The New Hampshire Climate Change Policy Task Force

New Hampshire Climate Action Plan

A Plan for New Hampshire's Energy, Environmental and Economic Development Future

Appendix 4.4: Reduce Vehicle Emissions through State Actions

Prepared by the
NH Department of Environmental Services
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Recommended Actions

Actions recommended by the Task Force:

TLU Action 1.A.3 – Adopt California Low-Emission Vehicle (CALEV) Standards

Summary

New Hampshire should adopt the California Low-Emission Vehicle (CALEV) standards, including the tailpipe greenhouse gas emissions (GHG) standards. Under the Clean Air Act Section 209, states may not develop their own vehicle emission standards. The exception to that rule is the State of California, which may set its own standards provided they are at least as stringent as federal standards. California standards are typically more stringent than federal standards. The remaining 49 states have the option of either following federal emission standards or adopting the CALEV standards. The CALEV requirements include a tailpipe GHG standard that does not exist for federal emission standards. CALEV also includes a zero-emission-vehicle (ZEV) requirement (electric vehicles). States that adopt CALEV standards may choose to include the GHG and ZEV requirements or not. CALEV states allow only the sale of vehicles certified to CALEV standards.

Program Description

1. Mechanism (*i.e., how the policy or program achieves the desired result*):

   Adopting CALEV with the GHG standards would lower New Hampshire's greenhouse gas emissions by reducing emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (air conditioner refrigerants) from motor vehicles. States that adopt CALEV are responsible for enforcing the program provisions themselves, unlike states that operate under federal standards, where the standards are enforced by EPA. Therefore New Hampshire would be responsible for enforcing this program.

   California has adopted greenhouse (GHG) standards as part of its CALEV program but has not yet been granted the necessary waiver by the Environmental Protection Agency. The waiver denial has triggered litigation that is expected to be resolved in favor of California or approved under a new federal administration after January 2009.

2. Implementation Plan (*i.e., how to implement the specific policy or program*):
   a. *Method of Establishment (e.g., legislation, executive order):* Legislation
   b. *Resources Required:* DES staff, funds for economic and air quality analysis to support legislative action.
   c. *Barriers to Address (especially for medium to low feasibility actions):* Legislative opposition to California standards

3. Parties Affected by Implementation (*i.e., residents, businesses, municipalities, etc.*):
   a. *Parties Responsible for Implementation:* State government.
   b. *Parties Paying for Implementation:* It is estimated implementing CALEV in NH would require ½ Full Time Employee both for program passage, rule making, adoption, and on-going support. States have used a variety of funding options, including a fee paid by auto manufacturers, use of state funds (taxpayer), a vehicle registration fee, and others.
   c. *Parties Benefiting from Implementation:* The general public. Cleaner, more fuel-efficient vehicles will yield better air quality. The fuel savings of the vehicles meeting the lowest emissions standards are predicted to offset any higher vehicle cost in existing programs.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*):
   - Governor's Executive Order for use of more efficient state fleet vehicles.
   - TLU Action 1.A.1 – Support Stricter Corporate Average Fuel Economy Standards

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):

    a. *Existing:*

    b. *Proposed:* TLU Action 1.B.1 – Create a Point-of-Sale Financial Incentive for Higher-Efficiency Vehicles
    TLU Action 2.A.6 – Apply a Surcharge to High-Carbon Fuels

6. Timeframe for Implementation: Approximately 3 years to get through legislature and 1 to 2 years to develop and implement a state program.

7. Anticipated Timeframe of Outcome: 3 to 5 years for program implementation, then an additional 8 to 10 years for fleet saturation and significant CO_2 reductions.

Program Evaluation

1. Estimated CO_2 Emission Reductions:

    a. Short-term (2012): 0.16 $MMTCO_2e$/year
    b. Medium-term (2025): 1.78 $MMTCO_2e$/year
    c. Long-term (2050): 2.62 $MMTCO_2e$/year

2. Economic Effects:

    a. Costs:

        i. Implementation Cost: Moderate ($25 million to $125 million)
        ii. Timing: Constant / even
        iii. Impacts: Consumer / Auto Manufacturers

    b. Savings:

        i. Potential Economic Benefit: Moderately high ($125 million to $500 million)
        ii. Timing: Low short-term / mostly long-term
        iii. Impacts:

3. Other Benefits/Impacts:

    a. *Environmental*: This would reduce emissions of carbon dioxide, greenhouse gases, and other primary air pollutants in order to mitigate the effects of climate change and pollution of our ecosystems. This would lead to improved air and water quality directly as well as have more indirect effects on the fish and wildlife and the ecosystems upon which they depend.

    b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease.

    c. Social: Increased energy efficiency typically has short-term payback periods and can then provide savings for consumers and economic security for the State in the mid to long-term. By producing energy sustainably and domestically, the economy will benefit through increased jobs within the state.

    d. *Other*: Vehicles certified to CALEV "partial" and "advance technology partial zero emission vehicles" (PZEV and ATPZEV) standards that are sold in states that have adopted CALEV carry a 15-year/ 150,000-mile warranty. Those same vehicles sold in non-CALEV states carry only the standard warranty (typically 3 years/36,000 miles).

    The New Hampshire Automobile Dealers Association has noted there may be negative impacts on customer choice (not as many vehicles available) and increased vehicle costs to the consumers.

All New England states with the exception of New Hampshire have adopted CALEV.

4. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*):
    a. *Technical*: No significant technical barriers
    b. *Economic*: Because this program must be enforced by the state, not by the federal government, there will be some cost to the state to implement and enforce the program.
    c. *Statutory/Regulatory*: This program will require legislative action. In the past there has been opposition in the NH Legislature to adopt any California standards.
    d. *Social*: It is anticipated there will be high public acceptance of this program that will bring cleaner, more efficient vehicles with longer warranties to NH dealerships.

5. Other Factors of Note: Since all surrounding states have adopted the CALEV standard a large percentage of vehicles sold in NH already meet that standard as dealerships want the ability to trade vehicles with their cross-border dealerships. The GHG portion of the CALEV standard is currently under litigation and the final outcome is not clear, however, early court decisions have upheld the standard.

6. Level of Group Interest: High. The working group considered this an essential action to undertake in the early mid-term (2012) to achieve significant reductions in CO_2 emissions from the transportation and land use sector.

