donald Shoup estimates that for one individual, charging $50/month for parking will reduce their individual VMT by 30% (using an elasticity of -.5). VMT reduction could come from reduced trips, use of alternative transportation, or redirected trips. As discussed below, additional analysis would be needed to estimate air quality benefits in our region of the associated VMT decrease.

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Preliminary sense of anticipated costs and economic impact:

- Additional cost to drivers to park
- Additional cost to those businesses not passing added cost on to consumers
- Opportunity for revenue generation or cost recovery for providing parking facilities
- Reduced car-traffic in otherwise high-traffic areas (which could be both beneficial and costly; for example: individuals that previously drove somewhere, may avoid shopping trips and instead buy elsewhere, while others will visit more frequently as parking is more readily available).

Additional technical analysis/input needed to refine benefits/costs estimates:

Refinement of the evaluation of this measure would require an in-depth analysis of the following, in coordination with CDOT and CDPHE:

- Research on potential legal implications of making priced parking mandatory.
- Analysis of mechanisms for tax/fee collection, and overall administration (ex: would you need to establish a special district, could localities collect fee/tax, etc).
- Regional price points and associated elasticities to determine the extent to which priced parking would affect VMT and associated emissions in BOTH the short and long-term.
- Investigate where pricing strategies that presumably reduce VMT and associated emissions would offer the most benefit to regional ozone values (for example: Central Business Districts, along key corridors, etc).
- Updated emissions reduction estimates using assumptions from the above analysis and EPA’s new emissions model (MOVES). Also using assumptions from the above analysis, conduct additional photochemical air quality modeling to determine impact of lower emissions on ambient ozone levels.
- Research where voluntary programs have been used.
- Consider pilot potential or priced parking (such as cash-out program).

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Implementation of this measure will require extensive collaboration with municipalities and businesses, since imposition of parking pricing measures do not fall under the jurisdiction of state or regional air quality management agencies.

Parking pricing strategies includes those designed to either (1) pricing parking, by increasing the cost of driving a single occupancy vehicle by charging for parking, or (2) incentives, to increase the use of alternative transportation in lieu of parking (such as parking cash-out, preferred parking for carpoolers, etc).
Pricing strategies

Mandatory Programs
We found no examples of mandatory priced parking in the United States. However, there are examples in Asia: Beijing, Guangzhou, Hanoi and Jakarta.53

Voluntary Programs
An example of voluntary program that exists today:
- Model fee structure/equations for pricing municipal parking facilities. For example, the State of Washington has created a website that showcases model parking codes.54
- Policies that reduce employee parking subsidies, so that commuters must pay some or all of their parking costs (such as many employers do in Denver).

Examples of voluntary programs that may exist today (although further research is needed):
- Public parking in lieu of private parking. Encourage localities to allow developers to pay a fee in lieu of providing parking spaces. That revenue can then be used for public parking infrastructure or used for alternative transportation.55
- Coordinate on/off-street parking facility management and charging for it. For example, motorists will choose the most affordable parking choice, if on-street is cheaper than off-street; coordination is needed to manage pricing/supply.

Incentives
Mandatory/Voluntary Programs
- Programs such as Parking Cash Out offer incentives to employees to use alternative transportation rather than driving alone. Employees might be offered a transit pass in lieu of a parking spot. Implementation could be voluntary, or mandatory. The City of Santa Monica, CA implemented a mandatory Parking Cash Out program for employers with over 50 employees.56
- Create development incentives, such as faster permit processing for meeting specific parking requirements (parking minimum/maximums/shared use, etc).57

Demonstrated ability to take "SIP Credit" for the measure:
As far as we have determined to date no state has taken SIP credit for a parking pricing program. However, the cost of parking is generally included in baseline transportation modeling. Any air quality benefits in this region associated with such a strategy would be considered in the air

http://www.mrsc.org/Subjects/PubSafe/offpark.aspx
56 California Health and Safety Code § 43845 http://www.leginfo.ca.gov/cgi-bin/displaycode?section=hsc&group=43001-44000&file=43845
http://www.mrsc.org/Subjects/PubSafe/offpark.aspx
quality baseline modeling, conducted by DRCOG, results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

Not likely in near-term or mid term. This strategy would be difficult to implement in a mandatory sense, it has not been implemented in the U.S. This would require each jurisdiction to pricing parking which creates a competitive disadvantage.

**Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):**

- GHG emission benefits through reduced VMT, congestion, and fuel usage.
- Increased revenue for localities and businesses.
- Increased quality of life due to lower congestion.

**Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):**

- This measure may present equity concerns for low-income residents because parking pricing is considered regressive (low-income individuals may pay a higher percentage of their income toward pricing compared to individuals of higher income). However, revenues could be redistributed to offset potential inequities to enhance mobility options for low-income individuals.
- There was no record of mandatory priced parking in the US in a preliminary literature review, however, as mentioned above there are voluntary programs in place in some states/regions.
- Parking pricing is typically market-driven where demand for parking facilities exceeds supply. Therefore, it may be more pragmatic to control supply of parking facilities rather than mandating pricing.
- Voluntary/market driven implementation is relatively easy to accomplish at local level.
Preliminary Assessments Completed and Discussed in 2010

C. Alternative Transportation and Land Use Measures

Table C: Overview of Strategies Assessed

Detailed Assessment for the following strategies:

Alternative Transportation and Land Use Measures
C1. Expand Transportation Demand Management (TDM) Programs
C2. Reduce Speed Limit
C3. Combined Land Use Tools and Strategies for Reducing VMT and Associated Air Emissions
C4. Full Build Out of FasTracks
C5. Evaluate RTD Fare Structure
C6. Increase Transit Service Levels
C7. Strategically Manage Park and Ride Facilities
C8. RTD Station Area Planning
C9. Real-Time Traveler Information (RTTI)
C10. Bike/Pedestrian Facilities (including bike sharing)
C11. Car-Sharing Programs
C12. Neighborhood Electric Vehicles (NEV)
C13. Management of Parking Supply
C14. Changes to State Land Board Mission/Policies/Decisions
C15. Employer Trip Reduction (ETR) Programs
C16. Linking Personal Behavior and Societal/Environmental Costs
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### TABLE C

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description of Measure</th>
<th>Experience in Colorado/Other Areas</th>
<th>Existing Authority or Needed Approvals</th>
<th>Implementation/SIP Measure Feasibility</th>
<th>Additional Analysis Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expand Transportation Demand Management (TDM) Programs</td>
<td>The expansion of TDM programs would focus on reducing demand for single occupancy vehicle trips by encouraging the use of alternative forms of transportation such as carpooling, vanpooling, bicycling, teleworking, use/expansion of RTD’s Eco Pass program, compressed work weeks or any employer-based program that encourages the use of alternative transportation for commuting purposes.</td>
<td>Transportation Demand Management Programs are common throughout the Denver region. Examples of such programs include the Denver Regional Council of Governments’ (DRCOG) “RideArrangers” program and Boulder’s “Driven to Drive Less” campaign.</td>
<td>Currently being implemented voluntarily</td>
<td>Unlikely to be included as mandatory program in SIP Potential as a Voluntary Mobile Emission Source Program (VMEP)</td>
<td>Analysis of long-term VMT changes from individual programs Additional analysis of program costs Better cost/benefit analysis Analysis of predictive reductions vs. actual reductions</td>
</tr>
<tr>
<td>Reduce Speed Limit</td>
<td>This strategy requires lowering of the speed limit through statutory authority for highways in the ozone nonattainment area. We anticipate that the speed limit would be lowered to a maximum of 55 mph in this analysis and that the reduced speed limit could apply equally to trucks and cars, or could be applied differentially.</td>
<td>Speed limits are currently used throughout the state of Colorado, but are not adjusted to optimize traffic flow for air quality purposes. Other states (Texas, Tennessee) have used speed limit variations to improve air quality.</td>
<td>The state legislature, CDOT, local authorities have the authority to set speed limits within the state.</td>
<td>Could be included in SIP Included in baseline modeling</td>
<td>Analysis of the emission benefits of speed limit changes (modeling) Cost analysis associated with changing speed limits Analysis of safety considerations associated with slower speeds</td>
</tr>
<tr>
<td>Measure</td>
<td>Description of Measure</td>
<td>Experience in Colorado/Other Areas</td>
<td>Existing Authority or Needed Approvals</td>
<td>Implementation/SIP Measure Feasibility</td>
<td>Additional Analysis Needed</td>
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<tr>
<td>Combined Land Use Strategies for Reducing VMT and Associated Air Emissions</td>
<td>This strategy requires a mix of strategies to increase density, diversity (mix of use), destination accessibility, distance to transit, and design characteristics that creates a built environment that improves air quality.</td>
<td>Programs are in effect throughout Colorado to optimize land use. Most are implemented at the local or regional level. For example, DRCOG has an Urban Growth Boundary that is implemented at the local level through the Mile High Compact.</td>
<td>Currently being implemented voluntarily</td>
<td>Could be included in SIP Included in baseline modeling or as control measure</td>
<td>Analysis of the built environment’s impact on travel and associated air emissions Evaluation of economic benefits/costs Analysis of associated infrastructure demand changes</td>
</tr>
<tr>
<td>Full Build Out of FasTracks</td>
<td>The full build out of FasTracks is currently included in the baseline modeling assumptions for DRCOG’s Regional Transportation Plan and subsequent air quality conformity modeling. FasTracks is a $6.5 billion dollar, program to build 122 miles of new commuter and light rail, 18 miles of bus rapid transit service, 21,000 new parking spaces and enhanced bus service for easy, convenient bus/rail connections.59</td>
<td>FasTracks is currently underway in the region.</td>
<td>Authority already exists</td>
<td>Included in baseline modeling</td>
<td>Evaluate air quality impact of FasTracks Monitor funding levels and project changes</td>
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Alternative Transportation & Land Use Subcommittee | Overview of Strategies Analyzed
<table>
<thead>
<tr>
<th>Measure</th>
<th>Description of Measure</th>
<th>Experience in Colorado/Other Areas</th>
<th>Existing Authority or Needed Approvals</th>
<th>Implementation/SIP Measure Feasibility</th>
<th>Additional Analysis Needed</th>
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</table>
| Evaluate RTD Fare Structure   | Transit fares (and subsequent increases/decreases) have an effect on a traveler’s choice to take transit. Fare structures are generally related to revenue generation, fare-box recovery laws, and market analysis. | RTD continuously evaluates fare structures and revenue streams. | Authority already exists               | Included in baseline modeling                    | Evaluate travel demand impacts of RTD fare structure
Analysis of air quality impacts |
| Increase Transit Service Levels | This strategy would increase transit service levels to induce demand for transit and reduce vehicular trips and subsequent emissions. Examples of increased service may include: less time between transit headways (bus every 10 minutes as opposed to every 30 minutes), more bus routes, and more service during non-peak times (evening, weekends, etc). | RTD continuously evaluates transit levels of service trying to accommodate demand while maximizing efficiency. | Included in baseline modeling            | Evaluate travel demand impacts of RTD service level changes Analysis of air quality impacts |
| Strategically Manage Park and Ride Facilities | This strategy would involve optimization of park and ride facilities in terms of the number of spaces and subsequent pricing/regulatory policies used to manage the demand for parking. | Currently being done through RTD and local government with facilities along RTD travel corridors. | Authority already exists               | Included in baseline modeling                    | Promote best practice information and potential air quality benefits
No further analysis at this time |
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<tr>
<td>RTD Station Area Planning</td>
<td>This strategy would optimize station location, facility placement, connectivity, and access to transit services. How, when, and where transit stations are located affects a traveler’s choice to use transit. For example, if a station only has one entry/exit point and little pedestrian access, the difficulty getting to the station may prohibit individuals from using it.</td>
<td>Station planning is being done through RTD and coordinated with local government and DRCOG.</td>
<td>Authority already exists</td>
<td>Included in baseline modeling</td>
<td>Promote best practice information and potential air quality benefits \No further analysis at this time</td>
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<tr>
<td>Real Time Traveler Information</td>
<td>Real-Time Travel Information (RTTI) for this paper’s purpose is related to transit operations. RTTI provides travelers with information on transit schedules, delays/cancellations, and headways (when the next transit vehicle will arrive at a given stop). A number of dissemination methods exist including: telephone, internet, in-vehicle, hand-held devices, and field devices (ex: electronic display boards with arrival/departure information).</td>
<td>Currently being done through RTD with enhancements scheduled in 2013 and thereafter.</td>
<td>Authority already exists</td>
<td>Included in baseline modeling</td>
<td>Promote best practice information and potential air quality benefits \No further analysis at this time</td>
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<td>Bike/Pedestrian Facilities</td>
<td>This strategy looks at the creation of bicycle and pedestrian facilities to improve air quality. Examples include: multi-use trails, bike trails, bike lanes, shared lanes, sidewalks, and bike sharing programs.</td>
<td>Bike, pedestrian and bike sharing facilities are currently available.</td>
<td>Authority already exists</td>
<td>Included in baseline modeling</td>
<td>Additional analysis on facilities and impact on mode choice</td>
</tr>
<tr>
<td>Car-Sharing Programs</td>
<td>Car-sharing programs allow people to have on-demand access to a shared fleet of vehicles on an as-needed basis. Usage charges are assessed at an hourly and/or mileage rate. In addition some car-share organizations charge a refundable deposit and/or a low annual membership fee. These fees typically cover all costs associated with vehicle usage, including insurance, maintenance, parking, and gas.</td>
<td>There are two car-sharing programs in the Denver metro and numerous examples throughout the US.</td>
<td>Authority already exists</td>
<td>Included in baseline modeling</td>
<td>Additional analysis on the impact of car sharing in the region</td>
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<td>Pursue modeling of car sharing as appropriate</td>
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<td>Neighborhood Electric Vehicle</td>
<td>This strategy would increase the use of Neighborhood Electric Vehicles (NEV) in the Denver region. NEVs are battery electric vehicles that are generally limited to local roads (typically 25 mph or less). A NEV battery pack recharges by plugging into a standard outlet and does not produce direct tailpipe emissions, they typically have a 30 mile range before needing a recharge.</td>
<td>NEVs are currently available and legal throughout Colorado and in numerous states.</td>
<td>Authority already exists</td>
<td>Included in baseline modeling</td>
<td>Additional analysis of NEV mode share impact on emissions</td>
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<td><strong>Management of Parking Supply</strong></td>
<td>Parking supply varies from public (on street) to private (surface lots, residential garages, etc). The supply of parking makes travel by automobile possible. This strategy looks at how parking supply effects vehicle travel, which in turn effects air quality. It begins to explore the next steps in evaluating the management of parking supply and its effect on regional air quality.</td>
<td>Parking supply management is currently handled at the local level and through market forces. Strategic management is common in high-density urban centers.</td>
<td>Authority already exists for voluntary program.</td>
<td>Included in baseline modeling</td>
<td>Could be included as TCM in SIP</td>
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<tr>
<td><strong>Changes to State Land Board Mission/Policies/Decisions to Reduce Contributions to Sprawl, VMT Increases and Associated Emissions</strong></td>
<td>Changes to State Land Board mission/policies/decisions to reduce contribution to sprawl, VMT increases and associated emissions.</td>
<td>Additional analysis is needed to verify whether SLB policy changes have been used for air quality purposes.</td>
<td>While it is uncertain, most likely through the SLB or through the legislature. Additional analysis is needed.</td>
<td>Included in baseline modeling</td>
<td>Analysis of SLB decisions and subsequent effects on built environment Analysis of legal barriers</td>
</tr>
<tr>
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<td><strong>Employer Trip Reduction Programs</strong></td>
<td>Employer Trip Reduction programs or Employee Commute Options as they are sometimes called encourage employers to effect how their employees commute to work, when they work and where they work. The primary purpose of these programs is to reducing vehicle miles traveled (VMT), reduce congestion, and make alternative transportation more viable.</td>
<td>Colorado has explored the use of ETRs, but never implemented a mandatory program. California and Washington have experience with mandatory programs.</td>
<td>Mandatory program would need to be legislated</td>
<td>Could be included as TCM/VMEP in SIP</td>
<td>Pursue as voluntary measure, interwoven with TDM strategy.</td>
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<tr>
<td><strong>Linking Personal Behavior and Societal/Environmental Costs</strong></td>
<td>Linking personal behavior and environmental/societal costs connects the dots between citizens, their personal behaviors and effects to the environment, specifically how transportation and land use choices effect air quality. The focus of this strategy is to develop the public will for sustainable behavior change that will ultimately decrease VMT and improve air quality.</td>
<td>Numerous programs in Colorado and throughout the nation try to accomplish this.</td>
<td>Voluntary program needs no additional authority/ approval</td>
<td>Unlikely</td>
<td>Continue to promote marketing and outreach that link personal behavior and societal/environmental costs. No further analysis as stand-alone measure.</td>
</tr>
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C1. Expand Transportation Demand Management (TDM) Programs

**Measure type:** Alternative Transportation

**Measure description:**

Transportation Demand Management Programs are common throughout the Denver region. Examples of such programs include the Denver Regional Council of Governments’ (DRCOG) “RideArrangers” program and Boulder’s “Driven to Drive Less” campaign. The expansion of such programs would focus on reducing demand for single occupancy vehicle trips by encouraging the use of alternative forms of transportation such as carpooling, vanpooling, bicycling, teleworking, use/expansion of RTD’s Eco Pass program, compressed work weeks or any employer-based program that encourages the use of alternative transportation for commuting purposes.

