Appendices

Mobile Sources Subcommittee Report to the Air Toxics Advisory Committee (ATAC) Recommendations for Air Toxics Reductions from Mobile Sources

Appendix I: On the Books and Proposed Mobile Source Controls to Reduce Air Toxics in Maine					
Mobile Source Emission Reduction Strategies	**Agency lead**	**Sector**	**Benefits/Costs**	**Air Toxic Reductions (H,M,L) and phase in period**	
California Low Emission Vehicle Program including ZEV	State	On-road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits** l lower PM emissions and VOCs, ozone precursors, NO_X and hydrocarbons	**L**	CA LEVII implemented in 2004. GHG emission standards (Pavley) & ZEV will be phased in starting in 2009. There will be more benefits over EPA Tier II controls in the out years. Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
On-Board Diagnostic Inspection Program: All vehicles in Cumberland county must have an OBD inspection with annual safety inspection. 520 inspection stations, statewide.	Federal	On-road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** 1996 and newer vehicles are equipped with computers that indicate when emission control systems are malfunctioning. In Cumberland County, owners are required to repair emissions equipment. In other areas, repair is voluntary. [1]	**L**	Mandatory in Cumberland county only, but important for reducing hot-spot risks in Portland area. Began in 1999. Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs: Full Credit gas cap in Cumberland Co, no credit for inspection stations.
Tier 2 Emission Stds/Sulfur in Gasoline: SUVs, pickups, vans subject to emission stds. 30 ppm average S in fuel (2005) w/ 80 ppm max..	Federal	On-Road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** 90% reduction of S from the national average, allows pollution control devices. Tier 2 also refers to the substantially cleaner federal car enabled by using the cleaner gasoline. Maine has adopted CA LEV as the State's "new car" program	**H**	**C**ontrols accounted for in the Mobile model, and increase over time with fleet turnover. Emission reductions are off-set somewhat by increased VMT. Phase in complete by Jan 2006 of Low Sulfur gasoline. Included in MATI Revised On-Road

[1] 1996 or newer car & light truck are equipped with "on-board" computer system that monitor engine, transmission, and emissions control components. "Check Engine" light identify minor problems before they become major repair bills. OBD is an important air improvement tool in Cumberland County. Technicians use OBD checks to identify vehicles that are in need of repair and therefore are exceeding emissions standards. The State program REQUIRES vehicles in Cumberland County to get repairs Everywhere else for newer cars-if their OBD2 light (or MIL) is on, it informs everyone that their (1996 and newer) vehicle is operating improperly and should be repaired.

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					HAP Emission Trends Mobile6.2 Runs.
Executive Order Requires the state to purchase low emission and most fuel efficient vehicle in vehicle class. Requires the state fleets to report VMT and improved fuel efficiency of new vehicle purchases.	State	On-road – Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** 59% of new vehicle purchases improve emissions. Reduced 396 tons of CO_2 for FY 2005-2007 7 & associated ATs.	**L**	Low statewide impact, but important in fostering markets for low emission vehicles. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Education and Outreach Program CBSM campaign for reduced idling.	State	On Road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** Reduced idling;	**L**	Idling emissions comprise and unknown % of the inventory. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Clean Car Labeling Program: Label vehicles that get 30 mpg or better	State	On Road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** Promote incentives to purchase cleaner vehicles;	**L**	Low statewide impact since is a voluntary program, but important in fostering markets for low emission vehicles. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Mobile Source Air Toxics Rule:	Federal	On Road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** Rule Proposed on March 29, 2006 will revise MSAT 1, establish national average benzene in fuel standards at current RFG levels, establish emissions for automobiles running at cold temperatures, and require spill	**H-M**	The national benzene standards for gasoline, as proposed, allow for national trading so may or may not reduce HAPs in Maine. The emission standards for cold temperature operation should reduce HAPs in Maine. The gas can law will have no additional impact, since the std is required already under

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			proof gas-cans nation wide.		state law. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Education and Outreach - targeting young people and new drivers about transportation alternatives and ways to reduce the impacts of driving. Statewide -- Maine Energy Education Program (MEEP) http://home.psouth.net/~meep/main.html. Kids in Transportation, http://www.gpcog.org/info.php?p=ODk0Mi4yMg (Cumberland County) and http://www.katyc.org/ (York County). .	State	On Road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))	**Benefits:** Reduce VMT, etc. for nominal costs. **Costs:** All three programs work together but are funded differently	**L**	Not included in mobile6.2 Runs
Car Pooling - GoMaine http://www.gomaine.org/ program will soon be increased from 12 to 21 vans for vanpools and a large database of potential and existing carpoolers.	State	On Road - Autos (including light, medium & other trucks under 8,500 lbs, GVW))		**L**	Included in Mobile6.2 Model
Heavy Duty Diesel: Heavy Duty Diesels engine emission	Federal	On-Road-Heavy Duty	**Benefits:** Emission controls and lower S content in fuel,	**H**	Engine manufacturers will have flexibility to meet the new standards