7. References:
    - http://www.mwcog.org/uploads/committee-documents/t1hZWFs20061211131143.pdf
    - http://www.nescaum.org/topics/mobile-source-controls-and-programs
    - http://www.nescaum.org/documents/reducing-ldv-ghg-nescaum-cooper-dec2006.pdf/
    - http://www.dep.state.fl.us/air/rules/ghg/california/62-285_slides_031808.ppt#1

TLU Action 1.B.1 – Create a Point-of-Sale Financial Incentive for Higher-Efficiency Vehicles

Summary

New Hampshire could create a new vehicle point-of-sale "feebate," which would provide financial incentives to purchase vehicles that are high in fuel-efficiency and low in greenhouse gases (GHG) emissions, accompanied by financial disincentives to purchase low-efficiency, high-GHG-emitting vehicles. A buyer of a new vehicle would be rewarded with a rebate for a high-efficiency vehicle but would have to pay a fee or surcharge for a low-efficiency vehicle (hence the name "feebate"). The program could be made virtually revenue-neutral by using the surcharges paid on low-efficiency vehicles to cover the rebates on high-efficiency vehicles. The Task Force recommended the implementation of a higher "feebate" to encourage greater fuel economy.

Program Description

1. Mechanism (*i.e., how the policy or program achieves the desired result*):

   A point-of-sale feebate on sales of new vehicles encourages the selection of fuel-efficient vehicles during new car purchases by creating financial incentives for their purchase. This action would increase the overall efficiency of the on-road vehicle fleet and bring about reductions in motor vehicle GHG emissions. The feebate would add to existing market signals (e.g., high fuel prices) by prompting consumers to purchase more fuel-efficient cars. An effective feebate would be about 5 percent of the vehicle price – sufficient to elicit the desired level of response from consumers and manufacturers[1]. Unlike the price of fuel, the degree of incentive provided by feebates is controllable entirely through policy and is immune to market fluctuations.

   Two main implementation alternatives are apparent: 1) apply the rebate or surcharge at the point of sale (i.e., at the automobile retailer), or 2) apply the rebate or surcharge at initial vehicle registration. The former alternative would have the advantage of immediacy, i.e., the buyer would be aware of the charge prior to making a purchase decision and could weigh the benefit/cost of the feebate when comparing sticker prices in the dealer's showroom. The latter alternative would reduce the incidence of buyers purchasing vehicles in other states to avoid surcharges on high-GHG-emitting vehicles.

2. Implementation Plan (*i.e., how to implement the specific policy or program*):

   a. *Method of Establishment (e.g., legislation, executive order):* Implementing the feebate would require legislative action through an amendment to RSA 261 (Registration of Vehicles) and a change in Department of Safety Rules (Chapter Saf-C 500 Vehicle Registration Rules), which establishes motor vehicle registration rates, rules, and procedures.

   b. *Resources Required*: Little new revenues would be required; however, an incremental administrative burden would be placed on DMV and /or town clerks to collect the surcharge and disburse the rebate. Additional forms and changes to accounting systems would also be required. A GHG rating system and corresponding feebate schedule would need to be developed and maintained. Administrative costs of the program could be built into the structure of the surcharge. Resources to effectuate the necessary legislative and administrative rule changes would also be required.

   c. *Barriers to Address (especially for medium to low feasibility actions):* There may be consumer resistance from those who either need higher GHG emitting vehicles (contractors, those with large families, etc.) or have a strong preference for them. The feebate program has been successfully attacked in other states as "anti-SUV" or as amounting to an SUV tax. There may be resistance from town clerks if the burden for administering the feebate program is placed on them without additional resources.

[1] Bandivadekar, Anup P. (2008) Evaluating the Impact of Advanced Vehicles and Fuel Techniques in US Light Duty Vehicle Fleet. Massachusetts Institute of Technology, (http://web.mit.edu/mitei/research/spotlights/bandivadekar_thesis_final.pdf) 182 pp.

3. Parties Affected by Implementation (*i.e., residents, businesses, municipalities, etc.*):

    a. *Parties Responsible for Implementation*: Town clerks and the Department of Safety – Division of Motor Vehicles, if the feebate is charged at the point of first registration; or Motor Vehicles alone, if the feebate is handled at the point of sale. The Department of Environmental Services would most likely be responsible for developing and maintaining the vehicle GHG rating and feebate schedule.

    b. *Parties Paying for Implementation*: Purchasers of high-GHG-emitting vehicles; Department of Safety, Department of Environmental Services, and municipalities or automotive dealers.

    c. *Parties Benefiting from Implementation*: Purchasers of low-GHG-emitting vehicles, as well as the general public, who would benefit from reduced emissions.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*):

    a. *Existing*:

        - Federal income tax credit for hybrid vehicles, which expires on December 31, 2010.
        - "Granite State Clean Cars" labeling program

    b. *Proposed*:

        - TLU Action 1.B.2 – Implement a Carbon-Based Vehicle Registration Fee Structure. This action is very similar to the feebate program but involves a fee applied to annual vehicle registration instead of, or in addition to, a point-of-sale feebate.
        - TLU Action 2.A.5 – Increase the State Gasoline Tax

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):

    a. *Existing*:

    b. *Proposed*:

        TLU Action 1.A.1 – Support Stricter Corporate Average Fuel Economy Standards
        TLU Action 1.A.3 – Adopt California Low-Emission Vehicle (CALEV) Standards
        TLU Action 1.D.1 – Increase Highway Automobile Efficiency
        TLU Action 1.D.2 – Address Vehicle Idling

6. Timeframe for Implementation: Legislative action would require one year to complete; following that, 6 to 12 months would be needed to implement the program administratively.

7. Anticipated Timeframe of Outcome: It is anticipated that the feebate would have an immediate impact on vehicle choice. However, assuming an average passenger car fleet turnover of 12.5 percent per year, the outcome would be felt only gradually over an 8-year period.

