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

Alternative Transportation and Land Use Subcommittee
December 17, 2010

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Preliminary Draft for Discussion Only

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Table 1 - Overview of Strategies Considered

Measure	Description of Measure	Experience in Colorado/Other Areas	Existing Authority or Needed Approvals	Implementation/SIP Measure Feasibility	Additional Analysis Needed
Full Build Out of FasTracks	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[1] 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.[2]	FasTracks is currently underway in the region.	Authority already exists	– Included in baseline modeling	Evaluate air quality impact of FasTracks Monitor funding levels and project changes
Evaluate RTD fare structure	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.	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.	Authority already exists	– Included in baseline modeling	Evaluate travel demand impacts of RTD serve level changes Analysis of air quality impacts

[1] RTD, 2010. *2010 Annual Program Evaluation (APE). http://www.rtd-fastracks.com/main_190*
[2] RTD. 2010. "Projects" http://www.rtd-fastracks.com/main_30

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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.	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
RTD Station Area Planning	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.	Station planning is being done through RTD and coordinated with local government and DRCOG.	Authority already exists	– Included in baseline modeling	Promote best practice information an potential air quality benefits No further analysis at this time
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).	Currently being done through RTD with enhancements scheduled in 2013 and thereafter	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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Measure	Description of Measure	Experience in Colorado/Other Areas	Existing Authority or Needed Approvals	Implementation/SIP Measure Feasibility	Additional Analysis Needed
Bike/pedestrian facilities	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.	Bike, pedestrian and bike sharing facilities are currently available.	Authority already exists	– Included in baseline modeling	Additional analysis on facilities and impact on mode choice
Car-sharing programs	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.	There are two car-sharing programs in the Denver metro and numerous examples throughout the US.	Authority already exists	– Included in baseline modeling	Additional analysis on the impact of car sharing in the region Pursue modeling of car sharing as appropriate
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). 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 are currently available and legal throughout Colorado and in numerous states.	Authority already exists	– Included in baseline modeling	Additional analysis of NEV mode share impact on emissions

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Measure	Description of Measure	Experience in Colorado/Other Areas	Existing Authority or Needed Approvals	Implementation/SIP Measure Feasibility	Additional Analysis Needed
Parking supply management	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.	Parking supply management is currently handled at the local level and through market forces. Strategic management is common in high-density urban centers.	Authority already exists for voluntary program.	– Included in baseline modeling – Could be included as TCM in SIP	Quantify emission benefits of parking supply Further analysis of co-benefits
Changes to State Land Board mission/policies	Changes to State Land Board mission/policies/decisions to reduce contribution to sprawl, VMT increases and associated emissions.	Additional analysis is needed to verify whether SLB policy changes have been used for air quality purposes.	While it is uncertain, most likely through the SLB or through the legislature. Additional analysis is needed.	– Included in baseline modeling	Analysis of SLB decisions and subsequent effects on built environment Analysis of legal barriers
Employer travel-reduction programs	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.	Colorado has explored the use of ETRs, but never implemented a mandatory program. California and Washington have experience with mandatory programs.	Mandatory program would need to be legislated	– Could be included as TCM/VMEP in SIP	Pursue as voluntary measure, interwoven with TDM strategy No further analysis as mandatory measure

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Measure	Description of Measure	Experience in Colorado/Other Areas	Existing Authority or Needed Approvals	Implementation/SIP Measure Feasibility	Additional Analysis Needed
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 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.	Numerous programs in Colorado and throughout the nation try to accomplish this	Voluntary program needs no additional authority/approval	– Unlikely	Continue to promote marketing and outreach that link personal behavior and societal/ environmental costs No further analysis as a stand-alone measure

Measure type: Alternative Transportation and Land Use

Measure name and 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[3] 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.[4]

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 needed to refine benefits/costs estimates:

- Data on air quality benefits (i.e. ridership #s, 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.

[3] RTD, 2010. *2010 Annual Program Evaluation (APE). http://www.rtd-fastracks.com/main_190*

[4] RTD. 2010. "Projects" http://www.rtd-fastracks.com/main_30

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.

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Measure type: Alternative Transportation and Land Use

Measure name and description: Evaluate RTD fare structure to increase demand

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.[5]

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 reuiqred. 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.[6] 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 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.

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

[5] C.R.S. § 32-9-119.7

[6] Federal Transit Administration, 2003. **TCRP Report 95: Pricing and Fares**

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. [7]
- 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.

[7] City of Madison. 2010. "Clean Air Action Day: Free Rides on Metro" Press Release. http://www.cityofmadison.com/news/view.cfm?news_id=495

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Measure type: Alternative Transportation and Land Use

Measure name and description: 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. 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 elasticiticies 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.[8]

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 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.

[8] Federal Transit Administration, 2003. **TCRP Report 95: Transit Scheduling and Frequency, Traveler Response to Transportation System Changes.**

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).

Measure type: Alternative Transportation and Land Use

Measure name and description: Strategically manage park and ride facilities to increase demand for transit

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 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)[9]

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.