Any single program type would require involvement, commitment and often investment by employers, as well as government agencies, in some cases. Pilot programs are a useful way of testing the effectiveness of select programs in reducing trips, associated VMT and air emissions.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

Air quality benefits would be tied primarily to reduced VMT; additional air quality benefits would also accrue from reduced idling, start-ups, and other ancillary emission producing activities associated with single occupancy vehicle use.

VMT reduction estimates vary greatly depending on the level and breadth of TDM program(s) implementation and participation, as well as actual travel behavior change. At a regional scale with aggressive TDM program implementation, VMT reductions could range from .33%\(^{60}\) to 1.5%\(^{61}\), with presently un-quantified associated air quality benefits for the Denver region.

**Preliminary sense of anticipated costs and economic impact:**

Program costs, associating funding mechanisms and VMT/emission reduction opportunities vary and are not yet fully understood. However, DRCOG’s work in this area offers some important insight. Over the past five years, DRCOG has allocated a total of $3.75M to a TDM funding pool for such initiatives as pilot programs designed to advance innovative TDM programs and Transportation Management Organization start-ups. This funding has occurred via the

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\(^{60}\) DRCOG RideArrangers analysis of 2008 numbers by DRCOG staff.

Transportation Improvement Program (TIP) process. Also, during the past five years, DRCOG has provided a total of $9.5M to the RideArrangers program.

DRCOG plans to allocate in the next TIP cycle an additional $11.9M to TDM over a four year time period. Furthermore, DRCOG has made TDM programs eligible to apply for larger amounts of funding through the TIP process Air Quality Improvement (AQI) pool, which includes approximately $14M from 2012 through 2015.

DRCOG has estimated that The RideArrangers program itself reduces approximately 85 million VMT per year. A recent CDOT study estimates that TDM programs cost from $0.01 to $0.05 per VMT reduced\(^{62}\), while DRCOG reported in 2008 that its TDM programs cost from $0.03 to $3.83 per VMT reduced with a total average of $0.12 per VMT reduced.\(^{63}\)

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Determine the most appropriate method for quantifying the air quality benefits from a (or several distinct) TDM programs in the nonattainment area, building on what has been done for air quality planning purposes elsewhere in the country (via voluntary programs. See Below).
- Analyze air quality benefits associated with individual programs that reduce VMT, since benefits likely will be realized differently in different areas within the nonattainment area (provided an appropriate method for doing so can be developed).
- Analyze the long-term VMT changes from individual TDM programs that exist within the nonattainment area, since most estimates do not include long-term behavior change estimates.
- Update emissions estimates using EPA's new emissions model (MOVES) before considering TDM programs as a possible SIP measure. **NOTE:** DRCOG has indicated that it could include the use of TDM programs in baseline modeling, provided that commute mode share estimates can be obtained. A further literature review would likely provide needed information.
- Evaluate the overall benefit (predictive and actual) and enforceability of TDM programs for SIP purposes and the relative benefits of mandatory vs voluntary programs (using information from Atlanta and Dallas (see below))
- Further analyze associated TDM program costs and cost effectiveness.

**Implementation feasibility** (e.g. Who has authority? Who needs it? Who implements the measure?):

Very feasible as a voluntary measure. DRCOG, RTD, local governments, TMO/TMAs, employers and other organizations have the authority to offer voluntary TDM programs, and do. The Ride


\(^{63}\) Per DRCOG staff Sept. 2010.

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Arrangers program offered by DRCOG is currently offered region-wide and targets employers. The North Front Range MPO offers the Smart Trips program for northern Colorado.

As a mandatory measure, TDM program implementation feasibility is unknown since to our knowledge there are no mandatory TDM programs in existence in the US.

Demonstrated ability to take "SIP Credit" for the measure:

To date, TDM programs have been only applied on a voluntary basis. Credit for them can be taken in the SIP via EPA's "Voluntary Mobile Emission Source Program (VMEP), or they could be included in baseline modeling. Both Atlanta and Dallas/Fort Worth trip reduction programs take advantage of EPA's VMEP guidance and take credit for these voluntary programs in their respective ozone SIPS. EPA only allows credit to be obtained for SIP purposes if proper information is provided in technical support documents. Such information includes projected emissions reductions, program monitoring/reporting and a commitment to reach forecasted emissions reductions by program implementers. TDM programs are not currently included in RAQC/DRCOG baseline emission modeling, but they could be with additional resources for doing so.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Emission reductions associated with DRCOG's RideArrangers program could be in place in time for SIP inclusion since this program is already functioning and has current funding through the TIP process through present day to 2015. An expanded RideArrangers program could also be in place in time for SIP inclusion, provided that expansion efforts and associated EPA required analysis of the program occurs in a timely manner. Any new TDM programs selected through the next TIP cycle will begin in 2012 and results should be ready in time for SIP implementation as well.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Greenhouse gas emission benefits through reduced VMT, congestion and fuel usage.
- Increased quality of life benefits may also be realized, such as more enjoyable commute time and less stress as a result of driving in a congested area.
- Decreased quality of life could result if alternative mode choice is found to be less enjoyable than driving alone.
- Cost savings for parking infrastructure.
  - According to a recent study of a parking structure by the University of Colorado-Boulder, it costs 2.5 times as much to accommodate an additional person in the parking structure than to shift one person from driving to an alternative mode. The

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total annual savings, compared to providing 350 net new parking spaces, was approximately $550,000 or $1,570 per space.\(^6^5\)

**Other considerations/comments** (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- TDM programs are prevalent throughout the country as voluntary programs. Program costs/benefits vary greatly based on amount of funding and the success of the program.
- The two aforementioned programs in Atlanta and Dallas/Fort Worth are included as VMEPs in their respective SIPs.
- There is an interest in using funds obtained from tolls to pay for TDM programs; however CDOT has indicated this is unlikely to occur because funding is typically used to repay bonds used to build the roads.
- CDOT also noted that in addition to the difficulty in using tolls to support TDM, there would also be a need for public support for this approach, which is an unknown until there is a system in place to test.

C2. Reduce Speed Limit

Measure type: Alternative Transportation

Measure description:

This strategy requires lowering of the speed limit on highways within the ozone nonattainment area via legislative action (see below). For purposes of this evaluation, we assume lowering the speed limit to a maximum of 55 mph and applying the reduced speed limit evenly to trucks and cars. Another option could be to apply different speed limits to trucks and cars and/or consider other speed limit variations.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The primary anticipated air quality emissions benefit is NOx reduction due to lower combustion temperatures, which occur at lower speeds. Some CO reduction would also occur. A very preliminary, rough, “one-run analysis” by CDPHE and RAQC staff without the aid of DRCOG’s travel model data, indicates approximately 4.6 to 6.8 tpd of NOx reduction in 2010 (approximately 4% to 6% of the mobile source NOx emissions), with a speed limit change to 55 mph for all on-road vehicles. However, the NOx reductions that would occur for one on-road large diesel truck is estimated to be approximately 7 to 10 times greater than reductions from one individual passenger truck or car. This measure is significantly more effective for large diesel trucks.

Preliminary sense of anticipated costs and economic impact:

While not yet quantified, cost estimates for this measure would need to consider new speed limit signage, enforcement, public education, longer transport time for delivered goods.

Additional technical analysis/input needed to refine benefits/costs estimates:

- Fine tuning the emission benefit estimates by running DRCOG regional travel models and the MOVES mobile sources emissions model.
- Conducting photochemical modeling to determine the impact of the estimated emissions reductions on air quality in the nonattainment area.
- Run DRCOG’s regional travel model to evaluate the benefits of varying reduced speed limit levels. Free flow speeds (varying by facility type and area type) form a set of basic model input parameters. Adjusting speeds downward and re-running the model may result in shifts in travel such as:
  - Reductions in overall vehicle miles traveled (VMT), as longer travel times will result in people choosing destinations closer to home;
  - Shifts to rail transit, as this mode is not affected by roadway speeds;
  - And lower average speeds overall.
- Evaluate the cost associated with varying speed limits
- Analyze safety considerations associated with slower speeds in some areas (see below).
Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Implementation feasibility will likely be a challenge, since legislation would be needed to set a lower speed-limit within the state of Colorado for air quality planning purposes. At this time:

- The state legislature has the statutory authority (CRS 42-4-1101) to set speed limits within the state.
- CDOT and local authorities (CRS 42-4-1102) also have the statutory authority to alter speed limits based on traffic investigations and surveys. CRS 42-4-111 authorizes local jurisdictions to reduce speed limits with respect to streets and highways within their jurisdiction.
- Colorado law does not specifically state whether different highway speed limits may be established for different types of vehicles, for various weather conditions or for different times of the day. However, the law provides that signs may be erected directing traffic to use certain lanes, (42-4-1007(1)(c)). This provision can be used to limit the speed of certain vehicles (e.g., trucks) on specific highway lanes.
- State and local agencies would be responsible for new signage and for enforcing the new speed limits.

Demonstrated ability to take "SIP Credit" for the measure:

This measure could provide quantifiable and verifiable credit in the SIP through the use of the appropriate transportation models and the MOVES emissions model.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Very likely that this measure could be in place within a one-two year time frame, provided legislative support exists. However, the likelihood of legislative support for such a measure is unknown at this time.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG benefits
- Energy conservation benefits. Research indicates that lower speed limits do not necessarily increase highway safety. While it can be said that highway accidents occurring at lower speeds result in less severe injuries, it is more difficult to conclude that lower speeds lead to fewer accidents.
- Highway safety experts in US and Europe have also studied this matter and concluded that increases in travel speeds lead to more deaths and decreases in travel speeds result in fewer deaths. 

speed limits were raised by many states in 1996, travel speeds increased and motor vehicle fatalities went up approximately 15 percent on Interstate highways in those states.

• Results of analysis at 58 experimental sites in 22 US states where speed limits were lowered revealed that accidents were affected as follows: a reduction in accidents of 11 percent to an increase of 26 percent at a 95 percent confidence limit.\(^68\)

• CDOT experience with lowering/raising speed limits has been as follows\(^69\):
  o Speed does play a role in accident severity.
  o Engineering speed studies show that speed limits cannot be effectively enforced without the consent and voluntary compliance of the public. Investigations prove that people will drive the roadway as they perceive the conditions and will ignore a speed limit that is unrealistically too low or too high (as happened along portions of I 25 after T Rex was completed).
  o Reducing speed limits may benefit air quality; however, the challenge will be public compliance and enforcement.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

• This measure is currently employed as an air quality strategy in Texas and Tennessee and a number of European countries The Texas Commission on Environmental Quality (TCEQ) adopted a speed limit reduction strategy in the state SIP, setting speed limits to 5 mph below the previously posted limits where speeds were 65 mph or higher before May 1, 2002. The strategy became effective May 1, 2002 in the Dallas-Fort Worth (DFW) area and on May 1, 2005 in the Houston-Galveston-Brazoria (HGB) area. NOx emissions reductions were estimated at approximately 5 tpd in the DFW area and 2 tpd in the HGB area. In addition, the counties surrounding the NAA of DFW were included in the speed limit reduction strategy due to modeled evidence of local “transport” of emissions into the NAA.

• In 2003, Tennessee analyzed reducing the speed on rural interstates in the 9 county Knoxville area from 70 mph to 55 mph for trucks and from 70 to 65 mph for all other vehicles as a SIP measure for Knoxville area. The estimated NOx reduction from only trucks was 5.8 TPD while from trucks and cars it was 6.0 tpd (approximately a 4% reduction in total NOx emissions). A negligible VOC increase was noted in both cases.

• In 2001 the Netherlands modeled reductions in NOx emissions of 5% on freeways from an approximate speed reduction of 12 mph (from approximately 62 MPH to 50 MPH).

• During the energy crisis of the 1970’s the US federal government mandated a national 55 mph speed limit which resulted in a reduction in gasoline usage by more than 5%.

\(^67\) Wim van Beek et al, The Effects of Speed Measures on Air Pollution and Traffic Safety, (Netherlands)


\(^69\) CDOT. 2010. Correspondence from Sandi Kohrs, Colorado DOT, Branch Manager, Planning and Performance Measures
C3. Combined Land Use Tools and Strategies for Reducing VMT and Associated Air Emissions

Measure type: Land Use

Measure description:

These tools implement a selection of broad land use strategies designed to achieve outcomes consistent with those motivating the RAQC’s work. They include:

- Increasing cooperative integrated planning for regional growth, transportation, and land use;
- Increasing land use development densities by targeting growth to urban centers and creating/enhancing urban growth boundaries;
- Building Transit Oriented Communities;
- Promoting neighborhood design and connectivity by employing innovative development strategies;
- Enhancing first/last mile transit connections and increasing of urban circulators.

RAQC evaluated specific land use tools for reducing VMT and associated air emissions and the following tools will be further analyzed in 2011 as part of the Ozone SIP planning:

- Urban Growth Boundaries
- Regional Transportation Plan Selection Criteria
- Corridor Planning
- Local Land Use Tools & Policies to improve air quality
- Transit-Oriented Development
- Financial/Economic Tools & Policies to improve air quality
- Revenue Sharing
- Community Land Trusts
- Purchase/Transfer of Development Rights

Many studies explore the relationship between the built environment and travel behavior. The built environment has a profound impact on vehicle miles traveled and air quality. There are key influences affecting the nature of built environment which the subcommittee explored; those influences were identified as “desired results” of associated land use strategies and are often referred to as the “5 Ds”. They include the following and in one way or another influence travel behavior and air quality:

70 Note these “tools” represent a condensation of a longer list of “land use “ measures for reducing VMT and air quality. The list was condensed to identify more clearly the key implementation differences for purposes of SIP planning. They can be used in conjunction with each other or independently, but require extensive local, regional and state-level collaboration among all interested parties; public and private.
o **Density** - Density refers to the number of units per acre, by increasing density, more units (housing, commercial, retail, etc) are located in a particular area than what might occur.

o **Diversity (Mix of Uses)** - Mix of uses refers to the mix of uses in one area. This includes retail, office, commercial, housing, and public spaces. This type of development pattern encourages walkability, livability, reduced trips, and community. (ex: jobs to housing balance).

o **Destination Accessibility** - Ease or convenience of trip destinations from point of origin, often measured at the zonal level in terms of distance from the central business district or other major centers.

o **Distance to Transit** - Ease of access to transit from home or work (ex: bus or rail stops).

o **Design (Connectivity and Access)** - Neighborhood layout and street characteristics, particularly connectivity, presence of sidewalks, and other design features (ex: shade, scenery, presence of attractive homes) that enhance the pedestrian-bicycle friendliness of an area.

These “5-D’s” often work synergistically (e.g., higher density with mixed use development has more affect on travel behavior than singularly). Additionally, their resulting air quality benefits may be additive, for example one can enjoy differentiated air quality benefits from each desired outcome, which can be added together to calculate total air quality benefit). More detail on the “5 D’s” can be found in Table 1.

Table 2 presents how each of the tools evaluated by the RAQC might be used in ozone SIP planning, including: how a particular tool affects one or more of the of the “5 Ds”, how the tool might be used in the SIP, at what government/community level the tool would need to be applied to be successful and what future analysis is need to fully evaluate the tool for consideration in developing the ozone SIP.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

Air quality benefits would come primarily from reduced VMT. However, ancillary air quality benefits may be seen from reduced trips, fewer start-ups, evaporative emissions, etc. Current research has established a clear link between the built environment and travel demand. With this linkage comes a variety of broadly estimated air quality benefit estimates, as noted in Table 1. You will also note that some estimates are additive. For example, a development may see a 2% reduction in VMT due to density, a 2% reduction due to increased access to transit and a 2% reduction due distance to downtown, ultimately resulting in a 6% reduction in VMT due to the combined influence of the built environment.
Preliminary sense of anticipated costs and economic impact:

At this stage of evaluation, costs are extremely difficult to predict. However we can generally assume the following:

- **Cost increases** from additional transportation infrastructure to accommodate increased growth in key areas and additional transportation options (ex: increased roadway capacity, transit service, etc.).
- **Cost savings** from reduced local government operating costs due to reduced utility/infrastructure needs, as a result of more compact development (e.g., cost/household decreases for sewer/water/transportation infrastructure such as construction and maintenance of roads, sewer, etc.).
- **Cost savings** from reduced household transportation costs as distances to work, shopping, school, etc. are decreased, households have the option of owning fewer cars and more alternative transportation options become available.