Program Evaluation

1. Estimated CO_2 Emission Reductions:

Action to Implement	CO_2 Emission Reductions ($MMTCO_2e$)		
	2012	2025	2050
Feebate of $500 per 0.01 gallon/mile (new vehicles 14% more fuel efficient)	0.23	0.73	1.00
Feebate of $1000 per 0.01 gallon/mile (new vehicles 22% more fuel efficient)	0.34	1.07	1.47

1. Economic Effects:
    a. Costs:
        i. Implementation Cost: Low (0-$2.5 million)
        ii. Timing: Constant / even
        iii. Impacts: State government
    b. Savings:
        i. Potential Economic Benefit: High ($500 million to $1 billion)
        ii. Timing: Low short-term/ mostly longterm
        iii. Impacts:

2. Other Benefits/Impacts:
    a. *Environmental*: Many higher-fuel-economy vehicles also lower emissions of ozone precursors and particulate emissions; therefore, in addition to GHG reductions this action would reduce harm to vegetation from ozone, and reduce pollutants contributing to regional haze. If, the fee revenues were used to support expansion of public transit, then VMT and associated GHGs emissions could decrease and these benefits could be increased.
    b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease.
    c. *Social*: If implemented as a revenue-producing program the revenue could help support public transit, thereby providing greater transportation choice and helping to meet the needs of the growing elderly population and individuals who cannot afford a personal vehicle. There are added advantages through reduced dependence on foreign oil as higher fuel economy leads to reduced overall demand. However, by increasing the cost of vehicles, this measure may – depending on the size of the fee – adversely affect individuals who cannot, or choose not to, use public transportation or purchase a fuel efficient vehicle.
    d. *Other*: Keeps significant US dollars in the US economy rather then sending abroad to oil producing countries.

3. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*):
    a. *Technical:* The existing variation in vehicle fuel economy is sufficient to allow the establishment of a registration fee. Advanced vehicle technologies (e.g., batteries, fuel cells) are still under development,

but the carbon-based registration fee could help to drive technological development by increasing demand for high fuel economy/low carbon vehicles and send a clear market signal.

b. *Economic*: *Economic*: This measure will have an economic benefit for those who own fuel efficient vehicles. This measure may also create economic opportunities for the State by generating revenues to expand transit opportunities within New Hampshire and between other states. The program can be designed to support itself, so will not be an economic burden to the state budget.

c. *Statutory/Regulatory*: There may be resistance to adding additional fees to high GHG emitting vehicles and therefore penalizing consumers for their choices. Additionally, feebates must be carefully designed to avoid legal pitfalls, as Maryland's program was deemed to preempt Federal CAFE regulations.

d. *Social*: There would be social resistance to adding another "tax" but broad and increasing public support for addressing climate change and use of the revenues (if any) to expand transportation options could drive acceptance.

4. Other Factors of Note: If combined with other Actions that improve fuel economy, a feebate has the potential to increase the average fuel economy to a greater degree.

5. Level of Group Interest: High. The working group considered this an essential action to undertake in the near-term to achieve significant reductions in CO_2 emissions from the transportation and land use sector.

6. References:

- http://www.nescaum.org/documents/reducing-ldv-ghg-nescaum-cooper-dec2006.pdf/

TLU Action 1.C.3 – Install Retrofits to Address Black Carbon Emissions

Summary

This action would install retrofit technologies on diesel trucks with a model year of 2006 and older, or retire diesel trucks and replace them with new technology and cleaner operating engines to achieve reductions of black carbon particulate matter. Also, retrofit technologies would be installed on diesel non-road equipment, including construction equipment, diesel generators, and the like.

Program Description

1. Mechanism *(i.e., how the policy or program achieves the desired result) :*

   Black carbon is formed through the incomplete combustion of organic fuels and is a major component of particulate matter (PM), or soot, produced by diesel engines. This substance has been identified as having a large and fast-acting warming effect on the atmosphere. Black carbon absorbs light (thus increasing heat) in both airborne particles and in particles deposited on snow pack, where they reduce the snow's reflectivity. Fine PM can travel long distances on air currents and is a major cause of regional haze and air pollution contributing to respiratory ailments. Measures to control black carbon emissions would therefore be beneficial in both mitigating climate change and protecting public health.

   Diesel trucks built in 2007 and later include technology that dramatically reduces PM emissions. For older trucks, there are various retrofit technologies available for exhaust systems to reduce PM emissions from diesel engines. For non-road diesel vehicles and equipment, emissions standards will not be implemented until future years, so all such vehicles and equipment would benefit from PM emission retrofits.

2. Implementation Plan *(i.e., how to implement the specific policy or program):*
   a. *Method of Establishment (e.g., legislation, executive order):* Executive Order to require retrofits for equipment working on state contracts and for all state vehicles (as feasible - retrofits do not exist for all equipment). Create awareness and promote the installation of retrofit technologies or retirement of diesel engines with a model year of 2006 or older.
   b. *Resources Required:* State staff to implement program. Funds to pay for equipment. Ranges from providing messaging and creating awareness to mandating retrofits on certain fleets, government, commercial, etc.
   c. *Barriers to Address (especially for medium to low feasibility actions):* Depending on the type of vehicle, retrofits can range in costs from $1,000 to $10,000 per vehicle.

3. Parties Affected by Implementation (i.e., residents, businesses, municipalities, etc.):
   a. *Parties Responsible for Implementation:* Diesel equipment owners, government.
   b. *Parties Paying for Implementation:* Costs can be included in construction contract costs, covered by available federal grants, or paid by diesel equipment owners.
   c. *Parties Benefiting from Implementation:* General public health as well as operators of diesel equipment who have the greatest exposures.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*):
   - Federal Diesel Emissions Reduction Act, currently providing some limited funds for diesel retrofits and engine rebuilds.

- Ultra Low Sulfur Diesel requirements now in place for on-road fuel and scheduled for non-road fuel in 2010 allows use of most effective technology, particulate filters.

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):
    a. *Existing:*
    b. *Proposed:* GLA Action 4.2.1 – Reduce Diesel Particulate Emissions through Use of Retrofit Devices

6. Timeframe for Implementation: Immediate, as diesel retrofit technologies currently exist.

7. Anticipated Timeframe of Outcome: 2008 through 2025. Beyond 2025, diesel trucks with a model year of 2006 or older will be twenty years or older and will begin to be retired. Some non-road engines will likely continue to benefit from retrofits beyond this time frame.