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standards and cleaner diesel fuel		Diesel	will cut criteria pollution by 95 percent. Sulfur in diesel fuel will be lowered by 97% (from 500 parts per million to 15 parts per million). Diesel exhaust comprises a significant portion of the cancer risk from air toxics in Maine.		through a phase-in approach between model years 2007 and 2010. The fuel provision will go into effect in June 2006 and will be phased-in through 2009. Fleet turn-over will eventually lead to reduced emissions. Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Expedite Fleet Turn-over of transit buses: DOT has a fleet turnover policy to accelerate transit fleet turnover by replacing half the transit fleet at half its useful life (~every six years), if funding is available. An example is the replacement of island explorer buses in Acadia National Park.	State	On Road – Public Transit	**Benefits:** Fleet turnover will place the cleanest vehicles available in the ME fleet sooner. New vehicles are much cleaner than retrofit vehicles, reducing PM emissions by 90% and NO_X by 95% **Costs:** The cost differential for the 2007 compliant buses would be included in operators' capital budgets,@ $7,000.	**L**	Toxicity-weighted Emissions from Heavy duty vehicles comprises about 19% of the on-road mobile emissions and about 4% of total state-wide emissions. Transit buses comprise .09% of the Heavy duty vehicle emissions. However, this may be a necessary strategy to reduce ATs to acceptable risk levels, particularly if the reductions focus on hot-spot locations. Now approximately 13 buses are replaced each year, primarily in the Portland region. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Creation of new transit services. Maine DOT is in the process of creating new transit services in the State of Maine – including the South Coast shuttle service in Ogunquit and Wells and the Midcoast transit service in Brunswick.	State - DOT	On-Road – Public Transit	**Benefit:** This will reduce the amount of VMT traveled and air toxics generated. **Costs**: [Anna Price is researching COST]	**L**	A relatively small portion of total VMT will be reduced by these transit services. While these two new services will produce minor reductions, additional transit service and expansion could add up, especially in southern Maine. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2

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					Runs.
Expansion of existing propane transit services: Maine DOT is the process of expanding existing transit services. The Island Explorer service on Mount Desert Island. The fleet is growing from 17 to 29 propane buses. Downeast Transportation Industries is also providing year-round service to commuters in the area.	State - DOT	On-Road – Public Transit	**Benefit**: This will reduce VMT and air toxics generated. **Costs**: Approximately $250,000. Federal incentives will reduce the cost of new 2007 HD NGV or LPG vehicles by up to $32,000.	**L**	A relatively small portion of total VMT will be reduced by these transit services. According to the Propane Education and Research Council (PERC), propane vehicles reduce air toxics by 98%, including benzene, 1,3 butadiene, formaldehyde and acetalaldehide. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.
Compressed Natural Gas Fleet: Portland METRO built a CNG fueling station with public access 13 CNG transit buses and 3 CNG school buses in fleet	State	On-Road – Public Transit	**Benefits:** 90 % reduction of PM Beginning with 2007 engines, new NG engines will produce one-sixth the NOx of new diesel engines. Fuel Station is publicly accessible which means other fleets can use it. Guaranteed use by 15 to 20 vehicles is enough to induce private enterprise to build and operate additional CNG infrastructure with a pre-negotiated fuel charge.	**L**	Toxicity-weighted emissions from Heavy duty vehicles comprises about 19% of the on-road mobile emissions and about 4% of total state-wide emissions. Transit buses comprise .09% of the Heavy duty vehicle emissions. However, this may be a necessary strategy to reduce ATs to acceptable risk levels, particularly if the reductions focus on hot-spot locations. Not Included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs.