Additional technical analysis/input needed to refine benefits/costs estimates:

Additional analytical needs are significant and vary from tool to tool. Table 2 identifies short term analytical needs for purposes of initial SIP measure and baseline strategy decisions that will need to be made by the RAQC in 2011/2012. Ultimately, the following analysis will be needed for those tools that make the initial cut:

- Additional regional and micro scale analysis of built environment’s influence on VMT.
- Modeling and economic evaluation of benefits/costs, urban form and associated infrastructure demand changes.
- Air quality benefits of VMT reductions need to be estimated using assumptions from the above analysis and EPA’s new emissions model (MOVES).
- Additional photochemical air quality modeling required to determine impact of lower emissions on ambient ozone levels.

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Implementation of land use tools to reduce VMT and air emissions takes immense cooperation at the locally and regionally, as well as at the state level. Also, since many participants drive land development processes, these efforts require many public and private sector entities to support and advance this measure. Authority for doing so lies with many: local governments for land use planning, developers aided by market forces and incentives to build using the land use code designed to encourage a built environment build-out that is reflective of higher densities, increased mixed use, and greater connectivity/accessibility; DRCOG articulating long-range region growth policy. Furthermore, since the nonattainment area will include areas covered by the North Front Range Metropolitan Planning Organization (NFRMPO), and possibly Pikes Peak Air Council of Governments (PPACG), these regional governing bodies and municipalities and business within them will also be called upon to participate in such efforts.

While DRCOG and other regional planning agencies are currently considering prioritizing project selection to urban centers, employment and population location is dependent on development, land use regulations and market forces. The State of Colorado does not mandate land use
planning at the statewide level, and there is no current statutory authority granted to DRCOG (or any regional entity) for development review.

A comprehensive approach to land use planning in Colorado would have to occur via state legislation for this measure to offer tangible air quality benefits in the foreseeable future.

Table 2 provides an initial sense of the level at which each of these tools would have to be implemented in order to be considered for SIP purposes.

**Demonstrated ability to take "SIP Credit" for the measure:**

Air quality benefits from land use activities could be included in SIP planning in two ways:

1. As part of air quality baseline modeling; for things that already being done and that can continue.
2. As a specific quantifiable control strategy identified in the SIP, that is either mandatory or voluntary (if voluntary, the measure must qualify under EPA’s Voluntary Mobile Source Emission Reduction Policy.

Regardless of how they are incorporated, the land use assumptions made in a SIP must be based on the best available information and must realistically predict its future impact on VMT and air quality within the nonattainment area (based on state, regional, and local policies and plans). EPA guidance recommends the inclusion of specific land use policy only if:

- The policy has already been adopted by an appropriate jurisdiction, or
- The policy is planned and there is an enforcing mechanism to ensure it will happen, and
- The policy’s effects have not been account for elsewhere (no double counting)\(^1\)

Land use policies/projects and any air quality benefits associated with such a strategies would most likely be considered in the air quality baseline modeling, conducted by DRCOG. (Need to explain why). The results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles.

Land use policies/projects can be included as a control measure if they are quantifiable, surplus, enforceable, permanent, and adequately supported.\(^2\)

Defined elements and associated emission reductions of this strategy could also be included as a Voluntary Mobile Source Emission Reduction (VMEP) policy. Such strategies must be quantifiable, surplus, permanent and adequately supported. VMEP measures are limited to 3% of the total emission reductions needed to reach attainment. If a VMEP strategy does not meet target reductions, the responsibility for those reductions falls with the State.\(^3\) VMEP strategies cannot “double-count” emissions benefits included in baseline modeling.

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Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Since land use tools for reducing VMT and air emissions take a long time to take effect, land use assumptions beyond current practice are unlikely for inclusion in the upcoming SIP. However, policies and programs implementing DRCOG’s MetroVision goals could be in place and have measurable effect in longer-term air quality planning.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Increased transit ridership.
- Reduced demand for water and wastewater service, and preservation of developable land; the clustering of development (preserving more open space).\(^{74}\)
- Increased quality of life as individuals spend less time in cars/congestion, have more transportation options available.
- Increased disposable income at the household level (all else remaining equal) from possible reduction in household auto fleet.
- More resilient building mix. Buildings can interchange uses more easily; there is greater diversity in housing options and buildings/uses can adapt to changing economic conditions and community needs more easily.
- Reduced water use. More compact development has lower per capita water consumption than less compact development.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- The Sacramento Area Council of Governments (SAGOG) included emission reductions from a variety of Transportation Control Measures (through 2018 planning horizon) that support density and development in urban centers (0.1 TPD VOC, 0.9 TPD NOx), but did not take emission reduction credit in the SIP.\(^{75}\)
- The Dallas-Fort Worth SIP listed sustainable development practices as a Voluntary Mobile Emission Reduction Program, but did not take emission credit in the SIP.\(^{76}\)
- DRCOG is considering increases in density and promoting development in urban centers in its 2035 Metro Vision Plan and Regional Transportation Plan update.
- DRCOG has included support for land use strategies that increase density and growth in urban centers in its 2012 – 2017 Transportation Improvement Program.
- Atlanta’s Atlantic Station redevelopment (which included a mixed – use infill/redevelopment near downtown Atlanta) utilized programs such as a Community Land Trust, private

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\(^{74}\) DRCOG. 2007. “Metro Vision 2035 Update Scenario Descriptions”


\(^{76}\) “Approval and Promulgation of Air Quality Implementation Plans; Texas; Dallas-Fort Worth Voluntary Mobile Emission Reduction Program.” 70 Federal Register 165 (26 August 2005), pp. 50209 – 50210.
contributions, Tax Incremental Financing (TIF), in addition to federal, state, and local dollars to incentivize development and was included as a TCM in the SIP for conformity purposes.\footnote{Leary, Brian. 2010. “Improving Air Quality, Economic Well-being and Community Design at the Project Level: A Developer’s Perspective.” http://raqc.org/postfiles/board_meetings/2010/june04/Leary1.pdf}

- CDOT is studying ways to better integrate land use and transportation planning by developing scenario planning tools to help local communities understand the impacts of different land development scenarios on transportation infrastructure costs. The tools can help communities identify ways in which to develop that promote a sense of community and quality of life and provides for connectivity among land uses as well as multiple transportation modes. Designs that focus on innovative neighborhood design create places where residents can live, work and play and do so by walking, biking or transit. This will reduce vehicle miles traveled and provide many benefits such as lower GHG emissions, lower transportation costs, less congestion, and better health. In such a community, more travel modes can also be accommodated.
Table 1 – Land Use Objectives for Reducing VMT and Enhancing Air Quality

<table>
<thead>
<tr>
<th>Land Use Objectives (the 5 Ds)(^{78})</th>
<th>Density</th>
<th>Mix of Uses or Diversity</th>
<th>Destination Accessibility</th>
<th>Distance to Transit</th>
<th>Connectivity and Access Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>People, employees, floor area ratio (FAR) or housing units per acre.</td>
<td>Number and types of uses within a given area.</td>
<td>Distance from home to central business district or other major centers</td>
<td>Whether or not home or work is within ¼ to ½ mile of the trip origin/destination.</td>
<td>Proximity to transportation services (transit, bike/ped, roads). Specifically, block size, intersection density, and link-to-node ratio.</td>
</tr>
<tr>
<td>Emission Reduction Potential</td>
<td>VMT reductions may be seen between 5 – 12% as residential densities are doubled (on local and regional scale).(^{79})</td>
<td>VMT reductions may be seen around 5% as land use mix is doubled.(^{80})</td>
<td>VMT decrease of 1.2% from 2005 levels in 2035.(^{81}) (Modeled by Urban centers capturing 50% of household growth and 75% of employment growth between 2005 and 2035).</td>
<td>A 10% increase in transit supply variables results in a 0.7% decrease in VMT.(^{82})</td>
<td>VMT reductions vary greatly but as much as 20% -26% as accessibility is doubled.(^{83} 84 85)</td>
</tr>
</tbody>
</table>

\(^{78}\) The 5 Ds were used in the recent study *Driving and the Built Environment*. It is important to note that many of these strategies are complementary and the VMT reduction potential is additive. It is also to note that not all VMT reductions are created equal. Reducing VMT could be achieved from affecting each of these factors: (a) reducing trip lengths, (b) reducing trip frequencies, (c) reducing travel by automobile (mode shift), and (d) reducing the number of cars per household.


\(^{84}\) LUTAQH. 2005. *A Study of Land Use, Transportation, Air Quality and Health in King County, WA*. Prepared by Lawrence Frank & Co., et all for King County, WA.

\(^{85}\) These VMT reduction numbers may be influenced by other exogenous variables; localized modeling is needed to ascertain the influence of connectivity and distance to transit on VMT.
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### Table 2 - Evaluation of Land Use Tools for Ozone SIP Planning

<table>
<thead>
<tr>
<th>Air Emission Reduction Tools</th>
<th>Description of Use</th>
<th>Desired Result</th>
<th>Application level</th>
<th>Implementation Approach</th>
<th>Pursue for Future Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategies Requiring Further Analysis in 2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban Growth Boundary</td>
<td>UGB’s are established to manage growth within a geographic area. They can increase density of urban development (ex: Oregon, Washington, and Tennessee).</td>
<td>Densification of development</td>
<td>Urbanized area</td>
<td>Voluntary or mandatory</td>
<td>YES. Need analysis of how existing UGB’s along Front Range have managed growth (eg: Boulder, Weld Counties, DRCOG). Discussed during 10/26 Subcommittee Meeting</td>
</tr>
<tr>
<td>Regional Transportation Plan Selection Criteria</td>
<td>Regional transportation planning must be conducted by all recipients of USDOT funds. (ex: DRCOG’s Regional Transportation Plan and Transportation Improvement Program) and can affect land use development patterns. DRCOG uses scoring criteria in the transportation project selection process to incentivize growth in urban centers. For example, a project will get x points if it is in a designated urban center, has multi-modal access, or other criteria, depending on the funding pool.</td>
<td>Densification of development in urban areas, improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Urbanized area</td>
<td>Incentive</td>
<td>YES. Need to evaluate how RTP and TIP scoring criteria changes could be strengthened to effectively reduce VMT and associated air emissions. Discussed during 10/26 Subcommittee Meeting</td>
</tr>
</tbody>
</table>

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<tr>
<td><strong>Corridor Planning</strong></td>
<td>Corridor plans are generally completed by localities, MPOs, or the state DOT to plan for multi-modal improvements along a designated corridor. Plans may include access, frontage, design elements, vegetation, lighting. The plan for a specific corridor affects the subsequent investment along that corridor and can affect demand whether people choose to drive or use alternative transportation. (ex:CDOT’s I-70 Mountain Corridor Plan ) Collaborative transit corridor planning is underway along RTD’s western corridor in coordination with FasTracks.</td>
<td>Improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Urban and rural areas</td>
<td>State and regional requirement</td>
<td>YES. Need to evaluate how Corridor Planning can affect VMT and associated air emissions through multi-modal planning and provision of alternative transportation. Discussed during 10/26 Subcommittee Meeting</td>
</tr>
<tr>
<td><strong>Local Land Use Tools/Policies to Improve Air Quality</strong></td>
<td>Local land use regulations include a number of code provisions designed to guide development. Where and how development is affected in code varies from locality to locality. For example, includes the optimization of zoning code, design and subdivision regulations, parking requirements, planned unit development (PUD), Traditional Neighborhood Design, etc.</td>
<td>Densification of development while promoting diversity of uses, improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Local Level</td>
<td>Voluntary</td>
<td>YES. Analysis of air quality impacts of local land use tools. This re-grouping was discussed during the 11/12 Subcommittee Meeting Dissemination by RAQC as best practices to improve air quality.</td>
</tr>
</tbody>
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<tr>
<td>Transit-Oriented Development</td>
<td>Transit-oriented development encourages a mix of land uses around transit that offer multi-modal connectivity between transit and employment, retail, residential, and recreational uses. Achieving TOD requires collaboration between RTD, localities, businesses, developers, and users. (ex: Englewood’s City Center)</td>
<td>Densification of development around transit stops, improved destination accessibility, reduced distance to transit, and design features that make alternative transportation options more attractive/viable.</td>
<td>Urban and rural areas</td>
<td>Voluntary</td>
<td>YES. The subcommittee believes additional analysis of potential VMT benefits of neighborhood-scale TOD linked to local bus stations (as opposed to FasTracks) is warranted because the benefits of this more localized tool have not been determined and such TOD projects are underway around the region. This will complement what we know about FasTracks-related TOD and provide a better sense of how this tool might result measurable VMT and air emissions regionally and certain localities. Discussed during 10/26 Subcommittee Meeting</td>
</tr>
<tr>
<td>Financial/Economic Tools/Policies to Improve Air Quality</td>
<td>Local governments can use a variety of financial and fiscal tools to create incentives for certain types of development that will reduce VMT and trip generation and therefore improve air quality. Fiscal tools may include: Impact fees to fund alternative transportation, reduced property taxes/fees to encourage sustainable redevelopment, grants to promote sustainable redevelopment, Tax Increment Financing to subsidize sustainable development and community improvements, and Industrial Revenue Bonds to promote sustainable development. Economic development planning activities such as business incubators, innovative leasing agreements, and Business Improvement Districts can also be used to promote sustainable development.</td>
<td>Provide financial economic incentives to promote increased density, diversification of use, destination accessibility and design that makes alternative transportation options more attractive/viable.</td>
<td>Local Level</td>
<td>Voluntary or mandatory</td>
<td>YES. Analysis of how employing financial and economic development incentive tools can ultimately drive air quality benefits. Discussed during the 11/23 Subcommittee Meeting</td>
</tr>
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<tr>
<td>Revenue Sharing</td>
<td>Revenue sharing programs allocate a part of a locality’s tax income to other localities. A formula is used to allocate the money. (Ex: State of Maine’s Municipal Revenue Sharing program)</td>
<td>By sharing revenue among localities, there is less competition to bring in/retain businesses for tax revenue; this can affect the density and diversification of use seen in development.</td>
<td>Local Level</td>
<td>Mandatory</td>
<td>YES. The Board identified revenue sharing as a potential tool for influencing the built environment and its subsequent affect on air quality. Discussed at 12/3 Board Meeting.</td>
</tr>
<tr>
<td>Community Land Trusts (for both the preservation of open space, and the provision of affordable housing/development)</td>
<td>Community Land Trusts (CLT) can be used to achieve different goals (preserving open space/working lands, providing affordable housing, etc). CLTs are private non-profit organizations that buy and hold land permanently, preventing market forces from causing prices to rise. For example, a CLT will separate the land ownership from the ownership of improvements (i.e. house), there are usually stipulations on how much an owner can re-sell a home for, maintaining affordability. (ex: Maple Park in Lowry)</td>
<td>Increase density, diversity of land use, and distance to transit.</td>
<td>Local or Regional</td>
<td>Voluntary</td>
<td>YES. Determine how this tool can be used to improve air quality, including researching examples from other areas that have been used in this way. Discussed during the November 23 Subcommittee Meeting</td>
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<tr>
<td>Purchase/Transfer of Development Rights (PDR/TDR/Conservation Easements)</td>
<td>Purchase of Development Rights (PDR) and/or Transfer of Development Rights (TDR) programs are created to promote higher density development while reducing the development potential in rural areas. They offer financially competitive options for development (or not developing) a property. For example, with PDR, a developer may want to develop more densely, so it purchases the development rights from a property owner. That property owner can no longer develop the parcel (or as much) as allowed previously, unless it purchases development rights. (ex: Adams County TDR Program)</td>
<td>Increase density through targeting growth to key areas.</td>
<td>Local or regional level</td>
<td>Voluntary</td>
<td>YES. Determine how this tool can be used to drive the 5 D's that can lead to decreased VMT. Discussed during November 23 Subcommittee Meeting.</td>
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<tbody>
<tr>
<td>Items to be Considered for Future Analysis</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Plan-Making (includes: Park/Green Space, Main Street/ Downtown, Economic Development, Neighborhood, Bike/ Pedestrian, Neighborhood, Transit, Transit-Oriented Development Plans)</td>
<td>There are a host of local plan types available to guide how the built environment and the associated infrastructure grows/changes/develops. These plans may be advanced by a planning office, or by other departments such as parks and recreational, and transportation. There are many types of plans, and the following list is not exhaustive.</td>
<td>Plans and their subsequent effect on the built environment vary, but can all influence density, diversity of use, destination accessibility, distance to transit, and design. However, it depends on the content of plans/policy and the related implementation.</td>
<td>Area specific (ex: downtown, Local Level, Regional)</td>
<td>Voluntary</td>
<td>NOT AT THIS TIME: While the subcommittee recognized the importance of Plan-Making it chose not pursue further analysis on these measures with the exception of Corridor Plans. This decision was made because corridor planning offers a more direct link between land use decisions and VMT/emission and is underway in the Metro area. The other plan making tools simply don’t seem to provide as promising results, given the RAQC’s charge. Discussed during 10/26 Subcommittee Meeting.</td>
</tr>
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<tr>
<td>State Planning Requirements (includes: Development Review, Comprehensive Planning, and Concurrency Requirements)</td>
<td>Planning requirements mandated by state law may include requirements for cities/towns/counties/regions, etc. (ex: Oregon’s Urban Growth Boundary law)</td>
<td>State Planning Requirements have the ability to influence density, diversity of use, destination accessibility, distance to transit, &amp; design. However, it depends on the content of plans/policy and the related implementation.</td>
<td>Mandated at state level, but generally carried out at either regional or local level.</td>
<td>Mandatory</td>
<td>NOT AT THIS TIME. While the subcommittee recognizes the importance of state planning requirements, it recommends that additional analysis of these measures be tabled due to the complexity and controversy surrounding any potential effort to pass enabling state-wide planning legislation necessary for mandating such an approach. Furthermore, any air quality benefits would occur well into the future. Discussed during 10/26 Subcommittee Meeting.</td>
</tr>
<tr>
<td>Context Sensitive Solutions (CSS)</td>
<td>Context Sensitive Solutions is a collaborative, interdisciplinary approach to develop transportation facilities that fit the physical setting and preserves scenic, aesthetic, historic, and environmental resources, while maintaining safety and mobility. CSS was incorporated in part through SAFETEA-LU (Federal Transportation Bill). (ex: CDOT has committed to using CSS in the planning along the I-70 corridor).</td>
<td>CSS have the ability to make diversity of use more attractive, increase destination accessibility, distance to transit and improve design features to make alternative forms of transportation more attractive/viable.</td>
<td>Local, regionally, and statewide</td>
<td>Mandatory (under SAFETEA-LU) and Voluntary</td>
<td>Tool was rolled into “corridor planning” Discussed during 10/26 Subcommittee Meeting.</td>
</tr>
</tbody>
</table>