Program Evaluation

1. Estimated CO_2 Emission Reductions:

Action to Implement	CO_2 Emission Reductions ($MMTCO_2e$)		
	2012	**2025**	**2050**
Employ DOCs (reduce PM emissions by 25%)	0.07	0.40	0.70
Employ FTFs (reduce PM emissions by 50%)	0.14	0.80	1.39
Employ DPFs (reduce PM emissions by 85%, increase diesel fuel use by 3%)	0.23	1.30	2.25

2. Economic Effects:
    a. Costs:
        i. Implementation Cost: Moderate ($25 million to $125 million) to Moderately high ($125 million to $500 million)
        ii. Timing: Immediate / higher initial costs
        iii. Impacts: Businesses
    b. Savings:
        i. Potential Economic Benefit: Low (0-$2.5 million)
        ii. Timing: Constant / even
        iii. Impacts:

3. Other Benefits/Impacts:
    a. *Environmental*: This would reduce emissions of carbon dioxide, greenhouse gases, and other primary air pollutants in order to mitigate the effects of climate change and pollution of our ecosystems. This would lead to improved air and water quality directly as well as have more indirect effects on the fish and wildlife and the ecosystems upon which they depend.
    b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease.

c. *Social*: The reduced health impacts will result in overall benefits to the economy through reduced healthcare costs as well as the avoided cost of lost productivity due to sick days.

d. *Other*

4. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*):

   a. *Technical*: There are minimal technical challenges anticipated as the technology already exists.

   b. *Economic*: There may be resistance at the cost of $1,000 to $10,000 per unit for particulate traps.

   c. *Statutory/Regulatory*:

   d. *Social*:

5. Other Factors of Note: There are three basic types of retrofits:

   Diesel Oxidation Catalysts (DOCs) can be used on virtually any diesel engine and will reduce PM by approximately 25%. DOCs are similar in appearance to mufflers and there is no maintenance involved after installation and devices usually last for six years. They may not be appropriate for engines older than 1990. Total installation costs are in the range of $1,000 - $2,000.

   Flow through Filters (FTFs) work similarly to DOCs but have additional filtering material, e.g. wire mesh to capture more PM. FTFs will reduce PM by approximately 50%. FTFs require a duty cycle to create a minimum exhaust temperature, and not all diesel vehicles are able to meet this criteria. There is no maintenance involved after installation and devices usually last for six years. Installation costs are normally in the range of $3,000 - $4,000.

   Diesel Particulate Filters (DPFs) can be either active or passive. A passive DPF works by simply filtering the exhaust flow. An active DPF relies on additional energy to increase the heat in the exhaust to burn off excess PM. DPFs reduce PM by approximately 85%. A passive DPF requires a duty cycle to create a minimum exhaust temperature and not all diesel vehicles are able to meet this criteria. Active DPFs can be used with virtually any diesel engine. DPF filters must be cleaned with a special machine every 12 to 24 months at a fee of $200 to $400. DPFs will also increase fuel use by 1 to 3% for passive applications and up to 7% for active applications. Installation is normally in the range of $5,000 - $10,000.

6. Level of Group Interest: High. The working group considered this an essential action to undertake in the near-term to achieve significant reductions in CO_2 emissions from the transportation and land use sector.

7. References:

- http://www.epa.gov/OMS/retrofit/
- http://www.epa.gov/ne/eco/diesel/retrofits.html
- http://www.epa.gov/cleandiesel/documents/retrofit-tech-prog-exp.07-2005.pdf
- http://www.epa.gov/otaq/retrofit/documents/f02048.pdf
- http://www.arb.ca.gov/diesel/documents/rrpFinal.pdf
- http://www.arb.ca.gov/diesel/documents/rrpapp3.PDF
- http://www.marama.org/diesel/urbanfleets/documents/Urban_Fleets_%20050512_%20WescottDieselStudy.pdf
- http://www.mass.gov/dep/water/wastewater/diesel.htm

TLU Action 2.A.1 – Implement a Commuter Trip Reduction Initiative

Summary

Establish a state-supported initiative to increase the number of employers implementing commuter trip reduction programs. These programs use a variety of strategies – including parking "cash-out," car/vanpooling, flex time, and telecommuting – to increase the use of commute and work options that contribute less to greenhouse gas emissions than travel by single-occupancy vehicles (SOV). The state initiative would employ a variety of mechanisms, which could include targeted education and outreach, awards and recognition, and business tax incentives. This action could be implemented as part of supporting regional transportation management associations (TLU Action 2.B.2.f).

Program Description

1. Mechanism (*i.e., how the policy or program achieves the desired result*): Provide resources, marketing, and potentially financial (tax) incentives for companies that implement commute trip reduction programs. Possible elements of such a program include:
    a. Parking cash-out: Assigns a monetary value to the employee benefit of free parking and more fairly subsidizes employees' use of alternative commuting modes. Basic idea: it costs businesses money to provide free parking to employees who commute in SOVs. When what is effectively an employee benefit is given a cash value that can be accrued by employees (i.e., cash allowance in lieu of a parking space), employees are motivated to accept the money and explore other commuting options – even if they employ them only 1 or 2 days a week.
    b. Flexible or compressed work schedules: Flexible schedules allow for alternative start/end times to provide better coordination with transit or carpool schedules. Compressed work weeks – e.g., four 10-hour days instead of five 8-hour days – could eliminate one commuting trip per week.
    c. Telecommuting/satellite offices: Allow workers to work from home, or from a satellite office that is closer to home, to reduce travel required.
    d. Incentives: Priority parking for carpools and guaranteed ride home programs for carpool/transit users are just two examples of possible incentives that workplaces can provide to reduce total vehicle miles traveled.

2. Implementation Plan (*i.e., how to implement the specific policy or program*):
    a. *Method of Establishment (e.g., legislation, executive order):* Employer-driven with support from state and local transportation entities (resources, information, marketing)
    b. *Resources Required:* Redistribution of resources by employers. State expenditures on staffing and materials to develop informational resources and market the program. Could also involve tax credits for participating businesses (to encourage greater participation and performance).
    c. *Barriers to Address (especially for medium to low feasibility actions):* Program implementation by employers. Lack of effective alternative travel options (e.g., no/minimal bus service).