[9] Federal Transit Administration, 2003. **TCRP Report 95: Land Use and Site Design, Traveler Response to Transportation System Changes.**

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.[10][11]

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, lessoned 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 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.[12]

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[10] EPA, 2001. **Improving Air Quality through Land Use Activities.** http://www.epa.gov/oms/stateresources/policy/transp/landuse/r01001.pdf

[11] 65 FR 37286 http://www.gpo.gov/fdsys/pkg/FR-2000-06-14/pdf/00-14993.pdf

[12] 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.

Measure type: Alternative Transportation and Land Use

Measure name and description: RTD station area planning

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.[13]

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 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.

[13] Federal Transit Administration, 2003. **TCRP Report 95: Land Use and Site Design, Traveler Response to Transportation System Changes.**

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.[14]
- 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.

[14] Iseki, Hiroyuki, and Brian D. Taylor, 2010. "Style versus Service: An Analysis of User Perceptions of Transit Stops and Stations. http://www.nctr.usf.edu/jpt/pdf/JPT13-3Iseki.pdf

Measure type: Alternative Transportation and Land Use

Measure name and description: Real-Time Traveler Information (RTTI)

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.[15]

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).[16]

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
  - Real-time transit information

[15] NCHRP. 2009. **NCHRP Synthesis 399: Real Time Traveler Information Systems.** http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_399.pdf

[16] Federal Transit Administration, 2003. **TCRP Report 95: Land Use and Site Design, Traveler Response to Transportation System Changes.**

        - GPS/RFID units
        - Software to translate vehicle location data
- Educational and outreach materials
- Consumer purchase of technology to receive information (ex: smart phones)

Additional technical analysis 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.

Measure type: Alternative Transportation and Land Use

Measure name and description: Bike/pedestrian facilities (including bike sharing)

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.[17] 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.[18]

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.[19]
  - 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.[20]

[17] DRCOG, 2000. "Travel in the Denver Region" http://www.drcog.org/documents/DRCOG%20TDR%20Report.pdf
[18] B-Cycle, 2010. "Denver B-Cycle Finishes Successful First Season with 102,00 B-Cycle Rides". http://denver.bcycle.com/News.aspx?itemid=63
[19] FHWA. 2001.*Designing Sidewalks and trails for Access.*http://www.fhwa.dot.gov/environment/sidewalk2/pdf.htm
[20] DRCOG. *Guidelines for Successful Pedestrian and Bicycle Facilities in the Denver Region.* Ihttp://www.drcog.org/documents/2010%20Ped%20Bike%20Guidelines%20booklet.pdf

- Bike lane/shared lane (only striping): $1.30/SF (White edge striping 4" wide (Thermoplastic))[21], striping 1 mile of bike lane/sharred lane would cost $6,864 (does not including labor or paving costs).

- Cost of bike share program
  - Cost of bikes, stations, and kiosks
  - Cost of operations/maintenance/transport of bicycles
  - Cost of promotions, marketing, membership services
  - 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 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.

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

[21] City of Arvada. 2010. Average infrastructure costs.

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.

Measure type: Alternative Transportation and Land Use

Measure name and description: Car-sharing programs

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.[22] A review of US car-sharing programs estimates an average VMT reduction of 40% per car-share participant.[23] [24] 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.[25]

[22] Rodier, Caroline, and Susan Shaheen, 2003. Carsharing and Carfree Housing: Predicted Travel, Emission, and Economic Benefits.
[23] Shaheen, Susan et al, 2008. "North American Carsharing: A Ten-Year Retrospective" 2009 Transportation Research Board.
[24] Transportation Research Board, 2005. TCRP 108: Car-sharing: Where and How it Succeeds.
[25] eGo CarShare, 2010. Email Correspondance: "Car Sharing Data" dated 12/9/2010

Additional technical analysis 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.

Measure type: Alternative Transportation and Land Use

Measure name and description: Neighborhood Electric Vehicles (NEV)

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.[26]
- 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.[27] [28] 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 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.[29]

[26] GemCar, 2010. "Price Your Own" http://www.gemcar.com/build/
[27] GemCar, 2010. "Affordability" http://www.gemcar.com/affordability/default.asp?ID=356
[28] Xcel Energy, 2010. "Colorado Residential Electric and Gas Rate Schedule Summaries" http://www.xcelenergy.com/SiteCollectionDocuments/docs/COResRates.pdf

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.[30] 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.[31] NEVs must comply with applicable federal manufacturing equipment standards. [32]

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.
- The use of NEVs can help create a 1st/last mile connection to transit and promote alternative transportation use.[33]

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

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[29] Insurance Institute for Highway Safety, 2002. "Status Report" Vol, 37, No. 4. http://www.iihs.org/externaldata/srdata/docs/sr3704.pdf

[30] C.R.S. § 42-4-109.6
[31] C.R.S. § 42-4-109.5
[32] C.R.S. § 42-4-240
[33] South Coast Air Quality Management District, 2010. "Electric Vehicle Workshop Coming to Carson" http://www.aqmd.gov/news1/2010/EV101pr.htm