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<th>Pursue for Future Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehensive Planning</td>
<td>Comprehensive plans (or general plans) are used by most local governments to provide a long-range vision for growth and development. Commonly, specific developments or improvements are checked against both the localities comprehensive plan and local zoning regulations. In Colorado, these are created voluntarily by localities.</td>
<td>Comprehensive Plans have the ability to influence density, diversity of use, destination accessibility, distance to transit, and design. However, it depends on the content of plans/policy and the related implementation.</td>
<td>Local level (although in some areas, regional comprehensive planning is prevalent)</td>
<td>Voluntary (although some states mandate comprehensive planning)</td>
<td>NOT AT THIS TIME. Comprehensive planning is not currently mandated under state laws, and plans vary dramatically. Subcommittee did not wish to pursue further analysis due to associated complexity, controversy similar to that stated above under state planning requirements. Furthermore, any air quality benefits would occur well into the future. Discussed during 10/26 Subcommittee Meeting.</td>
</tr>
<tr>
<td>Dissemination of Best Practice Information Regarding Land Use Regulations and Air Quality</td>
<td>Information on best practices related land use, pricing, alternative transportation can be (and currently is, by DRCOG, RAQC, DOLA, CDOT, etc) disseminated to localities to help promote land use planning that supports air quality goals.</td>
<td>Through the dissemination of best practices, localities/organizations have access to information on the air quality impacts of land use strategies.</td>
<td>Local level</td>
<td>Voluntary</td>
<td>NOT AT THIS TIME. Remove as stand alone sub-strategy, dissemination of best practices is a tool for implementing sub-strategies. Discussed at 11/12 Subcommittee Meeting.</td>
</tr>
</tbody>
</table>

<sup>1</sup> The measures included in this table would generally be included in baseline land use assumptions and modeling for the SIP instead of specific SIP measures.
<table>
<thead>
<tr>
<th>Lending/Insurance Practices (ex: difficulty in obtaining loans for mixed-use development)</th>
<th>Description of Use</th>
<th>Desired Result</th>
<th>Application level</th>
<th>Implementation Approach</th>
<th>Pursue for Future Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently, some lending/insurance practices create disincentives for mixed use/dense development through lending/insurance processes. For example: some lenders policies restrict financing transit oriented developments, which can provide a disincentive to developers to build these types of development.</td>
<td>Improve financing options to developers that build projects that promote density, diversity of use, connections to transit, &amp; design features that make alternative transportation options more attractive/viable.</td>
<td>Local level (primarily through developers)</td>
<td>Voluntary</td>
<td>NOT AT THIS TIME. Removed as stand alone sub-strategy. The RAQC's influence on changing financial institution policy is limited. Discussed at 11/23 Subcommittee meeting.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intergovernmental Agreements for Growth Management</th>
<th>Description of Use</th>
<th>Desired Result</th>
<th>Application level</th>
<th>Implementation Approach</th>
<th>Pursue for Future Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intergovernmental Agreements (IGAs) are used as a tool for regional planning, encourage cooperation on specific developments, or along key corridors. (ex: Boulder County and Schmidt Property Public Trail Construction IGA)</td>
<td>Increase density through managing growth.</td>
<td>Local level (with regional implications)</td>
<td>Voluntary</td>
<td>TBD. Tool is considered an important implementation tool in many areas, such as Corridor Planning and Urban Growth Boundaries. Discussed during 11/23 Subcommittee meeting.</td>
<td></td>
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</thead>
<tbody>
<tr>
<td>Items to be Analyzed as Alternative Transportation Strategies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bike/Pedestrian Facilities (including bike sharing)</td>
<td>The provision of bike/pedestrian facilities at strategic locations can create multi-modal access and increase the use of bikes and/or walking for transportation.</td>
<td>To be reviewed as stand-alone alternative transportation measure.</td>
<td>TBD. Evaluate as alternative transportation measure.</td>
<td>Will be furthered considered by the sub committee as it discusses alternative transportation measures. Discussed preliminarily during 10/26 Subcommittee meeting.</td>
<td></td>
</tr>
<tr>
<td>Transit (light rail, commuter rail, bus, shuttle)</td>
<td>The provision of transit can create multi-modal access and increase the use transit for transportation.</td>
<td>To be reviewed as stand-alone alternative transportation measure.</td>
<td>TBD. See above.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car Sharing</td>
<td>The provision of car/bike sharing programs presents on-demand transportation options for individuals (ex: eGo Car Share; B-Cycle).</td>
<td>To be reviewed as stand-alone alternative transportation measure.</td>
<td>TBD. See above.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transit Station/Stop Planning (includes: Parking management and neighborhood access)</td>
<td>RTD is constantly evaluating where transit stops/stations should be sited (added, taken out). RTD assesses the need for parking and subsequent pricing for parking facilities. The provision of parking and whether it is priced impacts access to transit facilities and whether or not an individual will choose to take transit. RTD has specific guidelines for the design of its facilities. These guidelines include design, signage, safety, lighting, access, etc. These factors affect the desirability of transit as an alternative mode.</td>
<td>To be reviewed as stand-alone alternative transportation measure.</td>
<td>TBD. See above.</td>
<td></td>
<td></td>
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4. Full Build Out of FasTracks

**Measure type:** Alternative Transportation and Land Use

**Measure description:**

High speed transit forms the foundation to promote the full build out of FasTracks, including BRT, commuter rail, light rail, transit and HOV infrastructure.

The full build out of FasTracks is currently included in the baseline modeling assumptions for DRCOG’s Regional Transportation Plan and subsequent air quality conformity modeling. FasTracks is a $6.5\textsuperscript{86} billion dollar, program to build 122 miles of new commuter and light rail, 18 miles of bus rapid transit service, 21,000 new parking spaces and enhanced bus service for easy, convenient bus/rail connections.\textsuperscript{87}

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

Air quality benefits are included in the baseline modeling assumptions by DRCOG. While included in the modeling, there is not data on the air quality impacts of FasTracks exclusively, additional modeling could be done to obtain this information.

**Preliminary sense of anticipated costs and economic impacts:**

- The total cost of FasTracks was last estimated at $6.5 billion. This includes:
  - Cost of planning, engineering, and design
  - Cost of land acquisition
  - Cost of infrastructure
  - Cost of operations and maintenance

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Data on air quality benefits (i.e. ridership numbers, VMT reductions) of full build-out
- Data on air quality benefits of other build-out scenarios (timing)
- Additional analysis of cumulative affects through land use modeling

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

FasTracks is currently underway through RTD. They have the authority to plan, implement, and obtain funding for the program.

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Current funding projections indicate completion of the FasTracks program by 2042. RTD is currently considering additional funding options to guarantee completion of the system by 2018 or shortly thereafter.

**Demonstrated ability to take "SIP Credit" for the measure:**

Build out of FasTracks by 2018 is included in the baseline modeling assumptions that are fed into the travel demand model by DRCOG and subsequently used to model emissions.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

The full build out of FasTracks by 2018 is currently included in the baseline modeling assumptions used to project travel behavior and associated emissions in the SIP.

**Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):**

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Greater access and mobility individuals
- Increased quality of life
- Economic development along corridors
- Regional competitiveness (new employers, tourism, events, etc.).

**Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):**

- Current revenue forecasts do not match the original proposal approved by voters (the full-build out in the time specified may not be feasible). RTD Board is currently looking at possible increase in sales tax to close the gap for full build out.
- Transportation/air quality modeling by RTD and DRCOG does not quantify the cumulative impacts on air quality if FasTracks is built, not built, or only built in part.
C5. Evaluate RTD Fare Structure

**Measure type:** Alternative Transportation and Land Use

**Measure description:**

Transit fares (and subsequent increases/decreases) have an affect on a traveler’s choice to take transit. Fare structures are generally related to revenue generation, fare-box recovery laws, and market analysis.

Fares may include individual trip payment, multiple-ride tickets, or unlimited-ride passes or tickets. RTD’s board policy requires a 20% fare box recovery; Colorado statutes require a 30% recovery rate from all revenue sources except sales tax, and ADA required services are excluded.\(^\text{88}\)

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

To estimate air quality benefits, the research on transit fare impacts on mode choice is required. Research in the US and Europe observes a range of aggregate fare elasticities values from -0.1 to -0.6, the average for the US is about -0.4. Therefore a 10% decrease in fares will result in a 1 – 6% increase in ridership.\(^\text{89}\) Rail elasticities vary from - 0.09 to -0.22 (a 10% decrease in fares will result in between a .9 – 2.2% increase in ridership). Local elasticity measures are needed to quantify air quality benefits due to transit fare changes.

**Preliminary sense of anticipated costs and economic impacts:**

- Decreases in fares may result in a loss of revenues for RTD, but would reduce the expense of transit for users (dependent on elasticity of demand). Loss could partly be reduced by increased ridership

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Assessment of price elasticities for fare increases/decreases and the impact on demand and revenue.
- Assessment or route changes that would need to take place to ensure fare box recovery requirements.

\(^{88}\) C.R.S. § 32-9-119.7

\(^{89}\) Federal Transit Administration, 2003. TCRP Report 95: Pricing and Fares
Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

RTD has the authority to adjust transit fares regularly.

Demonstrated ability to take "SIP Credit" for the measure:

If modeling can show increased ridership and therefore less VMT, air quality benefits associated with such a strategy would need to be considered in the air quality baseline modeling, conducted by DRCOG, results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles. Including as a specific SIP measure would severely limit RTD’s ability to adjust fares as needed.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Fare changes could be included in the baseline modeling assumptions used to predict travel behavior and emissions for the region.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Increased demand for transit services
- Greater access and mobility for individuals

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- RTD currently regularly evaluates fare structures to match revenue demands.
- Elasticities vary by region, network, time of day, trip purpose, and service levels. Additionally, long-term elasticities vary from short-term estimates, detailed analysis is needed to evaluate the affects of this strategy in the RTD service area.
- Some areas of the country have programs that provide free transit service on ozone action days. \(^90\)
- RTD is in the process of planning and implementing enhancements to gather fares more easily and to allow users to use a “smart card” with funds available for transit rather than having to purchase passes and/or have cash available. The program is projected to launch in 2013.

C6. Increase Transit Service Levels

**Measure type:** Alternative Transportation and Land Use

**Measure description:**

This strategy would increase transit service levels to induce demand for transit and reduce vehicular trips and subsequent emissions. Examples of increased service may include: less time between transit headways (bus every 10 minutes as opposed to every 30 minutes), more bus routes, and more service during non-peak times (evening, weekends, etc).

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

There has been much research on transit service level and corresponding transit ridership. Although there are numerous examples of calculated elasticities, they vary dramatically depending on the transit system. Studies throughout the US indicate elasticities for transit frequency changes range from +0.33 to +1.14, or a 10% increase in bus frequency will result in between a 3.3% to a 11.4% increase in transit ridership. Elasticity for train service is slightly different with elasticities between +0.5 to 0.9.91

**Preliminary sense of anticipated costs and economic impacts:**

- Cost of transit operations (increased labor, buses, trains, etc.).
- Cost of marketing materials, service schedules, etc

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Elasticities/predicted ridership data from headway/service levels
- List of additional technical analysis that may aid in our analysis of benefits/costs

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

RTD has the authority to increase the level of service of transit, the largest hurdle will be the increased cost.

**Demonstrated ability to take "SIP Credit" for the measure:**

Level of service is currently included in the baseline modeling assumptions that are fed into the travel demand model by DRCOG and subsequently used to model emissions.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Measure could be in place in time for SIP inclusion and it would most likely be included in baseline modeling done by DRCOG.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Increased access and mobility.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Increases in service are usually implemented due to demand for services
- Increases in service may not lead to proportional increases in transit demand
- Measure could reduce cost effectiveness of system and harm system performance (ex: lower cost effectiveness could be a competitive disadvantage when applying for federal transit funds)
- Depending on the ridership that is generated, any VMT reduction or fuel savings from increased transit service may be offset if ridership is not adequate (i.e. the emissions from the transit vehicle will be greater than if travelers drove their own vehicles
- Mode shift may come from pedestrian trips, which switch travelers from a non-polluting mode to a polluting one
- RTD is in the process of implementing some advanced bus tracking and ridership tracking technologies. These enhancements will create a more efficient network, but also make new data available to travelers about headways and service options (ex: different bus routes available through Smartphone application)
C7. Strategically Manage Park and Ride Facilities

Measure type: Alternative Transportation and Land Use

Measure description:

This strategy would involve optimization of park and ride facilities in terms of the number of spaces and subsequent pricing/regulatory policies used to manage the demand for parking.

There are currently over 70 park-n-Rides throughout the Denver metro region. Some of these facilities are priced and/or time limited, some are not.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The provision of park-and-ride facilities can help facilitate higher-occupancy mode choice (i.e. single occupancy vehicle to shared/pool rides or transit), and translate into air quality benefits. There currently is no research that provides quantifiable emission reduction estimates from either park-and-ride facilities or variations in operating those facilities (i.e. priced vs. non-priced).

Preliminary sense of anticipated costs and economic impacts:

- Cost of providing facilities
- Cost of payment kiosks and signage
- Personnel costs for enforcement/maintenance

Additional technical analysis/input needed to refine benefits/costs estimates:

- Analysis of parking pricing/supply affect on demand for transit
- Analysis of emissions generated from use of park and ride facilities (ex: kiss and ride, 1st/last mile connectors, idling, etc).
- Analysis on occupancy rates of current park and ride facilities (73% in 2003)
- Evaluation of current and planned park and ride facilities
- Analysis of parking facilities within proximity to transit operations not managed by RTD (ex: retail parking facilities near light rail stop)92

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Parking pricing and supply policy for park and ride facilities is currently managed through RTD.