3. Parties Affected by Implementation (*i.e., residents, businesses, municipalities, etc.*):
    a. *Parties Responsible for Implementation:* Employers and employees; other commuters
    b. *Parties Paying for Implementation:* Employers (with potential support from state or local entities through tax or zoning incentives).
    c. *Parties Benefiting from Implementation:* All commuters; adopting employees.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*): Existing transit, rideshare, and workplace programs (vary by workplace).

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):
    a. *Existing:*
    b. *Proposed:* Actions that increase the cost of driving alone:
    TLU Action 2.A.2 – Implement Congestion Pricing (*cross-referenced as TLU Action 1.D.5*)
    TLU Action 2.A.3 – Create a VMT-Based Insurance Premium Structure
    TLU Action 2.A.4 – Implement VMT-Based Registration Fees
    TLU Action 2.A.5 – Increase the State Gasoline Tax
    TLU Action 2.A.6 – Apply a Surcharge to High Carbon Fuels
    TLU Action 2.A.7 – Create Initiative to Reduce Availability of Free and Inexpensive Parking

    Actions that increase the availability of public transportation and/or housing in closer proximity to work places (see variety of actions under categories 2B and 2C).

6. Timeframe for Implementation: Could be implemented almost immediately, although it would vary depending on the extent of current employer programs to foster alternative modes. Leading employers could be strong models for implementation by others, particularly with the benefit of public education efforts at the state and local level.

7. Anticipated Timeframe of Outcome: 2009 and beyond.

<u>Program Evaluation</u>

1. Estimated CO_2 Emission Reduction: ANALYSIS UNDERWAY
    a. Short-term (2012): 0.03 $MMTCO_2e$ /year
    b. Medium-term (2025): 0.13 $MMTCO_2e$ /year
    c. Long-term (2050): 0.17 $MMTCO_2e$ /year

2. Economic Effects:
    a. Costs:
        i. Implementation Cost: Moderately low ($2.5 million to $25 million)
        ii. Timing: Constant / even
        iii. Impacted: Business
    b. Savings:
        i. Potential Economic Benefit: Moderate ($25 million to $125 million)
        ii. Timing: Low short-term/ Mostly long-term
        iii. Impacted: Consumer – evenly distributed

3. Other Benefits/Impacts:
    a. *Environmental*: This would reduce emissions of carbon dioxide, greenhouse gases, and other primary air pollutants in order to mitigate the effects of climate change and pollution of our ecosystems. This would lead to improved air and water quality directly as well as have more indirect effects on the fish and wildlife and the ecosystems upon which they depend.
    b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease.
    c. *Social*: Non-SOV transportation creates community and workplace communication opportunities that might not otherwise exist.

d. *Other*: CTR largely relies on redistribution of funds. Employers have an incentive to offer programs because they will either pay (or negotiate) lower leases because of reduced parking demand, or they will spend less money on owned real estate that can only be used for parking (wiser use of real estate because of lower parking requirements). No one "pays" – everyone wins.

4. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*): This action has a high potential for implementation.

    a. *Technical*: The infrastructure is already in place to implement CTR programs. Many key elements already exist. The only challenge exists in promoting and coordinating them. CTR solutions would strongly benefit from increased transit options.

    b. *Economic*: There are no major economic barriers here as implementation takes the form of a redistribution of resources already being spent. It has high appeal from an economic standpoint because employees not currently benefiting from their commute choices have an opportunity to do so.

    c. *Statutory/Regulatory*: Legislation not necessary.

    d. *Social*: An effectively promoted program with the benefit of a number of high-profile early-adopting companies should have a strong positive impact on individuals and workplaces. Employees of companies in NH meeting minimum size threshold. Benefits realized immediately upon voluntarily entering an employer's program. Financial benefits to employers would be realized over a longer term. Those who commute to work using non-SOV modes more fairly receive financial benefits from their choices. Ultimately, widely available cash-out program could reduce parking requirements and parking lot size, which could reduce impervious surfaces in urbanized areas benefited stormwater management efforts and water quality.

5. Other Factors of Note: Direct impact on NH GHG emissions depends on number of employers statewide that would meet the minimum employee threshold and impact would only be on commute trips. Cost to implement would be low with financial benefit accruing to individuals for their actions and to businesses in terms of reduced parking requirement burden. Parking cash-out uses the right market-based instruments to motivate behavior and demonstrate action and leadership by the private sector, public sector, and the individual.

6. Level of Group Interest: High – the working group considered this an essential action to undertake in the near-term to achieve significant reductions in CO_2 emissions from the transportation and land use sector.

7. References:

- http://righg.raabassociates.org/Articles/GHGPlanBody7-19-02FINAL.pdf (p 23)
- http://www.tc.gc.ca/programs/environment/utsp/TDM/prj73e.htm
- Shoup, David. "Evaluating the Effects of Cashing Out Employer-Paid Parking: Eight Case Studies." Paper published earlier as a program evaluation report for the California Air Resources Board. Transport Policy 4, no. 4 (1997): 201-216.
- Shoup, David. "An Opportunity to Reduce Minimum Parking Requirements." Journal of the American Planning Association 61, no. 1 (1995): 14-28. Cited in Shoup (1997)
- http://www.climateactionprogramme.org/features/article/transportation_and_greenhouse_gas_mitigation
- www.uctc.net/access/access13.pdf
- www.vtpi.org/wwclimate.pdf

TLU Action 1.D.1 – Increase Highway Automobile Efficiency

Summary

The State of NH should explore ways to maximize efficiency in highway vehicle travel, including mechanisms to reduce average travel speeds on state and interstate highways and to improve driving habits to improve overall vehicle fuel efficiency. This could occur through enforcement of existing speed limits and through driver education programs to increase driver awareness of the potential fuel savings from changes in driving behavior. Evaluation of a lower speed limit should also be conducted.

Program Description

1. Mechanism *(i.e., how the policy or program achieves the desired result):*

   The speed and manner in which a vehicle is driven has a significant impact on how fuel efficient that vehicle is. Because the amount of fuel used is directly related to carbon emissions (about 20 pounds of CO_2 per gallon of fuel used) improvements in fuel economy will reduce carbon emissions.