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• **School bus 12 year fleet turnover policy to insure school buses would be compliant with the 2007 HDDE standards.** • With current fleet turnover rates, this would be accomplished by 2019.	State	On Road – School Buses	**Benefits:** New school buses would have factory-installed DPFs and emissions controls for the ozone precursor, NO_X. **Costs:** The cost differential for the 2007 compliant buses would be included in operators' capital budgets.[2]	**L** **M**	There are 2600 school buses owned by Maine Municipalities. School buses make up a small fraction of total statewide toxicity weighted emissions (TWE), but are very important in protecting sensitive subpopulations (children). The national turnover rate is included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs, but not increased turnover rate. School buses comprise 0.2% of the VMT in the MOBILE 6.2 model.
Retrofit and replacement of the existing school bus fleet. 180 diesel school buses will be replaced with 2007-compliant buses under current fleet turnover schedules. To date 69 new (2005-2006) school buses retrofitted with DOCs. 416 older buses are currently being retrofitted with DOCs and closed crankcase ventilation systems.	State	On-Road - School Buses	**Benefits:** This maximizes reductions of PM2.5 from the school bus fleet on the most aggressive schedule. **Costs**:.$500,000 for installation of diesel oxidation catalysts (DOCs) and crankcase controls using the existing contract with Donaldson Company.	**L**	There are 2600 school buses owned by Maine Municipalities. School buses comprise 0.2% of the VMT in the MOBILE 6.2 model. School buses make up a small fraction of total statewide toxicity weighted emissions (TWE), but are very important in protecting sensitive subpopulations (children). Voluntary programs have less penetration than required programs. Not included in MATI Revised On-Road HAP Emission Trends Mobile6.2 Runs

[2] Federal incentives will reduce the cost of new 2007 HD NGV or LPG vehicles by up to $32,000. Meanwhile, 2007 compliant diesel vehicles will cost $10,000+ more than comparable 2006 vehicles. Beginning in October, 2006 federal tax credits for CNG and LPG will be $.50/gal for non-profit fleets and slightly less for for-profit fleets. Operating and maintenance costs for 2007-compliant diesel vehicles are expected to increase due to loss of efficiency. New NG engines are already meeting 2010 standards.

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Mobile Source Emission Reduction Strategies	**Agency lead**	**Sector**	**Benefits/Costs**	**Air Toxic Reductions (H,M,L) and phase in period**	
Marine Diesel Engines (commercial ships, recreational diesel etc.)[3] EPA will propose more stringent emission standards for all new commercial, recreational, and auxiliary marine diesel engines except the very large engines used for propulsion on deep-sea vessels. Stds & technology based on the Nonroad Diesel engines program. Requires low S fuel. Maine has 3 main ports for shipping freight: Portland, Eastport and Searsport. Maine DOT is planning to expand capacity at each of these ports in the coming years. Freight is measured in terms of tonnage that passes through these ports, which indicates port use.	Federal	Off-road – Marine Diesel	Benefits: EPA estimates that NOx and PM emissions could be reduced by 90 percent with emission controls. Low sulfur fuel required by the Clean Air Nonroad Diesel Rule, (May, 2004) will decrease PM and associated HAPs from existing engines.	**L**	Portland is the busiest port in New England[4], but our emission estimates in this sector are highly uncertain. statewide emissions likely low, but could be essential to hot-spot locations Lower sulfur fuels will be introduced in 2011 (500 ppm) and 2012 (15 ppm) (except Small refineries, etc can sell over 500 ppm fuel until 2009 and are not subject to the 15 ppm std until 2014). Emission reductions from emission controls are subject to fleet turn-over - fleet turnover is slow since these engines have a long life span and are expensive.

[3] Diesel boats and ships, which range in size and application from small recreational runabouts to large ocean-going vessels, are significant contributors to air pollution in many of our nation's cities and ports.

[4] Based on U.S. PORT RANKING BY CARGO VOLUME 2004, Portland ME is the 27th largest Port in the country (Boston is ranked 31). See http://www.aapa-ports.org/pdf/2004_US_PORT_CARGO_TONNAGE_RANKINGS.xls