Demonstrated ability to take "SIP Credit" for the measure:

Park and Ride facilities can be included in SIP planning in one of 2 ways. Park and Rides are currently included in the baseline modeling assumptions that are fed into the travel demand model by DRCOG and subsequently used to model emissions.

Park and Ride Facilities have been included in State Implementation Plans. For example, in Utah’s Carbon Monoxide SIP, several Park and Ride facilities are included as TCMs, the emission reductions for these is included as part of the conformity analysis.93,94

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Measure could be in place in time for SIP inclusion, it would most likely be included in baseline modeling done by DRCOG.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage
- Opportunity for shared facilities with adjacent organizations
- Other environmental benefits (reduced storm water run-off from parking lots, lessened urban-heat-island affect from asphalt)
- With parking facilities located outside of the Central Business District (CBD), the CBD may experience less congestion and emissions
- Relief to neighborhoods of “uncontrolled informal” parking

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Park and ride facilities are common throughout the US
- Priced park and ride facilities are common throughout US and Denver
- Parking management needs to be dealt with holistically. For example: if RTD prices a parking lot, but there are un-priced facilities adjacent to the stop, individuals will choose the un-priced spaces and the impact of pricing may be negligible.
- Some transit agencies take a different approach to park and ride facilities by either supplying fewer spaces, or charging more often. Portland, Oregon’s Metro light-rail system has chosen to supply fewer park and rides.95

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95 Hanson, Fred. 2010. “Keynote Presentation” RAQC Board Meeting.
A number of factors affect the use of park-and-ride facilities including: distance to destination, congestion, visibility, access, lot spacing, density, transit headways, pricing, safety, etc.
C8. RTD Station Area Planning

Measure type: Alternative Transportation and Land Use

Measure description:

This strategy would optimize station location, facility placement, connectivity, and access to transit services. How, when, and where transit stations are located affects a traveler’s choice to use transit. For example, if a station only has one entry/exit point and little pedestrian access, the difficulty getting to the station may prohibit individuals from using it.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

While there are not specific estimates for the air quality benefits of station planning, research has indicated that when concurrent and equal enhancements to regional accessibility are assumed, a 10% increase in regional accessibility (from design, access, and use diversity) could result in a 3.3% reduction in VMT.96

Preliminary sense of anticipated costs and economic impacts:

- Cost of station/facilities
  - Land purchase (outright, easements, right of way, etc.)
  - Facility costs
- Operational costs (lighting, maintenance, etc.)
- Costs to localities/developers to “connect” to facility (sidewalks, roads, etc.)

Additional technical analysis/input needed to refine benefits/costs estimates:

- Analysis of station planning’s affect on demand for transit
- Analysis of emissions generated from use of station operations (ex: kiss and ride, 1st/last mile connectors, idling, etc).
- Evaluation of current and planned stations

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Transit station planning is currently managed through RTD’s Strategic Plan for TOD. However, the reach of station area planning goes beyond what RTD does in its planning efforts and extends to the communities in which the stations are located and how they connect to the facility.

Demonstrated ability to take "SIP Credit" for the measure:

This is currently included in the baseline modeling assumptions that are fed into the travel demand model by DRCOG and subsequently used to model emissions.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?)

Measure could be in place in time for SIP inclusion, it would most likely be included in baseline modeling done by DRCOG.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Opportunity for shared facilities with adjacent organizations

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?)

- Transit stations, access, and the surrounding network are currently included in the baseline modeling assumptions by DRCOG. This is also included in most transportation/transit modeling throughout the US.
- Physical characteristics are only one part of mode choice. One recent study showed that physical characteristics have very little to do with transit user satisfaction; instead, frequent, reliable service in an environment of personal safety matters most to drivers.97
- There are a number of manuals/resources available with detailed information on station planning guidelines. These resources focus on intermodal connectivity which will result in higher ridership rates.


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C9. Real-Time Traveler Information (RTTI)

Measure type: Alternative Transportation and Land Use

Measure description:

Real-Time Travel Information (RTTI) for this paper’s purpose is related to transit operations. RTTI provides travelers with information on transit schedules, delays/cancellations, and headways (when the next transit vehicle will arrive at a given stop). A number of dissemination methods exist including: telephone, internet, in-vehicle, hand-held devices, and field devices (ex: electronic display boards with arrival/departure information).

Travelers who are informed about weather and driving conditions, delays and detours, and other situations that affect their travel can use information to make decisions and increase mobility, safety, and satisfaction of their trip. Having information available empowers travelers to reach informed decisions about trip making.98

Currently, RTD light rail stops, Market Street Station, Denver International Airport, and Civic Center Station have display boards that indicate when the next train or bus is scheduled to arrive. Bus schedule information is also available by calling the RTD call center.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

To estimate air quality benefits, analysis of how RTTI affects travel behavior is the first step. Several studies have indicated that RTTI is beneficial, and helps drive transit ridership, but how much it drives ridership is questionable. One study showed that through the installation of RTTI, transit ridership rose 13%, but the increase in ridership could also come from a number of factors (gas prices, congestion, marketing efforts, etc).99

Preliminary sense of anticipated costs and economic impacts:

- The infrastructure needed for RTTI varies and the level of implementation and might include:
  - Call center operations (physical center, staff, etc)
  - Web-based information (website, updates, database)
  - Electronic signage boards

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Real-time transit information
GPS/RID units
Software to translate vehicle location data
- Educational and outreach materials
- Consumer purchase of technology to receive information (ex: smart phones)

Additional technical analysis/input needed to refine benefits/costs estimates:
- Additional analysis on the affect of RTTI on traveler behavior and transit ridership
- Estimates of infrastructure cost
- Review of emerging technology

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):
RTD currently disseminates traveler information; however, enhancements to the type of information and methods of dissemination could be made.

Demonstrated ability to take "SIP Credit" for the measure:

There currently is no clear demonstrated ability to take SIP credit for this measure. It would have to be further investigated. At this point, any air quality benefits associated with such a strategy would need to be considered in the air quality baseline modeling, conducted by DRCOG, results of which are then fed into the travel demand model. These steps provide the emission estimates for motor vehicles.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):
RTTI could be included in the baseline modeling assumptions used to predict travel behavior and emissions for the region.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):
- GHG emission benefits through reduced VMT, congestion and fuel usage.
- More user-friendly transit system
- More efficient transit system: shorter dwell times, more efficient boarding, better rider experience
- Better data collection on riders and their travel behavior

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):
- RTTI is currently is use in varying degrees by RTD with the following enhancements scheduled over the next 5 years.
  - Radio Frequency Card Reader Updates (RFID) (projected launch 2011); program will track EcoPass ridership and eventually lead to a “stored value card” program where...
riders can use the card with money on it rather than have to obtain passes. Will include enhancements to track ridership.

- Transit signal priority pilots. Pilots testing advanced signal priority technology throughout region.
- CADD/AVL Updates (programmed for 2013) will provide predictive arrival system for RTD buses (presently use scheduled service on display boards and through MyStop program).

- Many transit providers use GPS – software tracking systems to obtain real-time bus information that can be disseminated to users.
- Infrastructure to enhance RTTI can be costly and is constantly evolving with technological improvements.
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C10. Bike/Pedestrian Facilities (Including Bike Sharing)

**Measure type:** Alternative Transportation and Land Use

**Measure description:**

This strategy looks at the creation of bicycle and pedestrian facilities to improve air quality. Examples include: multi-use trails, bike trails, bike lanes, shared lanes, sidewalks, and bike sharing programs.

**Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):**

Air quality benefits would be tied to reduced VMT and ancillary emissions that are diverted from motor vehicles through the modal shift to biking and/or walking. Air quality benefits vary based on facility type, and the number of individuals that choose to use the facility for biking/walking rather than driving. Similarly, air quality benefits for bike sharing programs are derived from the mode switch to a shared bike (zero emissions) from a polluting form of transportation. In addition, emissions created in the transport of shared bikes, and other operational activities should be factored in.

In the Denver region 7.6% of trips are taken by bicycle or walking, the average bike trip is 2.1 miles, the average walk trip distance is 0.75 miles. On any given day, there are 191,820 walk and 26,640 bicycle trips made. This information is over 10 years old and new data, and subsequent modeling should be done to ascertain the air quality impacts of bicycle and pedestrian travel.

In the inaugural year of Denver’s B-Cycle program, 102,981 rides were taken traveling 211,111 miles (the average ride was 2.01 miles), 43% of those miles are estimated to be reduced car trips – so roughly a VMT reduction of 90,773 miles.

**Preliminary sense of anticipated costs and economic impacts:**

- Cost of bike infrastructure
  - Bike path (paved): $5.50/SF Concrete, $2.50/SF Asphalt (6" thick trail), concrete paving of 1 mile of bike trail would cost $290,000 (does not including labor, right of way acquisition, grading, other land remediation, etc) with 10 ft trail.
  - Bike lane/shared lane (including sharrow): $2.75/SF or $25.00/SY (6" thick trail), paving of 1 mile of bike lane would cost $72,600 (does not including labor, right of way acquisition, grading, other land remediation, etc) with 5 ft trail.

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Alternative Transportation and Land Use Subcommittee | Bike and Pedestrian Facilities (Including Bike Sharing)
o Bike lane/shared lane (only striping): $1.30/SF (White edge striping 4” wide (Thermoplastic)\(^{104}\), striping 1 mile of bike lane/shared lane would cost $6,864 (does not including labor or paving costs).

- Cost of bike share program
  o Cost of bikes, stations, and kiosks
  o Cost of operations/maintenance/transport of bicycles
  o Cost of promotions, marketing, membership services
  o Cost to user (annual membership to B-Cycle is $65 with rates starting at $1.10/hour (first 30 minutes is free))

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Analysis of bicycle facilities impact on mode choice
- Analysis of current and future bike/ped infrastructure
- Travel demand modeling with/without bike/ped infrastructure (including any modeling assumption changes)
- Analysis of bike sharing programs impact on emissions
- MOVES modeling to estimate emissions from reduced car trips

**Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):**

Bicycle and pedestrian planning is common throughout out the Denver metro with a large network of trails, sidewalks, and bike lanes. Localities are continuously adding bike/ped facilities and analyzing connectivity. CDOT, localities, developers, businesses, and homeowners are responsible for the provision of bicycle and pedestrian infrastructure. Whether or not bike/ped facilities are required is left to either local governments or CDOT’s code/policy/plans.

**Demonstrated ability to take "SIP Credit" for the measure:**

This is currently included in the baseline modeling assumptions that are fed into the travel demand model by DRCOG and subsequently used to model emissions. Bike sharing programs are not specifically included in the modeling, but bicycle mode share is included.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

Measure could be in place in time for SIP inclusion, it would most likely be included in baseline modeling done by DRCOG.


\(^{104}\) City of Arvada. 2010. Average infrastructure costs.
Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Opportunity for shared facilities with adjacent organizations.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Bicycle and pedestrian facilities can be designed for transportation or recreational purposes.
- The provision of bicycle and pedestrian facilities is an important component of a multi-modal network that provides options to vehicular travel.
C11. Car-Sharing Programs

Measure type: Alternative Transportation and Land Use

Measure description:

Car-sharing programs allow people to have on-demand access to a shared fleet of vehicles on an as-needed basis. Usage charges are assessed at an hourly and/or mileage rate. In addition some car-share organizations charge a refundable deposit and/or a low annual membership fee. These fees typically cover all costs associated with vehicle usage, including insurance, maintenance, parking, and gas.

For example, the nonprofit eGo CarShare program in the Denver area charges $4.00/hour + $0.30/mile for use of a standard car such as a Toyota Prius.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits would be derived from reduced VMT, start ups, and ancillary emission benefits from reduced fuel/car usage. Research has indicated that car-sharing programs promote lifestyle changes in which households reduce the number of cars they have and the number of miles driven. Modeling in the Sacramento region predicted a 0.02% VMT reduction with aggressive implementation of car-sharing programs in select areas of the region.105 A review of US car-sharing programs estimates an average VMT reduction of 40% per car-share participant.106 107 In order to ascertain the regional impact of car-sharing programs, additional travel demand and emission modeling is needed.

Preliminary sense of anticipated costs and economic impacts:

- Cost of vehicles
- Cost of storage space for vehicles (parking spot)
- Cost of servicing/maintaining/operating vehicles (ex: fuel, oil changes, etc)
- Cost of car share operations (ex: call center, website, promotions, etc)
- Current cost estimates from eGo CarShare’s program is that on average, the annual total operating cost for a Prius (or similar) is $15,000 and their vehicles are driven 12,000-15,000 miles/year. Each vehicle serves approximately 45 members. Approximately 65% of their

members are signed up for their low-use (Peace of Mind) price plan which does not have any annual or monthly fees.108

Additional technical analysis/input needed to refine benefits/costs estimates:

- Analysis of market penetration of car-share both now and in the future
- Analysis of travel behavior change of car-share users
- Analysis of cost effectiveness of car-sharing programs

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Car-share programs are currently in place throughout the Denver metro area. Operations are currently expanding all the time with more vehicles available throughout the region.

Demonstrated ability to take "SIP Credit" for the measure:

Car-sharing would likely be included in the baseline modeling assumptions that are fed into the travel demand model by DRCOG and subsequently used to model emissions.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Measure could be in place in time for SIP inclusion and would likely be included in the baseline modeling assumptions.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage
- Increased mobility for individuals who do not own a personal vehicle
- Reduced cost of car ownership use and trip making to users
- Reduced parking demand
- Increased use of alternative modes by car-sharing participants
- Replacement of older vehicles with newer and cleaner vehicles on the road (car share fleets are typically newer and often include fuel efficient models)

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- In general, car-sharing programs support VMT reductions, but in some cases, individuals increased their VMT (ex: if an individual did not have access to a car previously)
- There are several car-sharing options currently available in the Denver metro area including: eGo CarShare and Occasional Car.

• ZipCar is the largest car-sharing program in the world with operations throughout the US, there are also numerous “local” car-sharing operations throughout the US.
• With competition for car-share markets, information on operations, profitability, and market expansion is proprietary, and difficult to obtain.
• Car-sharing programs typically do well in dense, urban areas where residents have other alternative transportation options available.
• Many businesses/organizations use car-sharing programs for employee travel rather than using fleet vehicles or reimbursing for mileage on personal vehicles.
• University markets have provided a niche market for car-sharing operations.
• Many car-sharing programs exist through public private partnerships, or grant dollars as user fees may not support operations.
C12. Neighborhood Electric Vehicles (NEV)

Measure type: Alternative Transportation and Land Use

Measure description:

This strategy would increase the use of Neighborhood Electric Vehicles (NEV) in the Denver region. NEVs are battery electric vehicles that are generally limited to local roads (typically 25 mph or less). A NEV battery pack recharges by plugging into a standard outlet and does not produce direct tailpipe emissions, they typically have a 30 mile range before needing a recharge.

NEVs require a drivers license to operate, registration and insurance.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

These vehicles have no emissions. There are emissions at the power plant that must be determined. HB1365 will be a critical element to consider in these calculations as well as the use of renewable sources such as wind and solar.

Preliminary sense of anticipated costs and economic impacts:

- Cost of vehicles. The average cost of a NEV starts at $7,495.00, but can go much higher depending on the vehicle.\(^{109}\)
- The cost of electricity to power the vehicle. At 100 miles per week, using $0.04604/kWh, annually, it would cost $47.88 in electricity.\(^{110}\) 111 This translates to $0.009/mile for the cost of fuel.
- Additional electric charging infrastructure.
- Additional NEV lanes, or connectivity of roadway infrastructure to accommodate NEV vehicles (ex: Lincoln, CA has special lanes striped for NEV/Bikes).

Additional technical analysis/input needed to refine benefits/costs estimates:

- Analysis of current and future NEV fleet in Colorado (demographic, use, penetration information)
- Analysis of electric charging infrastructure and future needs
- Mobile source emissions modeling with MOVES to determine emissions benefits of fleet turnover.

• Analysis of safety concerns as more NEV vehicles compete for road space with gasoline fleet.112

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

NEVs are defined in Colorado Statute as a low-speed electric vehicle that is capable of traveling at greater than 25 mph but less than 45 mph.113 NEVs are legally allowed on roads in Colorado with speed limits less than 35 mph, giving CDOT the authority to regulate the operation of NEVs on state highways located outside a municipality.114 NEVs must comply with applicable federal manufacturing equipment standards.115

Demonstrated ability to take "SIP Credit" for the measure:

The use of NEVs in the SIP would be included in the fleet mix used in calculating emissions for the purpose of air quality planning. In order to obtain “credit” for NEVs in the fleet mix, approval for adjustments to the fleet would be needed from EPA.