   U.S. Department of Energy data show that fuel economy decreases rapidly at speeds above 55 mph. The average loss in fuel economy is 9.7 percent when speed is increased from 55 to 65 mph, and an additional 8.2 percent when speed is increased from 65 to 70 mph[2]. Data from the American Trucking Association shows a loss in fuel economy of 27% when truck speed increases from 65 to 75 mph[3]. At a posted speed of 65 mph, many vehicles travel at 65 to 75 mph; and a significant percentage of traffic moves at even higher, less efficient speeds. The publication "Reducing Traffic Speed" by the Technology Transfer Center New Hampshire LTAP at UNH states: "Police Enforcement lowers traffic speeds when police consistently issue tickets. However, cities and towns must commit personnel for a long time. When enforcement ends, drivers will return to the prior speeds." The result of diminished enforcement is that motorists on major highways drive in excess of 65 mph. Stricter speed enforcement would benefit those who already adhere to speed limits as well as those who prefer to exceed speed limits. The benefits would come in the form of fuel savings, emission reductions, and reduced incidence of highway injuries and fatalities.

   Ecodriving USA, an educational effort sponsored by the Alliance of Automobile Manufacturers, has developed materials that could be used by the state to help educate motorists on the impact of their driving habits. Based on their on-line calculator, with the successful implementation of the EcoDriving program in the state, New Hampshire citizens could reduce carbon dioxide emissions by 1 million tons annually[4]. Some of the actions motorists can take to improve fuel economy include avoiding rapid stops and starts (a potential 33% savings), anticipating changes in speed to keep rolling in traffic rather than stopping and starting (a potential 20% savings), and using cruise control when on level terrains (a potential 7% savings).

2. Implementation Plan *(i.e., how to implement the specific policy or program):*
   a. *Method of Establishment (e.g., legislation, executive order):* Executive Order and/or legislation, changes to state's driver education requirements, outreach efforts.
   b. *Resources Required:* Department of Transportation, Law Enforcement, funds for new speed limit signs, funds for outreach and education.
   c. *Barriers to Address (especially for medium to low feasibility actions):* Politics associated with the change, enforcement costs, difficulties in changing personal behavior.
3. Parties Affected by Implementation (i.e., residents, businesses, municipalities, etc.):
   a. *Parties Responsible for Implementation:* State and local government, schools.

[2] http://www1.eere.energy.gov/vehiclesandfuels/facts/favorites/fcvt_fotw222.html
[3] http://drive55.org/content/blogcategory/21/38/
[4] According to www.ecodrivingusa.com accessed on December 15, 2008

b. *Parties Paying for Implementation:* State and local government.

c. *Parties Benefiting from Implementation:* Consumers – safer roads, and better gas mileage.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*):

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):

   a. *Existing*:

   b. *Proposed:* TLU and GLA actions that address changes to vehicle operation such as reduced idling and improved maintenance

6. Timeframe for Implementation: 6 months to 1 year to develop education and outreach materials and develop coordination/cooperation among law enforcement agencies to better enforce current speed limits. Changing speed limit signs could be done in about 2 weeks.

7. Anticipated Timeframe of Outcome: Immediate

Program Evaluation

1. Estimated CO_2 Emission Reduction (from changes to speed limits only):

Timeframe	**CO_2 Emission Reductions** ($MMTCO_2e$ per year**)**	
	Enforce Current Highway Speed Limits[5]	**Lower Posted Highway Speed Limits[6]**
Short-term (2012)	0.06	0.11
Mid-term (2025)	0.18	0.35
Long-term (2050)	0.25	0.48

2. Economic Effects:
   a. Costs:
      i. Implementation Cost: Low (0-$2.5 million) for both scenarios
      ii. Timing: Constant / even for both scenarios
      iii. Impacts: State government for both scenarios

   b. Savings:
      i. Potential Economic Benefit: Moderate ($25 million to $125 million) (Enforce)
         Moderately high ($125 million to $500 million) (Lower)
      ii. Timing: Low short-term / mostly long-term for both scenarios
      iii. Impacts: Consumer – evenly distributed for both scenarios

3. Other Benefits/Impacts:

   a. *Environmental*: This would reduce emissions of carbon dioxide, greenhouse gases, and other primary air pollutants in order to mitigate the effects of climate change and pollution of our ecosystems. This would lead to improved air and water quality directly as well as have more indirect effects on the fish and wildlife and the ecosystems upon which they depend.

[5] Assumes that a reduction in *average* highway speed from 70 to 65 would result in an 8.2% increase in fuel efficiency applied to highway miles assumed to be 40% of the total Vehicle Miles Traveled (VMT) annually in New Hampshire.

[6] Assumes that a reduction in *average* highway speed from 70 to 55 would result in an 17.1% increase in fuel efficiency applied to highway miles assumed to be 40% of the total Vehicle Miles Traveled (VMT) annually in New Hampshire.

b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease. There will be other health benefits due to the reduction in car accidents brought about by safer highways.

c. *Social*: Reducing vehicle speeds will slightly impact drive times but consumers will save money & highways will be safer. In addition there will be a reduced dependence on foreign oil and the associated economic stability that may bring through reduced economic risks of the global energy market as well as increase in dollars kept instate.

d. *Other*:

4. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*):

   a. *Technical*: There are no technical barriers to implementation. According to the NH State Police, the accuracy of police radar for speed limit enforcement is ± 1 mph when the radar is stationary, and ± 2 mph when moving.

   b. *Economic*: No data are available on whether additional law enforcement officers would be needed to implement the program, but additional tickets could bring in necessary revenue. No data has been developed on the cost of a motorists outreach and education effort. Should changing the speed limit signs be required it is not expensive.

   c. *Statutory/Regulatory*: Changes to speed limits would require legislation, but enforcement of existing speed limits as well as increasing consumer awareness would not. Changing requirements for driver education to include efficient driving habits could likely be done through administrative rule changes.

   d. *Social*: With proper marketing to consumers changes in driver behavior could be viewed in a very positive light due to the support for climate change and energy security efforts. It might be difficult to get the public to buy into reduced speed limits – this action could be perceived as infringing on personal freedoms.

5. Other Factors of Note: This could be combined with other programs such as allowing buses to travel at higher speeds which would help encourage commuters to use public transit. Emissions of nitrogen oxide, the primary pre-cursor pollutant to ground level ozone (smog) formation, also increase at speeds above 48 mph.