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Locomotives **engine emission stds:** EPA will propose more stringent locomotive engine emission standards. Stds & technology based on the heavy-duty diesel trucks and buses program. Availability of low Sulfur diesel fuel required under the new nonroad fuel rule allows use of this technology on locomotive engines	Federal EPA	Off-road - Locomotives	EPA estimates that NOx and PM emissions could be reduced by 90 percent Phased in over time with fleet replacement Low S fuel will create immediate benefits by reducing PM from existing engines.Locomotive engines must meet relatively modest emission requirements set in 1997. In May 2004, as part of the Clean Air Nonroad Diesel Rule, EPA finalized new requirements for nonroad diesel fuel that will decrease the allowable levels of sulfur in fuel used in locomotives by 99 percent.	**L**	Emission estimates for this sector are poor. Each unit can be a significant source. Statewide emissions likely low, but could be essential to hot-spot locations. Lower sulfur fuels will be introduced in 2011 (500 ppm) and 2012 (15 ppm) (except Small refineries, etc can sell over 500 ppm fuel until 2010 and are not subject to the 15 ppm std until 2014).
The SmartWay^{SM} Transport Partnership is a voluntary collaboration between U.S. EPA and the freight industry to increase energy efficiency. Focuses on fuel-saving strategies. Also has a model state anti-idling law. http://www.epa.gov/smartway/	Federal EPA	Off and On-Road Freight	Benefits: Focus on energy savings for multi-pollutant benefits, including calculation tools for companies. Costs: Focus on low cost and no-cost solutions at the company level.	**L**	Need to ensure that shifting from on-road sector (with controls) to rail or marine (with limited controls) does not negate HAP reduction benefits.
Aviation (aircraft, ground support equipment, etc.) that are modeled after the Clean Air	Federal	Off-road - Aircraft	EPA is amending the existing emission standards for NOx for new commercial aircraft	**L**	The emission estimates for this source category are highly uncertain. Reductions statewide are expected to be

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Nonroad Diesel Engines Program. Would require advanced emission-control technologies like those upcoming for heavy-duty diesel trucks and buses..			engines. Standards are equivalent to the NOx standards of the United Nations International Civil Aviation Organization (ICAO), aligning US with the international standards.		low, but may be significant for hot-spot locations. Stds effective on December 19, 2005 and apply to new aircraft engines utilized on commercial aircraft that include small regional jets, single-aisle aircraft, twin-aisle aircraft, and 747s and larger aircraft
Compression-Ignition Engines (farm, construction, mining, etc.)	Federal	Off-road – Construction Diesel	**Benefits:** Nonroad diesel engines are a significant source. Recently EPA set emission standards[5] for the engines used in most construction, agricultural, and industrial equipment. EPA also adopted nonroad diesel fuel sulfur stds, to prevent damage to advanced emission control equipment. The most recent nonroad engine and fuel regulations complement similarly stringent on-road regs	**H**	Lower sulfur fuels will be introduced in 2007 (500 ppm) and 2010 (15 ppm) (except Small refineries, etc can sell over 500 ppm fuel until 2009 and are not subject to the 15 ppm std until 2014). Emission Controls phased in with replacement of equipment, beginning with the smallest engines in 2008 larger engines in 2014, & 750+ horsepower in 2015.
Small Spark-Ignition Engines (lawn mowers, leaf blowers, chainsaws, etc.) [6]	Federal	Off-road – Small Gas Engines	In July 1995, EPA finalized the first federal regulations affecting small nonroad SI engines at or below 19	**H**	"Phase I" (1997-2007) : 32 percent reduction in HC emissions. Phase 2 (2001-2007): 70 percent reduction in HC+NOx emissions from

[5] See: www.epa.gov/nonroad-diesel/ for information on EPA's nonroad regs.

[6] Small spark-ignition engines are generally divided into 5 different classes. For the nonhandheld categories, Class I engines are used primarily in walk-behind lawnmowers and Class II engines are used primarily in lawn and garden tractors. For the handheld categories, Class III and IV engines are used primarily in residential equipment such as string trimmers, leaf blowers and chainsaws. Class V engines are used primarily in commercial equipment such as chainsaws.

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			kilowatts (kW), or 25 horsepower. EPA is presently looking at Phase 3 of these standards-primarily affecting non handheld Class I and II engines.		hand-held engines beyond the 32 percent reduction expected from the Phase 1 standards.[7] This reduction in HC+NOx emissions will be accompanied by an overall reduction in fuel consumption. Small SI engines currently produce approximately one tenth of U.S. mobile source HC emissions and are the largest single contributor to nonroad HC inventories nationwide.
Large Spark-Ignition Engines (forklifts, generators, etc.)	Federal	Off-road – small Gas engines	These standards cover nonroad spark-ignition (si) engines over 19 KW (25 hp). This includes many kinds of equipment including forklifts, generators, and many other farm, industrial and construction applications. These engines may operate on propane, gasoline, or natural gas.	**L**	Beginning MY 2004: EPA expects many manufacturers will add three-way catalysts to their engines and use electronic closed-loop fueling systems[8]. Beginning in 2007: Manufacturers will be able to control emission levels more broadly across the range of engine speeds and loads by improving control of air-fuel ratios at different operating modes. These improvements will reduce both steady-state and transient emission levels.
Marine Spark-Ignition Engines (boats, personal watercraft, etc.)	Federal	Off-road – Recreational	Emission standards for new SI gasoline marine engines used in outboards, personal watercraft, and jetboats (OB/PWC). Current, unregulated, stern	**L**	1998- 2006 phase in. OB/PWC were primarily 2-stroke technology that emitted high rates of HC exhaust and were the largest source of SI pollution. OB/PWC engines will be dramatically cleaner: They will be near the lower emission levels exhibited by today's

[7] This is equivalent to an annual reduction of 500,000 tons of exhaust HC+NOx emissions by the year 2027.
[8] These technologies have been available for industrial engines for many years.