Emissions benefits could be realized through modeling but regional credit is based on penetration into the overall fleet mix (assumptions made on what vehicles are being used in region).

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

It is not likely significant implementation and the resulting benefit could be achieved in time for the SIP. A large scale effort to realize significant benefits will take many years and is dependent upon incentives or a mandate utilized to promote fleet turnover/use.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

• GHG emission benefits through reduced VMT, congestion and fuel usage.
• NEVs operate at a slower speed and could increase safety on some roadways (the opposite could also be true).
• NEVs offer mobility options for individuals who cannot drive a high-speed vehicle.
• NEV routes can double as bicycle routes with proper design, thus creating more bike routes.


113 C.R.S. § 42-4-109.6
114 C.R.S. § 42-4-109.5
115 C.R.S. § 42-4-240
The use of NEVs can help create a first/last mile connection to transit and promote alternative transportation use.\textsuperscript{116}

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- NEVs can be charged with a simple 110-volt outlet.
- Some research indicates that some users of NEVs previously walked, biked, or used transit. This can have negative impacts if individuals are switching from a less zero energy mode (ex: walking) to NEVs.\textsuperscript{117}
- The Cities of Lincoln and Rocklin, CA have created NEV Transportation Plans.\textsuperscript{118, 119}
- The Community Redevelopment Agency of the City of Los Angeles developed a program that uses 15 NEVs and 30 electric-motor-assisted 2-passenger bicycle type vehicles (similar to “pedicabs”) to provide transportation options to individuals traveling in an area round Main Street and Union Station.
- The California South Coast Air Quality Management District sponsored a pilot program the use of NEVs for public and commercial uses.\textsuperscript{120}

C13. Management of Parking Supply

Measure type: Alternative Transportation and Land Use

Measure description:

Parking supply varies from public (on street) to private (surface lots, residential garages, etc). The supply of parking makes travel by automobile possible. This strategy looks at how parking supply affects vehicle travel, while in turn affects air quality. It begins to explore the next steps in evaluating the management of parking supply and its affect regional air quality.

Local land use codes typically establish parking minimums (and in some cases maximums) for different types of development. For example, in Denver’s zoning code, a retail establishment must provide at least 1.25 off-street parking spaces for each 1000 sq ft of gross floor area (a 4000 sq ft shop would require 5 parking spots). Without meeting this requirements, the retail establishment has to seek a variance (approval from the local planning body) to operate in that particular location.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

The availability of parking induces demand for automobile travel. How much is uncertain. Additional analysis on the VMT and air quality impacts of parking is needed to quantify air quality benefits.

Preliminary sense of anticipated costs and economic impacts:

- Cost of constructing parking facilities:
  - Average structured parking in Denver is $14,774/space with a range as high as $25,000 for above ground and $40,000 for below ground (depending on engineering/construction constraints).
  - Average surface spot in Denver is $4,000/space
- Cost of operations and maintenance of parking facility
  - National average is $494/space/year
- Intangible costs of parking

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Aesthetic, heat generation, water quality implications, property devaluation

Additional technical analysis/input needed to refine benefits/costs estimates:

- Additional analysis on the VMT and air quality impacts of parking supply is needed to quantify air quality benefits
- Regional survey of local parking requirements, supply, and demand
- Updated emissions reduction estimates using assumptions from the above analysis and EPA’s new emissions model (MOVES)

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

- Local land use codes dictate how much and where parking facilities are placed.
- Many new zoning codes have worked to reduce the number of parking spaces required, focusing on shared parking facilities and parking for non-motorized vehicles.

Demonstrated ability to take "SIP Credit" for the measure:

Parking programs could be included in the SIP in one of two ways:
1. In baseline modeling assumptions; or
2. As a Transportation Control Measure (TCM)

However, in order to be included as a TCM, the results of any parking management strategies need to be adopted by the jurisdiction that would enforce the measure. An example given by EPA is the creation of a parking maximum for development. An example of the use of parking management strategies in a SIP is Massachusetts’ Ozone and Carbon Monoxide SIP in which “controlling the growth of parking spaces in the South Boston neighborhood” was included.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Not likely in near-term or mid-term. While this strategy has important implications on trip making, the ability to reduce/manage parking in the region will take many years to coordinate and to affect air quality.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion, and fuel usage
- Through the use of shared facilities and reduced parking requirements, cost savings to developers and individuals
- Aesthetic benefits if surface parking lots are reduced

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- There are many innovative programs/pilots throughout the US that focus on parking including real time parking information, innovative parking structures, etc.
- Parking supply is managed to local government code and market forces, this complicates the ability to mandate parking supply/management change at the regional level.
- Park and Ride Facilities have been included in State Implementation Plans. For example, in Utah’s Carbon Monoxide SIP, several Park and Ride facilities are included as TCMs, the emission reductions for these is included as part of the conformity analysis.\(^{128}\)

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C14. Changes to State Land Board Mission/Policies/Decisions to Reduce Contribution to Sprawl, VMT Increases and Associated Emissions

Measure type: Alternative Transportation and Land Use

Measure description:

The State Board of Land Commissioners (also known as the State Land Board and the SLB) was established in 1876 to manage more than 3 million acres of land and 4 million acres of mineral rights that the federal government gave to Colorado to generate revenue for public education and some of the state’s institutions.

Table 1 below tabulates how much of the non-attainment area is owned/managed by the State Land Board. The Denver-Boulder-Greeley-Fort Collins-Loveland Non-attainment area includes a total of 5,314,391 acres.129

<table>
<thead>
<tr>
<th>State Land Board Total Acres</th>
<th>Acres in Non-attainment</th>
<th>% of Total Land in Non-attainment Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Ownership</td>
<td>2,825,404</td>
<td>162,499</td>
</tr>
<tr>
<td>Mineral Estate</td>
<td>11,969,179</td>
<td>960,804</td>
</tr>
<tr>
<td>Stewardship Trust</td>
<td>271,658</td>
<td>4,772</td>
</tr>
</tbody>
</table>

The SLB’s activities generate significant revenue annually for its trust beneficiaries, primarily through agricultural leases for grazing and crop lands, mineral development and interest earned on invested funds. In recent years, the board has expanded its efforts to increase revenue through commercial development activities and leasing lands for recreational activities.

The SLB’s policies can impact the built environment, sprawl, and associated emissions. This strategy would identify changes to those policies to improve air quality.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits would be tied to reduced VMT and associated air emissions.

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130 GIS Technician used ArcGIS calculated acreage
Preliminary sense of anticipated costs and economic impacts:

- Unknown at this time.

Additional technical analysis/input needed to refine benefits/costs estimates:

- Analysis of how SLB policies affect the built environment and associated emissions
- Analysis of potential changes to SLB policies/land decisions (e.g. criteria for selling/exchanging state lands within the non attainment area)
- Analysis of legal opportunities and barriers

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

Although further discussion with SLB staff is needed, we currently believe that changes to the SLB policy would need to be adopted by the Board itself, or in some cases, passed through the state legislature. It is not entirely clear how changes would be made at this time.

Demonstrated ability to take "SIP Credit" for the measure:

It is unknown whether SLB policy changes could be used for SIP credit. Further analysis is needed. If the policies could create measureable changes to the built environment and travel behavior, they could potentially be included in baseline modeling assumptions.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

Further analysis is needed, since we presently do not know the scope and nature of the SLB’s presence within the nonattainment area. Given this current uncertainty it is unlikely that emission reductions could be realized during the SIP timeframe.

Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- GHG emission benefits through reduced VMT, congestion and fuel usage.
- Revenue generation for the State of Colorado and its facilities
- Public health benefits via reduce VMT and a healthier built environment

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- To Be Determined
C15. Employer Trip Reduction (ETR) Programs

Measure type: Transportation and Land Use

Measure description:

Employer Trip Reduction programs or Employee Commute Options as they are sometimes called encourage employers to affect how their employees commute to work, when they work and where they work. The primary purpose of these programs is to reducing vehicle miles traveled (VMT), reduce congestion, and make alternative transportation more viable. Popular employee commute programs include transit subsidies, rideshare matching and preferential parking for carpools and vanpools, cash in lieu of free parking, pretax benefits for using transit or ridesharing, compressed workweeks (e.g., four 10 hour days instead of five 8 hour days), telecommuting, Flexcar business membership, and bike/walk programs. Most companies also offer a guaranteed ride home for personal emergencies for staff members who do not drive to work. A variation on the program would be trip reduction as part of new development approval for local governments which has been implemented in California.

These types of programs can be either voluntary or mandatory. Many states adopted mandatory programs in the late-1980’s and early 1990’s which were all repealed after federal legislation was passed in 1995 as H.R. 325 that amended the federal Clean Air Act to make employer trip reduction programs optional instead of mandatory. An example of this was the South Coast Air Quality Management District (SCAQMD) in California’s Regulation XV which was passed in 1987 and later repealed in 1995. In addition, the state of California passed state legislation in 1995 that prohibited air districts or other public agencies from mandating employer trip reduction programs unless such mandates are required by federal law. Washington is the only state with a mandatory program still in place. Many other states employ a voluntary program. Examples of these include programs that incentivize alternative commute options for employees such as Atlanta’s “Clean Air Campaign”. In the Denver metro area, transportation management associations (TMOs) and the Denver Regional Council of Governments (DRCOG) work with employers to develop and maintain commute options programs for their employees.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits would be tied to reduced VMT, decreased idling, reduced start-ups and fuel spillage.

One voluntary program in North Central Texas showed an estimated emissions reduction benefit at 0.43 tons per day (TPD) of NOx and 0.28 TPD for VOCs. Washington’s mandatory program

implemented as part of the State Clean Air Act reduced 125,700,000 VMT annually and 3,730 pounds of criteria pollutants in 2005.\textsuperscript{132}

**Preliminary sense of anticipated costs and economic impacts:**

Program costs vary based on design. Program costs per employee range from $24 - $250/employee.\textsuperscript{133} The median cost per ton of pollution reduced is $56,900. By comparison, inspection and maintenance programs’ median cost per ton is $4,500.\textsuperscript{134}

**Additional technical analysis/input needed to refine benefits/costs estimates:**

- Analysis of similar programs.
- Modeling to determine regional effect of a mandatory vs. voluntary program.
- Additional input and analysis of associated costs.
- Evaluation of similar programs to determine expected environmental impacts.

**Implementation feasibility** (e.g. Who has authority? Who needs it? Who implements the measure?):

For a mandatory program, state legislative action would be needed. In 1991, the General Assembly rejected a bill to establish a mandatory program. For a voluntary program, authority already exists in the form of a collaborative group of government, nonprofit organizations and businesses.

**Demonstrated ability to take "SIP Credit" for the measure:**

Credit could be taken as a voluntary program under EPA’s Voluntary Mobile Emissions Reductions Program (VMEP) and an example of this is North Central Texas.

**Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):**

As a voluntary program, it could likely be in place in time for inclusion in the SIP. Cooperatives already exist within DRCOG, local transportation management associations and CDOT to facilitate such a program. As a mandatory program, legislation would have to be passed in order to implement in time for SIP inclusion.

\textsuperscript{132} Commute Trip Reduction(CTR) Task Force 2005 Report to Washington State Legislature.

\textsuperscript{133} UrbanTrans Presentation to RAQC Ozone Transportation Stakeholder Group, December 2007.

\textsuperscript{134} Transit Cooperative Research Program in conjunction with the Transportation Resource Board and the Federal Highway Administration, “Employer and Institutional TDM Strategies”
Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Greenhouse gas emission benefits through reduced VMT, congestion and fuel usage.
- Increased quality of life benefits may also be realized, such as better lifestyle related to decreased commute time as a result of living in a denser community or savings related to reduced fuel usage.
- Decreased quality of life could result if alternative behaviors are found to be less enjoyable than old behaviors.
- Employers could realize improved morale from an added company benefit or better transportation options for employees.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- Employers have historically opposed mandatory programs in other states. This is particularly true of California's Regulation XV which was passed in 1987 and later repealed in 1995 at the same time federal legislation was passed making ETR programs optional.135
- Research shows that the most effective employer transportation demand management (TDM) programs incorporate financial incentives, such as tax or monetary credits and disincentives, such as priced parking.136
- Of the 13 areas that have had mandatory trip reduction laws or programs on the books, Washington is the only state to maintain those laws.137
- Funding sources are varied with some programs matching state and private dollars such as Washington’s which is $1 state to every $18 private.
  - Other funding sources are federal transportation (CMAQ) dollars.
- Employers that have the most motivation and success in implementing ETRs are those that are facing employee morale or retention issues and/or are facing the prospects of increasing costs or resources related to transportation.

135 Transit Cooperative Research Program in conjunction with the Transportation Resource Board and the Federal Highway Administration, “Employer and Institutional TDM Strategies.”

136 Transit Cooperative Research Program in conjunction with the Transportation Resource Board and the Federal Highway Administration, “Employer and Institutional TDM Strategies.” Chapter 19, page 130.

137 Transit Cooperative Research Program in conjunction with the Transportation Resource Board and the Federal Highway Administration, “Employer and Institutional TDM Strategies.” Chapter 19, page 129.
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C16. Linking Personal Behavior and Societal/Environmental Costs

Measure type: Transportation and Land Use

Measure description:

Linking personal behavior and environmental/societal costs connects the dots between citizens, their personal behaviors and effects to the environment, specifically how transportation, land use and other personal choices affect air quality. The focus of this strategy is to develop the public will for sustainable behavior change that will ultimately decrease VMT and improve air quality.

Preliminary sense of anticipated air quality benefits (e.g. NOx/VOC reductions? Potential reduction amount?):

Air quality benefits would be tied to reduced VMT, decreased idling, reduced start-ups, fuel spillage and reduced emissions from lawn care.

Preliminary sense of anticipated costs and economic impacts:

Program costs and funding vary depending on the scale of implementation. The RAQC has built an initial awareness and education campaign entitled Ozone Aware that has spent nearly $4 million over the past 6 years to attain a 96% awareness level in metro Denver. More funding will be needed to create the public will around desired sustainable behaviors.

Additional technical analysis/input needed to refine benefits/costs estimates:

- Analysis of appropriate social-ecological models and literature to determine course of action
- Determination of scale and reach
- Additional input and analysis of associated costs
- Evaluation of similar programs to determine expected environmental impacts

Implementation feasibility (e.g. Who has authority? Who needs it? Who implements the measure?):

The RAQC has the ability to implement such a program and has had an initial program in place for the past 6 years. DROCG, RTD, federal, state and local governments, TMO/TMAs, and other nonprofit organizations all have implemented programs to build awareness and change social or ecological behaviors.

Demonstrated ability to take "SIP Credit" for the measure:

Public will building, while critical to the success of many mandatory measures, is voluntary and therefore would most likely not be included in the SIP for credit.

Likelihood that measure could be in place in time for SIP inclusion (approx 2015); and, if later, how much later (e.g. 2 years? 10 years, etc?):

See above. As a stand alone strategy, this would most likely not be included in the SIP.
Preliminary assessment of co-benefits (e.g. other air quality, economic, quality of life, transportation etc):

- Greenhouse gas emission benefits through reduced VMT, congestion and fuel usage.
- Increased quality of life benefits may also be realized, such as better lifestyle related to decreased commute time as a result of living in a denser community or savings related to reduced fuel usage.

Other considerations/comments (e.g. Employed elsewhere, particular challenges/opportunities etc?):

- A combination of regulatory and voluntary approaches that are set up to address multiple drivers of behavior is the most effective way to achieve sustainable environmental behavior change.  
- While there are many successful public awareness and behavior change campaigns in existence, there is currently no known effort that specifically addresses ozone pollution and transportation/land use.