6. Level of Group Interest: High. The working group considered this an essential action to undertake in the near-term to achieve significant reductions in CO_2 emissions from the transportation and land use sector.

7. References:

- http://www.t2.unh.edu/fall04/pg6.html
- http://drive55.org/content/view/18/5/
- http://www1.eere.energy.gov/vehiclesandfuels/facts/favorites/fcvt_fotw222.html

TLU Action 1.D.2 – Address Vehicle Idling

Summary

Vehicle idling wastes fuel, damages engines, and results in excessive greenhouse gas and criteria air pollutant emissions. For example, overnight idling associated with long-haul trucking is estimated to consume 5 to 7 percent of all fuel used by heavy trucks. To address this issue, New Hampshire should implement a robust idling reduction program that affects all vehicles but, more specifically, sets idling reduction targets of 80 percent by 2010 and 100 percent by 2020 for heavy trucks. The proposed program would utilize a variety of approaches, including regulations, incentives for retrofits, and educational outreach to reduce idling times among all vehicle types across the state. The state could adopt regulations and provide outreach to eliminate all idling in light cars and trucks when conditions do not dictate the activity. For the trucking industry, recent developments in truck stop electrification (TSE) technology have improved available options for truck drivers to operate on-board systems without running their engines while parked.

Program Description

1. Mechanism (*i.e., how the policy or program achieves the desired result*):

   Options for an anti-idling program for cars and light-duty vehicles include public education, fines for idling infractions, and targeted enforcement in certain areas or locations.

   An anti-idling program for heavy duty vehicles would include outreach and fines based on vehicle type. However, truckers sometimes need to run their engines to maintain comfortable conditions inside their cabins during required breaks and/or to keep refrigerated cargo cold. Reducing the need for idling would require direct modifications of the existing truck fleet and/or rest stops. Incentives or loans would be required to accomplish the necessary retrofits.

2. Implementation Plan (*i.e., how to implement the specific policy or program*):

   a. *Method of Establishment (e.g., legislation, executive order):* Legislation leading to anti-idling regulations would be required, and state agencies would be tasked with developing and enforcing those regulations and implementing education and outreach programs.

   b. *Resources Required:* Funding for additional staff to run retrofit loan or incentive programs for rest stops and trucks and for enforcement for light-duty vehicle regulations.

   c. *Barriers to Address (especially for medium to low feasibility actions):* The identification of funding sources.

3. Parties Affected by Implementation (*i.e., residents, businesses, municipalities, etc.*):

   a. *Parties Responsible for Implementation*: NHDES would be required to develop regulations. Enforcement would fall to a variety of state and local entities depending on the target.

   b. *Parties Paying for Implementation:* State and local entities responsible for enforcement would bear the costs of implementation.

   c. *Parties Benefiting from Implementation:* Economic benefits would be accrued by fleet managers, owner-operators, and individual car owners. Society as a whole benefit from improved air quality and better health.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*): Heavy-duty fleet retrofits that affect vehicle fuel economy.

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):

    a. *Existing:* New Hampshire Code of Administrative Rules Env-A 1101.05, *Diesel and Gasoline-Powered Motor Vehicles*

    b. *Proposed:*
        - TLU Action 1.A.1 – Support Stricter Corporate Average Fuel Economy Standards
        - TLU Action 1.A.3 – Adopt California Low Emission Vehicle (CALEV) Standards
        - TLU Action 1.C.1 – Adopt a Low Carbon Fuel Standard

6. Timeframe for Implementation: Immediate

7. Anticipated Timeframe of Outcome: Immediate for light-duty vehicles with increased emission reduction as impacts of outreach and enforcement take hold. For the freight haulers, the outcome would still occur in the short-term but would be delayed due to the time that would need to be provided to comply with mandated retrofits or for the incentives to lead to the retrofits.

<u>Program Evaluation</u>

1. Estimated CO_2 Emission Reductions:

    a. Short-term (2012): 0.01 $MMTCO_2e$ /year
    b. Medium-term (2025): 0.02 $MMTCO_2e$ /year
    c. Long-term (2050): 0.03 $MMTCO_2e$ /year

2. Economic Effects:

    a. Costs:

        i. Implementation Cost: Low (0-$2.5 million)
        ii. Timing: Constant / even
        iii. Impacts: Business – evenly distributed

    b. Savings:

        i. Potential Economic Benefit: Moderately low ($2.5 million to $25 million)
        ii. Timing: Constant / even
        iii. Impacts: Business – evenly distributed

3. Other Benefits/Impacts:

    a. *Environmental*: This would reduce emissions of carbon dioxide, greenhouse gases, and other primary air pollutants in order to mitigate the effects of climate change and pollution of our ecosystems. This would lead to improved air and water quality directly as well as have more indirect effects on the fish and wildlife and the ecosystems upon which they depend.

    b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease.

    c. *Social*: There should be a net cost reduction due to greater overall fuel economy and lower long-term health care costs.

    d. *Other*: This measure will lead to reduced wear and tear on the engine and exhaust systems reduce operating and maintenance costs.

4. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*):
    a. *Technical*: The technology required to implement this action is available and can be implemented immediately.
    b. *Economic*: As fuel prices, especially diesel fuel used in heavy duty vehicles, continue to be elevated or even rise further, the economic benefits of idling reduction will act as an incentive to comply with new or more strictly enforced regulations.
    c. *Statutory/Regulatory*: There are existing regulations in NH (Env-A 1101.05) that specify the maximum idling time under specific environmental conditions and provide the basis for this action.
    d. *Social*: While there may be some resistance to turn vehicles on and off while waiting, the combined health and economic benefits of the practice will serve as leverage to reduce that resistance.

5. Other Factors of Note:

6. Level of Group Interest: Moderate. The working group considered this a supporting action to undertake in the near-term (i.e., supports other actions and/or achieves moderate reductions but not considered "essential" to achieve substantial CO_2 reductions from the transportation and land use sector).

7. References:

TLU Action 1.D.3 – Improve Traffic Flow

Summary

Revise state and regional guidance and policies to promote the use of appropriate measures to reduce congestion, improve traffic flow, and reducing GHG emissions associated with vehicle travel. Practical measures could include: 1) modern roundabouts at intersections, 2) synchronization of signalized intersections, and 3) reduction of access points through improved access management.