- 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.[34]
- The Cities of Lincoln and Rocklin, CA have created NEV Transportation Plans.[35] [36]
- 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.[37]

[34] Southern California Association of Governments, 2009. "Maximizing Mobility in Los Angeles – First & Last Mile Strategies" http://www.scag.ca.gov/nonmotorized/pdfs/LA-Maximizing-Mobility-Final-Vol2-Appendix1.pdf
[35] City of Lincoln, 2006. NEV Transportation Plan. http://www.ci.lincoln.ca.us/pagedownloads/Final%20NEV%20Transportation%20Plan.pdf
[36] Shafizadeh, Kevan and Kimberly Fox, 2009. "The Implmentation of Neighborhood Electric Vechiles: An evaluation of Safety and Impacts on Local Traffic in Lincoln, CA" 88th Annual Meeting of the Transportation Research Board.
[37] South Coast Air Quality Management District, 2010. "Electric Vehicle Workshop Coming to Carson" http://www.aqmd.gov/news1/2010/EV101pr.htm

Measure type: Alternative Transportation and Land Use

Measure name and description: Management of parking supply

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).[38] 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,[39] 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[40] [41]
- Cost of operations and maintenance of parking facility
  - National average is $494/space/year[42]
- Intangible costs of parking
  - Aesthetic, heat generation, water quality implications, property devaluation

[38] Denver, Colorado, Municipal Code. Article 8-45. http://www.denvergov.com/Portals/646/documents/DZC/8_Downtown_DZC_91710.pdf
[39] Carl Walker. "Industry Insights" http://www.carlwalker.com/sites/default/files/enews/2009_Q1.pdf
[40] McCallum, Aylene, 2010. Email Correspondence: "Average Construction Cost of Parking in Downtown Denver" dated 12/10/2010.
[41] Victoria Transportation Policy Institute. "Transportation Cost and Benefit Analysis II – Parking Costs" http://www.vtpi.org/tca/tca0504.pdf

Additional technical analysis 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.[43] 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.[44]

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

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[43] EPA, 2001. **Improving Air Quality through Land Use Activities.** http://www.epa.gov/oms/stateresources/policy/transp/landuse/r01001.pdf

[44] 94 FR 24371 http://www.federalregister.gov/articles/1994/10/03/94-24371/approval-and-promulgation-of-air-quality-implementation-plans-massachusetts-amendment-to

- 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.[45]

[45] 65 FR 37286 http://www.gpo.gov/fdsys/pkg/FR-2000-06-14/pdf/00-14993.pdf

Measure type: Alternative Transportation and Land Use

Measure name and description: Changes to State Land Board mission/policies/decisions to reduce contribution to sprawl, VMT increases and associated emissions.

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.[46]

Table 1 - State Land Board Acreage in Non-Attainment Area

	State Land Board Total Acres[47]	Acres in Non-attainment	% of Total Land in Non-attainment Area
Surface Ownership	2,825,404	162,499	3 %
Mineral Estate	11,969,179	960,804	18 %
Stewardship Trust	271,658	4,772	0.08 %

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

[46] RAQC, 2010. GIS Data Analysis. Layers: State Land Board and US EPA

[47] GIS Technician used ArcGIS calculated acreage

Preliminary sense of anticipated costs and economic impacts

- Unknown at this time.

Additional technical analysis 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?):

TBD

Measure type: Transportation and Land Use

Measure name and description: Employer Trip Reduction (ETR) programs

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 .43 tons per day (TPD) of NOx and .28 TPD for VOCs.[48] 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.[49]

Preliminary sense of anticipated costs and economic impacts

[48] North Central Texas State Implementation Plan Voluntary Mobile Emission Reduction Program. 2006.

[49] *Commute Trip Reduction(CTR) Task Force 2005 Report to Washington State Legislature.*

Program costs vary based on design. Program costs per employee range from $24 - $250/ employee.[50] The median cost per ton of pollution reduced is $56,900. By comparison, inspection and maintenance programs' median cost per ton is $4,500.[51]

Additional technical analysis 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.

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.

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[50] UrbanTrans Presentation to RAQC Ozone Transportation Stakeholder Group, December 2007.

[51] Transit Cooperative Research Program in conjunction with the Transportation Resource Board and the Federal Highway Administration, . "Employer and Institutional TDM Strategies"

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.[52]
- 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.[53]
- 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.[54]
- 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.

[52] Transit Cooperative Research Program in conjunction with the Transportation Resource Board and the Federal Highway Administration, "Employer and Institutional TDM Strategies."

[53] 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.

[54] 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.

Preliminary High-Level Evaluation Tool
for Supporting Initial Prioritization of Ozone Reduction Measures
Draft: Not for Distribution
December 17, 2010

Measure type: Transportation and Land Use

Measure name and description: 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, 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 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 .[55]
- 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.

[55] Kennedy, Amanda L. "Using Community-Based Social Marketing Techniques to Enhance Environmental Regulation." *Sustainability.* April 2010.