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Attachment D – RAQC Ozone SIP Strategies Selection: Goals and Criteria

**Purpose for Goals and Criteria:** The recognition of and agreement upon *explicit goals and evaluation/decision making criteria* will assist the RAQC members by using the same judgment measures for evaluating, prioritizing and selecting the best strategies for incorporation into the ozone SIP.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Meet specific federal EPA technical requirements for SIP content including the proactive management of potential regulatory impacts.</td>
<td>Prepare plans and analyses that meet requirements from EPA modeling and implementation rules and guidance.</td>
</tr>
<tr>
<td>2. Improve air quality in Colorado including reductions of ozone, other air pollutants, regional haze and greenhouse gases.</td>
<td>Air quality modeling and calculations should be broad enough to measure not only ozone reductions (NOx and VOCs) but also other pollutants of concern to the citizens of Colorado.</td>
</tr>
<tr>
<td>3. Encourage local community involvement and experimentation in improving air quality through voluntary efforts in the overall approach.</td>
<td>Identify examples of air pollution reduction measures developed by the RAQC or others that can be adopted by local government and others.</td>
</tr>
<tr>
<td>4. Create an attractive environment for promoting business development by achieving air quality goals.</td>
<td>Identify the costs, benefits, and economic impacts of various strategies.</td>
</tr>
<tr>
<td>5. Encourage multi-modal options for transportation solutions.</td>
<td>Identify incentives, policies, and initiatives that promote multi-modal options or reduce SOV use.</td>
</tr>
<tr>
<td>6. Encourage transportation solutions that pay for themselves.</td>
<td>Identify user fees or other pricing approaches for financing transportation infrastructure and encouraging reductions in VMT.</td>
</tr>
</tbody>
</table>
### Subcommittee task:
Identify and define some overall goals and decision-making criteria for presentation to the next RAQC meeting for discussion and adoption.

<table>
<thead>
<tr>
<th></th>
<th>Goal</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Encourage the use of cost-effective and efficient emissions control strategies on all sources (stationary, mobile, and area sources).</td>
<td>Identify the cost effectiveness of strategy implementation.</td>
</tr>
<tr>
<td>8.</td>
<td>Improve information for the public, local governments, and businesses regarding the benefits of ozone reduction.</td>
<td>Provide information on the positive effects of strategies for reducing ozone pollution on public health, quality of life, image, economic development, and environmental sustainability.</td>
</tr>
<tr>
<td>9.</td>
<td>Maximize the potential fiscal cost savings associated with potential air quality reduction strategies.</td>
<td>Analyze fiscal savings to government (full impacts of any control strategy implementation, including direct and indirect savings).</td>
</tr>
<tr>
<td>10.</td>
<td>Develop set of strategies from a short, medium, or long-term perspective.</td>
<td>Identify the timeframe over which the primary benefits of various strategies will be realized.</td>
</tr>
</tbody>
</table>
Attachment E – August 16, 2010 Modeling Meeting Memo

Regional Air Quality Council

Summary of August 16 Ozone Modeling Meeting and Next Steps

Meeting Date: August 16, 2010

Meeting Purpose: To provide RAQC board members with a more in-depth understanding of the role photochemical modeling plays in SIP development, the current status of modeling efforts; and to receive from independent modeling experts ideas and suggestions on these ozone modeling efforts. The emissions inventory, related data considerations, modeling assumptions, current modeling results, planned improvements to the model and a schedule of forthcoming modeling activities will be discussed.

Meeting Participants: Included RAQC Board members, RAQC and CDPHE staff, the AQCC’s modeling contractor (Environ-Alpine) and several invited modeling experts. Interested members of public attended to listen to the discussion.

Experts:
- Martha Hyder, Wind River Environmental Group, LLC
- Jana Milford, University of Colorado
- Gabrielle Pfister, National Center for Atmospheric Research
- Eric Sabina, Denver Regional Council of Governments
- Gregg Thomas, City and County of Denver

RAQC Members
- Melissa Chalona
- Paul Natale
- John Putnam
- Jep Seman
- Nancy Severson
- Dave Stuart

CDPHE/RAQC Staff
- Kevin Briggs
- Jerry Dilley
- Kate Fay
- Ken Lloyd
- Chuck Machovec
- Gordon Pierce
- Paul Tourangeau
- Dale Wells

Modeling Contractors
- Ralph Morris, Environ International
- Dennis McNally, Alpine Geophysics
**Outcomes and Next Steps:** At a future date in mid-2011 (before the August RAQC Meeting), the RAQC will host a "modeling forum", at which public comment on updated and improved will be taken. In the meantime, staff will begin to address the comments and recommendations made during the meeting by the panelists and RAQC members. A follow-up meeting will be scheduled during the first quarter of 2011 with the same group of modeling experts discuss updates, new information and responses to the discussion during the August 16, 2010 meeting.

**Key Comments/Recommendations by Experts and RAQC members:**

1. Address the basis for the 36 km boundary condition and why this scope is appropriate.

2. Present the rationale behind each sensitivity or "what if" scenario and consider modeling additional scenarios.

3. Provide a basis for the "more realistic" growth factors (slide #22).

4. Provide a basis for the domain outside of Colorado (slide #25)

5. Explain the steps (data used) you have taken to validate the model. What data have been used (including beyond Colorado) to determine background concentrations? Consider using Satellite data to evaluate pollution inflow? Perhaps use CASTNET?

6. Explain how attainment can be shown in some cases when Fort Collins monitors show an exceedance?

7. The impact of House Bill 1365 will be an important factor in determining emission reductions necessary to meet the final ozone standard. Ensure that the modeling analysis fully addresses these impacts.

8. How soon will an ozone attainment date by known? Attainment level?

9. How and when will new monitoring data be available for use in the model? Incorporate this data into upcoming modeling runs.

10. To test the effectiveness of transportation-related strategies, it will be essential to incorporate data and modeling results from DRCOG and CDOT. Explain how this will be accomplished and incorporated into the modeling predictions.

11. Efforts should be undertaken now to apply MOVES adjustment factors; not wait for EPA. Consider using the Weather Research Forecast (WRF) model, which will improve boundary conditions.

12. Explain how you reconcile data used in the model to enhance the model's performance. The VOC model performance seems off.

13. A potential vulnerability at this point is the boundary conditions analysis. Explain how we might better get "our arms" around this issue, once the final ozone standard is announced. Things to consider: evaluation of global models to see beyond the US to better determine what changes in pollution inflow effect boundary conditions. Will need to know how EPA would react to using this type of data.
14. Regarding the vertical velocity corrections, Explain how you are confident that they are the appropriate ones and why.

15. Explain why you believe the model is now more responsive to local emissions reductions?

16. Would it be feasible to study several more ozone episodes (instead of one so extensively)? It would seem that doing so would give us a better sense of how accurate the model predicts ozone concentrations, by having more actual observations.

17. Explain the basis for the oil and gas emissions projections. It seems it might be helpful to pursue additional emissions data from the industry to populate this important data base, since this industry's contribution to ozone remains significant. The WRAP might be able to help with this.

18. How will you continue to improve emission inventories? Particularly those for non-road and oil and gas sources? Improvements are needed to further improve modeling predictions.

19. Have you considered the impacts of biogenics on ozone formation (e.g. the Pine Beetle issue). This should be addressed in the modeling.

20. Does the modeling effort include predicting the impacts of climate change in the region?

**Preliminary and Partial Staff Responses to Meeting Questions, Comments and Recommendations**

**Attainment Analysis**

**When will the region understand the gap between current ozone levels and those necessary to reach attainment? How will region know what our target needs to be?**

While the gap is generally understood today, we will have the means by which to fully understand it after EPA announces the final ozone standard; now scheduled for July 2011. Since EPA’s proposed standard range is so wide and we are out of attainment with the current standard, we believe it makes more sense to spend time developing the menu of strategies necessary to reach whatever the final standards is now and later begin selecting the necessary combination of measures. Nonetheless, we can project that the Rocky Flats North monitor will register 73 ppb in 2020, based on preliminary emission control strategy sensitivity analyses presented at the Aug 16 meeting (assuming NOx reductions across the US, Colorado and the NAA and VOC reductions in the NAA). Furthermore:

- We anticipate knowing the 2008-2010 Design Values by the end of 2010 when quality assured data from the 2010 ozone season is available.

- Phase II model improvements are currently underway (MOVES, possible identification of missing VOCs, possible met modeling improvements etc) and further refinement of controls on large NOx Sources and available Fuels Options can allow for revised 2020 projections.
• We anticipated that we will have an improved understanding Boundary Conditions are anticipated during the SIP modeling, later in 2011, but will not be available in early 2011.
  o In previous modeling, the impact of the emissions in the 36 km domain where used to generate the total ozone concentrations described as the Boundary Conditions for the 12 km domain
  o In the planned Scope of Work for the SIP modeling, two-way nesting of the 36 km domain and the 12 km has been required similar to that employed in the current modeling for the 12 km and 4 km domains
  o This will allow for a Source Apportionment analyses to identify specific source categories/geographical locations of emissions within the 36 km domain, and initial Boundary Conditions assumed for the North, South, East, West and top of the 36 km domain.

• The modeling tools will aid in targeting the source categories and geographical locations that are important in the formation of ozone.
  o Source apportionment analysis can indicate the significant and insignificant VOC/NOx source categories/geographical locations in ozone formation
  o Sensitivity Analysis can demonstrate the ozone response to a potential reduction scenario.

• Control analysis is an expensive, iterative process and is not feasible for every individual strategy; however we will evaluate further changes based on the feedback from this meeting.
  o Modeling to date indicates that additional NOx reductions in the NAA, Colorado and beyond and VOC reductions in the NAA will be helpful moving forward.
  o As the VOC and NOx inventories are perturbed the VOC/NOx ratios and the chemical response changes to proposed reductions
  o The current understanding of possible future controls and the possible standard under consideration by EPA leaves the region in the position today of considering not single control strategies to close the gap but rather packages of control strategies.

Emissions Inventory

How is the model accounting for emission inventory growth?

There are established EPA protocols (including models) for estimating emissions and growth. The protocols followed for development of emissions inventories are described in the Technical Support Document prepared along with the SIP. Among the some models or data bases used include:
  o MOBILE6/MOVES – growth based on local traffic data, fleet turnover
  o NONROAD MODEL – growth based on fleet turnover, demographics
  o EGAS – an economic growth model for area/minor point sources
  o National Emissions Inventory (NEI) – growth based on local demographic data

Do emissions inventories consider fluctuations in temperature during the day due to meteorological and/or operational conditions?

• Upsets and unusual events can effect short-term ozone levels, however their overall impact is too small to consider in regional ozone concentration predictions.
• Nonetheless, we use temporal emission profiles for each source category.
• We generally use the emissions models such as, CONCEPT, SMOKE, etc., to provide week day/weekend hourly model-ready data and the emissions represent a typical summer day inventory. The daily/hourly processed emissions vary based on temperature, default usage profiles and other factors.
• Large sources with CEMS data are used in the base case modeling to capture actual conditions and are reflected in the Model Performance Evaluation
  o **Suggestion:** Investigate the importance of atypical emissions on ozone formation and determine if better temporal factors can be developed for relevant source categories (e.g., condensate tanks)
  o **Suggestion:** Consider improving the process for reporting emissions from upsets so that the emissions can be factored into the base year modeling inventories.

**How and when will you use EPA’s new MOVES model?**

• We are employing MOVES using currently available data for the purpose of providing a screening tool for strategies in early 2011. For the SIP, additional motor vehicle and transportation data collection will be required to achieve the full potential of the MOVES model later in 2011.
• **Suggestion:** Use the currently available default data and move forward with MOVES to assist in screening analyses.

**How comfortable are you with the current Nonroad emission inventory and model, used to estimate non-road/off-road equipment emissions? Is there enough data to fully investigate control strategies?**

• The MOVES model does not currently include a Non Road (NR) component; however, EPA plans to add a NR model component to MOVES. The date of the release of a MOVES NR model component is uncertain.
• The current NR model includes proprietary data and the model can be cumbersome to use for local control strategy evaluation.
• Subcategories can be broken out and, depending on the strategy, it is possible to estimate some reductions based on penetration of the strategy.

**How accurate are the Oil & Gas inventory projections and how can they be made more robust? What added value will more data offer?**

• We have considered industry studies and believe them to be the best source of data for predicting emissions growth.
• We have developed base year emissions from industry sources outside of Colorado, and Colorado’s Air Pollution Emissions Notice (APEN) system within the state.
• We have used The Western Regional Air Partnership (WRAP) various O&G basin studies in western states and the NorWest (Colorado D-J Basin) growth studies provided by industry in the recent SIP modeling to project future year emissions.
• We have also used historical data to project future growth in the Piceance basin.
• We anticipate receiving and considering updates to the WRAP data from Southwestern Wyoming Five County, Four Corners, and Uinta Basins
• **We will respond soon on how best to respond to the suggestion that we revisit the oil & gas inventory projections during the next SIP revision process next year.**
How do we estimate emission controls and track inventory changes in other states, and improve boundary conditions and understanding of background in NAA?

- Currently we track regional planning organization inventories and national emissions inventory (NEI) data for the 36/12 km domains
- *Suggestion: Evaluate some of the newer global models for base and potential future years to establish initial boundary conditions on the west coast.*
- *We will respond soon on how best to respond to the suggestion that we more fully understanding “background” conditions; possibly use satellite data for doing so.*

Will the Clean Air Interstate Rule (CAIR) which caps SO2 and NOx in 28 eastern states have an impact on Colorado?

- It is not likely that emissions reductions from CAIR will significantly affect summer ozone levels in Colorado. The meteorology associated with most ozone episodes tends to involve local and/or western U.S. air masses.
- The upslope winds from the east during high ozone episodes in the NAA tend to be associated with light winds, thermally-driven upslope flows, and local vertical recirculations through the actions of a Front Range Mountain-Valley circulation.

Have you evaluated the expected impact of Climate Change in 2020?

- The current photochemical modeling does not explicitly incorporate the effects of climate change. However it does reflect the reported meteorological regime of the base year (2006 in the recent SIP) and projects future ozone concentrations using the future 2020 emissions, chemistry algorithms and the base year meteorology.
- In the SIP time frame not much impact is anticipated. In 2020 timeframe the variability of meteorology still overwhelms climate change.
- Possibly in 2030 there will be some impact from climate change
- In the last SIP data analyses were presented in the WOE that removed the impact of meteorological conditions.
  - *We will respond soon to the suggestion that we at least qualitatively, and possibly quantitatively consider how ozone reduction measures impact climate change trends*

Model Performance & Improvements

What are model performance evaluation tools have you used? Do you/can you evaluate the model outside of Colorado for transport issues?

- The performance evaluation compares modeled fields with observations for variables such as wind speed, wind direction, temperature, and moisture. Upper air soundings and other data also are used in performance evaluation of the model.
- Clean Air Status and Trend Network (CASTNET) sites, a long term environmental monitoring program, administered and operated by EPA were used in evaluation outside of Front Range.
We will respond soon to the suggestion that we use available satellite data for evaluating performance, as well as surface and satellite Data Assimilation.

What were the improvements due to Vertical Velocity fix? Explain how these improvements make the model more responsive?

The improvements to the Vertical Velocity issue eliminated the elevated stratospheric ozone concentrations brought to ground level which overwhelmed the locally produced ground level ozone and negated the impact of reduction strategies applied to ground level sources.

The model more closely reflects monitored data across the West as well as in the NAA. CASTNET data were used to verify improvements across the west.

In terms of modeled changes in the NAA after the CAMx improvements in VV algorithms (CAMxVV), emissions reductions demonstrated improved ozone reductions when compared with previous version of CAMx.

What are other improvements to model performance being considered?

Currently planned Model improvements include:
- Identification of missing VOC emissions through inverse modeling analysis of 2006 speciated non-Methane organic compound (NMOC) data. The Division has not collected additional VOC data since 2006, but there are plans to collect VOC data by 2011
- Investigating Weather Research Forecast (WRF) model. WRF will likely replace MM5 in the SIP if it performs better.
  - Suggestion: Continue to investigate WRF
  - Suggestion: Look at a research portion of WRF – DART WRF
- Updated Oil & Gas Emissions
- Use of EPA MOVES model for motor vehicle emissions

Please consider making the base case modeling more accurate by studying individual episodes of high ozone etc. in the current 2006 base case?

More will be known about the requirements for base year selection after October 31, 2010 when the EPA addresses the proposed revised standard, and classifications.

We will respond soon to the following suggestions:
- Consider spending more time on base case modeling; perhaps continue using 2006 base case and understanding the June 2006 modeled results.
- Use data ensembles in base year modeling
- Instead of setting aside June, explain and understand why June model performance has degraded.

Are we planning to compare CAMx with CMAQ?

While this is not in the current workplan, we do recognize that we learn more about air quality models and air quality issues when more than one model is used. We will investigate the feasibility of adding this analysis to the current work plan.
Did we consider effect of biogenics (e.g. the pine beetles) on ozone formation, including projected future tree kills?