Program Description

1. Mechanism (*i.e., how the policy or program achieves the desired result*):
    a. Modern roundabouts: When an intersection is considered for reconstruction, the modern roundabout should be evaluated as a possible solution to improve the efficiency of the design. New Hampshire Department of Transportation uses this approach in their project development process. If a roundabout is determined to be a viable option, it is brought forward and presented to the public for further consideration. Whether a roundabout or signal is constructed is currently left to the public decision-making process. Educating the public on the environmental benefits of roundabouts would lead to greater acceptance of this design approach. A public policy requiring the use of roundabouts when shown to be appropriate for a given location (in preference to traffic signals) could be implemented to promote more widespread use of roundabouts in New Hampshire.
    b. Synchronization of signalized intersections: This process looks to optimize signal timing through a series of signalized intersections by interconnecting and coordinating the traffic signals along a corridor. Previous projects in New Hampshire have reduced vehicle delays by 16 percent and vehicle stops by 10 percent. NHDOT is currently undertaking a project to study and apply optimization techniques to 34 intersections in the Nashua Regional Planning Commission area.
    c. Access management: When existing highway corridors are improved by state, municipal, or private developments, access management principles should be incorporated. Intersections or roundabouts should be adequately spaced to allow proper turn movements and queue lengths. Proper spacing of intersections is also necessary to allow synchronization and coordination as described above. Private drive access to corridors must also be managed with the intent of limiting the number of individual drive access points. Private driveways should be combined by the use of frontage roads or access easements and directed to designated roundabouts or intersections.

2. Implementation Plan (*i.e., how to implement the specific policy or program*):
    a. *Method of Establishment (e.g., legislation, executive order):* NHDOT and municipalities have control of intersection design and coordination. Access management principles can be encouraged as part of the permitting process. New projects would be proposed through the public participation process and, upon acceptance, move forward through the funding and project development process.
    b. *Resources Required:* Additional education efforts regarding the benefits of modern roundabouts and access management principles. Funding would be required for intersection upgrades and traffic signal coordination projects.
    c. *Barriers to Address (especially for medium to low feasibility actions):* Acceptance of roundabouts instead of signals by the public, municipalities, and developers of commercial and retail property.

3. Parties Affected by Implementation (*i.e., residents, businesses, municipalities, etc.*):
    a. *Parties Responsible for Implementation:* NHDOT, municipalities, private developments.

b. *Parties Paying for Implementation:* Current funding sources, 10-Year Plan, local funding, private funding.

c. *Parties Benefiting from Implementation:* The traveling public.

4. Related Existing Policies and Programs (*i.e., those that address similar issues without interacting*):

   a. Current NH DOT policy is to analyze a roundabout at any location where a traffic signal is proposed to see whether this design approach is a viable intersection control option.

   b. The NHDOT is pursuing a project with CMAQ funding to study and optimize the operation of 34 intersections in the Nashua Regional Planning Commission area. This project should take 18 months to complete and is scheduled to begin in 2008.

   c. Access management is part of the design process at the state level. Additional educational efforts to promote access management should be provided to municipalities and the development community.

5. Complementary Policies (*i.e., those that achieve greater reductions through parallel implementation*):

   a. *Existing:* NHDOT currently considers modern roundabouts at all intersection locations.

   b. *Proposed:* NHDOT, traffic signal synchronization project.

6. Timeframe for Implementation: On average, intersection/signal coordination projects require 2 to 3 years to design, approve, and construct. On average, 4 to 5 traffic signalization projects on state roads are constructed each year. Most new signalized intersections are the result of new commercial development projects.

7. Anticipated Timeframe of Outcome: 2010 and thereafter.

<u>Program Evaluation</u>

1. Estimated CO_2 Emission Reductions:

   a. Short-term (2012): 0.01 $MMTCO_2e$/year
   b. Medium-term (2025): 0.04 $MMTCO_2e$/year
   c. Long-term (2050): 0.06 $MMTCO_2e$/year

2. Economic:

   a. Costs:

      i. Implementation Cost: Low (0-$2.5 million)
      ii. Timing: Constant / even
      iii. Impacts: State government

   b. Savings:

      i. Potential Economic Benefit: Moderately low ($2.5 million to $25 million)
      ii. Timing: Low short-term / mostly long-term
      iii. Impacts: Evenly distributed

3. Other Benefits/Impacts:

   a. *Environmental*: This would reduce emissions of carbon dioxide, greenhouse gases, and other primary air pollutants in order to mitigate the effects of climate change and pollution of our ecosystems. This would lead to improved air and water quality directly as well as have more indirect effects on the fish and wildlife and the ecosystems upon which they depend.

b. *Health:* Human health benefits will be realized by decreasing exposure to toxic and hazardous pollutants, many of which may have an effect that is exacerbated by the increase in hot summer days. Avoiding the impacts of air pollution can reduce the incidence of cardiac and respiratory disease.

c. *Social*: This action will lead to less vehicle delay and faster travel times for the traveling public

d. *Other*:

4. Potential for Implementation (*i.e., including challenges, obstacles and opportunities*): This action has a high potential for implementation.

   a. *Technical*: The technical resources and expertise required to implement these actions already exist and are in place at the State level and in the highway consultant industry. Additional training should be provided to promote the benefits. Not many technical challenges exist.

   b. *Economic*: These actions would compete with traditional and existing options for funding, 10YP, municipal funding, and private funding. No new funding mechanisms required.

   c. *Statutory/Regulatory*: No new statutory or regulatory requirements are needed.

   d. *Social*: An educational effort of the public is required to ensure public support since the installation of roundabouts in some communities has been difficult in the past.

5. Other Factors of Note: N/A

6. Level of Group Interest: Moderate. The working group considered this a supporting action to undertake in the near-term (i.e., supports other actions and/or achieves moderate reductions but not considered "essential" to achieve substantial CO_2 reductions from the transportation and land use sector)

7. References:

- Srinivas Mandavilli, Eugene Russell, and Margaret J. Rys, "Impact of Modern Roundabouts on Vehicular Emissions," Mid-continent Transportation Research Symposium, Ames, Iowa, August 2003.
- NHDOT Traffic Signal Optimization project description, 2005-2006 Congestion Mitigation and Air Quality Application Summary and Ranking, 2005.