- Yes. The 2008 SIP includes documentation of the tests for the 2010 model year performed based on beetle kill data west of the Continental Divide. The analysis at that time did not assume beetle kill along the Front Range. *This means that we may need to further consider this matter.*
Attachment F – 2011 Meeting Framework

**Overall Goal:** To position the RAQC Board by the November/December meetings to have a working sense of the magnitude of needed ozone reductions; and to preliminarily identify ozone measures for 2013 SIP and determine further 2012 analysis needed, using the broad list of emission control strategies assessed in 2010 and much of 2011.

**Key Assumptions:**
- Meeting Frequency: Monthly
- Meeting Length: 3 hours from 9:30 am-12:30 pm
- Meeting Time Slot: 1st Friday of the Month, except for:
  - April meeting scheduled for April 8, 2011
  - No July meeting (unless needed)
  - September meeting scheduled for September 9, 2011
- Meeting design components may change, based on RAQC Board preferences and progress-to-date evaluating and discussing topics/issues.
- Each meeting will include time for public comment and other business, as necessary


*Purpose: To Capture 2010 RAQC Progress and Set the 2011 RAQC Agenda*
- Report on EPA's recent announcement to postpone Revised Ozone Standard
- Discuss final Alternative Transportation and Land Use Subcommittee Assessments/Recommendations
- Discuss Draft 2010 Progress Report to the Governor and Recommended 2011 Meeting Framework
- Presentation by and Discussion with Joe Cortright, Impresa Consulting on his Economic Analysis of Improving Linkages Between Transportation and Land Use in the Denver Metro Area

**Meeting 2: February 4, 2011 – 2011 RAQC Work Program Kick-Off**

*Purpose: To confirm RAQC policy direction, introduce new RAQC members and discuss 2011 SIP measure analysis priorities and schedule*
- Review of Ozone SIP development timeline (with consideration of uncertainty due to EPA announcement delay)
- Discussion of 2011 SIP Measure Analysis Priorities and Schedule
- Review and discussion of RAQC 2011 Work Plan/Budget
- Update: Affect of Clean Air Clean Jobs Act implementation and Regional Haze SIP on Ozone SIP planning

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3 This goal and specific components of the meeting framework could change if EPA fails to publish the new ozone standard and associated implementation guidance by July 31, 2011, as currently indicated.
Meeting 3: March 4, 2011 - Further Discussion and Next Steps on Potential Ozone SIP Measures Involving Motor Vehicle Fuels

**Purpose:** To refine ozone SIP measure options involving motor vehicle fuels by discussing current status of options and identifying next steps

- Staff presentation on fuels report comments and planned responses/next steps
- Industry perspective on fuels report and discussion with RAQC
- Staff update on progress evaluating other motor vehicle fuels options (e.g. fleet CNG, electrification, ethanol etc.)
- Panel Discussion on other motor vehicle fuels options/market penetration
  - Industry representatives (EV, ethanol, gas)
  - Environmental Representatives
  - Local government (infrastructure development role and associated supply and fuels cost considerations)
- RAQC discussion and recommendations on Motor Vehicle Fuels Next Steps

Meeting 4: April 8, 2011 – Digging Deeper into the Linkages between Air Quality Planning, the Built Environment and Public Health Protection:

**Purpose:** To further discuss how the "built environment" can influence air quality planning, public health protection and the region’s economy; and identify concrete steps for advancing mutual goals. Invite DRCOG and Metro Mayor’s Caucus Executive Committee to attend.

- Staff “refresher” of Key Topics/Recommendations from June 2010 co-host meeting with DRCOG and Metro Mayors conference discussing innovative approaches to SIP planning in Atlanta and Sacramento
- Panel discussion with RAQC Board on the relationship between air quality planning and public health protection and management goals, objectives, costs and savings
  - CDPHE to introduce the topic and summarize programs
  - Academic Expert to provide national research on how the built environment can impact regional health care delivery costs
  - Health Care provider/Metro Chamber/other business (to focus on actual economic benefits (reduced health care costs) of "healthier" built environment
  - NGO or foundation (e.g. Colorado Trust/Colorado Health Foundation) to present grant making/financial incentive approaches for marketing “healthy” communities to business
- Panel Discussion with RAQC Board to initially prioritize land use measures under consideration for ozone SIP
  - Staff summary and status of measures under evaluation
  - Response and "reality check" discussion with developers, Metro chamber, health care providers, local land management agencies (county/regional/ municipal government), environmental/public health advocates
  - RAQC Board guidance to staff on next steps/needed adjustment, etc.
- Staff update on discussions with EPA regarding feedback on SIP appropriateness of potential SIP measures assessed in 2010 (see 2010 Progress Report to the Governor)

Meeting 5: May 6, 2011: Stationary source ozone SIP measures: Status, Options and Next steps

**Purpose:** To review and discuss available stationary source ozone control measures

- Update on role of stationary sources in ozone nonattainment
- Discussion of: 1) measures approved in current in ozone SIP or state legislation; 2) measures previously considered but not in current SIP; 3) strategies employed in other states; and, 4) federal measures.
Meeting 6: June 3, 2011: Transportation Pricing and Motor Vehicle (not fuels) Measures Evaluation Update and Discussion

**Purpose:** To discuss results of staff further evaluation of potential transportation pricing and motor vehicle measures preliminarily assessed in 2010

- Staff update on further evaluation and associated recommendations
- Discussion by RAQC Board on next steps

NO July Meeting Schedule or Hold for Possible July Meeting on July 8, topic to be determined based on need.

Meeting 7: August 5, 2011- Ozone Air Quality Modeling and Opportunities for Using Energy Efficiency-related Measures in the Ozone SIP

**Purpose:** To provide the RAQC Board with an updated perspective on air quality modeling efforts underway, which are designed to support ozone SIP development; and to consider the extent to which energy efficiency measures might offer ozone SIP benefits

- Staff presentation and RAQC discussion of ozone air quality modeling and significant developments, responses to 2010 technical meeting recommendations and modeling consultant’s work status and activities.
- Staff/expert (possibly including the Governor’s Office of Energy Conservation) presentation and discussion of the extent to which the RAQC may be able to use energy efficiency laws and initiatives as ozone reduction strategies, building on Colorado’s leadership in this area.

Meeting 8: September 9, 2011 – New EPA Ozone Standard and Implementation Guidance

**Purpose:** To evaluate and discuss EPA’s new ozone standard and related implementation considerations as they pertain to Ozone SIP development

- Staff presentation on new EPA ozone standard and implementation guidance
- Discussion with EPA region and headquarters staff on new standards and implementation guidance
- Discussion on how new standard and guidance will affect ozone SIP development timeline and strategy

Meeting 9: October 7, 2011 - Alternative Transportation Measures Assessment Status; and Basis and Magnitude of Emission Reductions Needed to Demonstrate Attainment and Maintenance of the Ozone Standard

**Purpose:** To provide the RAQC Board with an update and sense of the magnitude and general nature (transportation, mobile, stationary and area source) of ozone reductions likely needed to demonstrate attainment *(NOTE: This meeting is designed to set the stage for November and December meetings that will allow the RAQC Board to “bracket” and preliminarily identify ozone SIP measures).*

- Discuss and prioritize results of further evaluation of potential alternative transportation measures preliminarily assessed in 2010 and early 2011
- Discuss current preliminary understanding of the following, recognizing final air quality modeling results (“attainment year base case”) will not be available until December 2011:
  - Updated ozone attainment target *(Where do we need to be?)*
  - Updated base year modeling results considering impact of MOVES, other significant inventory adjustments (if relevant), and other improvements *(Where do we think we are?)*
  - Menu of potential ozone reduction strategies for the 2013 SIP *(How might we meet our goals?):
    - Measures under consideration that EPA would likely accept for affecting the emissions baseline
    - Measures under consideration that EPA would likely accept as SIP measures
• Measures under consideration that EPA would not likely accept
  Anticipated information needed to refine ozone projections and targets

Meeting 10: November 4, 2011 – Ozone SIP Measure Initial Selection

Meeting 11: December 9, 2011 – 2011 Accomplishments and Discussion of Strategic Next Steps and Timeline

*Purpose:* BOTH the November and December meetings would involve a highly interactive and facilitated effort by RAQC board members to select categories (stationary/area source, motor vehicle and motor fuels source, alternative transportation, transportation pricing, land use source) of air quality control measures for the following uses:

• Inclusion in 2013 ozone SIP as a SIP attainment measure
• Inclusion in 2013 ozone SIP as baseline reduction measure
• Discussion in 2013 ozone SIP as a potential ozone standard maintenance measure
• Exclusion from any ozone SIP consideration, why and how they might be used to assist overall air quality planning efforts in the nonattainment area (e.g. as a best management practice for land use authorities etc.)

The selection of measures for these categories would take into consideration the selection criteria developed in 2010, as well as which measures offer the greatest ozone air quality benefit for the overall cost. This effort would also inform the RAQC about which measures still need further evaluation to be finally considered as a SIP measure.
Attachment G – Stationary and Area Sources

Regional Air Quality Council

Progress Report to the Governor

List of Stationary Point and Area Source Emission Control Strategies

Draft December 22, 2010

Strategies Contained in Current Approved SIP (Ozone or Regional Haze) or via State Regulation

- Require Best Available Retrofit Technology (BART) on certain large stationary sources (power plants, e.g., Valmont 5, Cherokee 4, Trigen 4& 5, Pawnee, CEMEX): Regulation 3
- Require emission controls on sources of NOx and VOCs: Regulation 7, including:
  - Emission controls on new and existing oil and gas condensate tanks (90% system-wide VOC control for tanks ≥ 2 tpy for the 2011 ozone season) and dehydrators in the nonattainment area
  - Emission controls on new and existing industrial and commercial facility Reciprocating Internal Combustion Engines in nonattainment area
  - Emission controls on new and existing oil and gas pneumatic actuated valve devices in the nonattainment area (78%) – state-only
  - Statewide emission controls on new and existing oil and gas condensate tank (75%) and dehydrators (33%) outside of the NAA
  - Statewide emission controls on new and existing industrial and commercial facility Reciprocating Internal Combustion Engines
- Statewide emission controls on prescribed fire activities (AQR No, 9)

Strategies Previously Considered by RAQC or CDPHE and Not Used in Current Ozone SIP

- Promulgate California-type (more stringent) paints/architectural coatings/solvents/industrial and consumer products rule
- Reduce emissions from two stroke engines
- Require Stage II Vapor Recovery at gasoline stations
- Revise AQCC Regulation 7 (Control of Ozone Precursors) to address VOC emissions from additional stationary sources, such as:
  - refineries
  - bottling facilities

RAQC may need to revisit these strategies to determine the extent to which they were considered at an earlier date and decide whether they should be reconsidered.

Page 1
- container manufacturing.
- Insulation manufacturing

- Control emissions when completing oil and gas wells (green completions)
- Increase system-wide condensate controls (e.g., to 95% for all tanks)
- Require leak detection and repair at oil and gas well sites
- Require NOx controls on oil and gas drill rigs
- Control NOx and/or VOC emissions from other oil and gas sources
- Control emissions on large NOx sources (power plants, boilers, cement kilns) in NAA or statewide (currently under evaluation/study)
- Encourage early implementation of federal Maximum Achievable Control Technology (MACT) standards if reduce NOx and VOC emissions
- Require minor source Best Available Control Technology (BACT) for new and modified area and stationary point sources of NOx and VOCs
- Adopt Control Technique Guidelines (CTGs) for smaller VOC sources
- Establish tree planting guidelines and programs to reduce VOCs-
- Control emissions from back-up power generators

**Additional Ozone Control Strategies Not Previously Considered by RAQC/CDPHE and Employed Elsewhere in SIPs in the United States  (list subject to further development)**

- Lower NOx limits for boilers and steam generators for industrial applications
- Revised NOx limits for large water heaters and small boilers
- CARB limits on Consumer Products
- CARB limits on Adhesives, Sealants, Adhesive Primers
- CARB architectural coatings and automobile refinishing coating rules
- Zero Emissions Lawn and Garden (commercial) incentives for replacement of spark ignition gas mowers equipment
- Zero Emissions Lawn and Garden (residential) incentives for replacement of spark ignition hand held equipment
- Indirect Source Rule: Construction Mitigation to reduce off-road construction emissions from new development for large projects
- Operational Indirect Source Rule: reduce emissions associated with new development of large commercial and residential projects after project completion
- Texas Emission Reduction Program (TERP) –incentive to repower/replace/retrofit large off-road equipment

**Federal Standards**

- Control Technique Guidelines
  - Industrial Adhesives and Sealants\(^1\) (2008)
  - Solvent Cleaning Operations\(^1\) (2006)
  - Oil and Natural Gas Sector – combined NSPS, NESHAP, CTG\(^3\) (TBD)
• Maximum Available Control Technology (MACT) /Generally Available Control (GACT) Technology Standards
  o Paint Stripping/Surface Coating GACT\textsuperscript{1} (2007)
  o Metal Fabrication GACT\textsuperscript{2} (2007)
  o Chemical Manufacturing GACT\textsuperscript{1} (2009)
  o Paints and Allied Products Manufacturing\textsuperscript{2} (2009)
  o Bulk Terminals and Gasoline Dispensing Facilities GACT\textsuperscript{1} (2008)
  o Portland cement manufacturing MACT\textsuperscript{2} (promulgated 2010)
  o Electric Generating Unit MACT\textsuperscript{3} (2011)
  o Petroleum Refineries\textsuperscript{1} (2009)
  o Boiler/Process Heater MACT\textsuperscript{3} (promulgated 2012)
  o Boiler GACT\textsuperscript{3} (promulgated 2012)
  o Reciprocating Internal Combustion Engines or RICE MACT\textsuperscript{1} (2010)
  o Glass Manufacturing\textsuperscript{3} (2007)
  o Malfunction Amendments\textsuperscript{3} (TBD)
  o Oil and Natural Gas Sector – combined NSPS, NESHAP, CTG\textsuperscript{3} (TBD)
• Mobile Equipment Repair and Refinishing\textsuperscript{3} (2008)
• Emission Guidelines
  o Other Solid Waste Incinerators\textsuperscript{1} (promulgated 2008)
  o Hospital/Medical Infectious Waste Incinerators\textsuperscript{1} (promulgated 2009)
  o Commercial and Solid Waste Incinerators\textsuperscript{3} (revision promulgated 2012)
  o Sewage Sludge Incineration\textsuperscript{3} (2012)
• Area Source Rules
  o Emission controls in the nonattainment area on new paints/architectural coatings/solvents/industrial and consumer products (30% emissions reduction credit allowed)\textsuperscript{1}
  o Consumer Products\textsuperscript{3}
  o Industrial Adhesives/Sealants/Primers/Solvents\textsuperscript{3}
• Clean Air Transport Rule or CATR (Clean Air Interstate Rule or CAIR replacement)\textsuperscript{3} (eastern half of U.S.; 2012)
• CATR Phase II\textsuperscript{3} (potential nationwide application; promulgated 2013)
• Marine Diesel Engines\textsuperscript{3} (2010)
• Mobile Source Air Toxics fuel rule – requires non-spill and impermeable portable gas containers
• New Engine/Tailpipe Standards for Off-highway Vehicles\textsuperscript{3}
• New Source Performance Standards
  o Off-road and small engine standards – Tiers 2, 3 & 4\textsuperscript{3}
  o Locomotive Engines – Tier 4\textsuperscript{3} (2011)
  o Portland cement manufacturing\textsuperscript{1} (revision promulgated 2010)
  o Other Solid Waste Incinerators\textsuperscript{1} (promulgated 2008)
  o Hospital/Medical Infectious Waste Incinerators\textsuperscript{1} (promulgated 2010)
  o Commercial and Solid Waste Incinerators\textsuperscript{3} (revision promulgated 2012)
- Sewage Sludge Incineration\(^3\) (2012)
- Large Industrial/Commercial/Institutional Boilers\(^3\) (promulgated 2011)
- Residential Wood Heating\(^3\) (2011)
- Residential Coal Heating\(^3\) (2012)
- Compression Ignition and Spark Ignition Internal Combustion Engines\(^3\) (TBD)
- Oil and Natural Gas Sector – combined NSPS, NESHAP, CTG\(^3\) (TBD)

- Regional Haze
  - BART\(^1,3\) (2010-2013)
  - Reasonable Progress\(^3\) (2010-2013)

- 1996 PM2.5 NAAQS Implementation\(^1\) (2010)
- 2011 PM2.5 NAAQS\(^3\) (TBD)
- Revisions to General Conformity Regulations (2010)

\(^1\) Federal rule is promulgated and the compliance date has passed.

\(^2\) Federal rule is promulgated and the compliance date is pending.

\(^3\) Federal rulemaking anticipated by EPA.