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			drive/ inboards (SD/Is) are far cleaner than OB/PWC.		SD/I engines.
Recreational Vehicles (snowmobiles, dirt bikes, all-terrain vehicles, etc.)	Federal	Off-road - Recreational	Regs have separate emission standards for snowmobiles, off-highway motorcycles, and all-terrain vehicles. For snowmobiles, Three phases of standards for HC and CO emissions[9]. For off highway motorcycles and all-terrain vehicles, EPA standards mainly move engines from two-stroke to four-stroke technology with the use of some secondary air injection. EPA adopting requirements to address permeation emissions from all three types of recreational vehicles.	M	This is a significant source category. Emission reductions are subject to fleet turn-over.
Gas Can Rule Gas can manufactured with impermeable materials	State	All Mobile	**Benefits:** Reduced VOC emissions & associated HAPs	**L**	This is not a large source of TWEs, but may be important for reducing indoor air exposure.

[9] First phase standards for snowmobiles are a mixture of technologies ranging from clean carburetion and engine modifications to direct fuel injection two-stroke technology and some conversion to four-stroke engines. The second and third phases involve significant use of direct fuel injection two-stroke technology and conversion to four-stroke engines.

Appendix II – Funding Options for Mobile Source Air Toxic Reduction Programs	
Mobile Source Emission Reduction Funding Mechanism	**Feasibility**
Clean Diesel Fund: Set up a state clean diesel fund, similar to the Carl Moyer Program in California,[1] the TERP[2] program in Texas or New Jersey's temporary reprogramming of corporate business taxes.	**Political considerations:** Strong lobby opposed to new taxes – need to clearly articulate the need. Structures are in place to establish a funding mechanism, but would need to develop political support
Air Quality Fee on New Car Purchase designated for AT reductions.	**Political considerations:** Strong lobby opposed to new taxes – need to clearly articulate the need. Logistically fairly easy to implement and does not have constitutional barriers. $100/car would raise 8,000,000
Tax incentives to support transit & VMT reductions, etc.	**Political considerations: Would need to find off-sets for lost funding, & there is a s**trong lobby opposed to new taxes – need to clearly articulate the need.
AQ Fee on Automobile Registration	**Political considerations:** Strong lobby opposed to new taxes – need to clearly articulate the need. The Maine Constitution requires excise taxes to only be used to fund road construction. Additionally, would need to work with each town, since cars are registered by the towns.
AQ fee collected at toll booths	**Political considerations:** Strong lobby opposed to new taxes – need to clearly articulate the need. Need to research constitutional issues & likely resistance from the TPA.
Feebate Program – Additional fees for higher emitting, low fuel economy vehicles, are used for rebates on low emitting vehicles.	**Political Considerations:** Strong lobby opposed to new taxes – need to clearly articulate the need. Cost neutral. Would have to overcome historic poor reception by legislature due to concern for low income people. Federal study on feasibility to be completed in 2007.
AQ fee on fuel supplier	**Political considerations:** Strong lobby opposed to new taxes – need to clearly articulate the need. Similar mechanisms are already in place with the DEP Groundwater Fund
[1] See http://www.arb.ca.gov/msprog/moyer/carl_moyer_board_presentation_1_20_05.pdf	
[2] See http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/rg/rg-388.html.	

Appendix III - Top ranking strategies for Air Toxic Reductions from Mobile Sources, with estimated implementation Costs. The Shaded Strategies are recommended by MoSS for full ATAC recommendations													
Reduction Program Title	Implementation Approach	Sector that the strategy targets	Goals		AT reductions from strategy (TW-TPY)	% Reduction in Total Non-road inventory	% Reduction in Total On-road inventory	Annual Cost ($Million)	Normalized Annual Cost ($/TW-TPY)	Implementaion Timeframe	Hot-Spot Strategy?	GHG Benefit?	CAP benefit?
Expand Mandatory On-board Diagnostics & Repair Program Statewide	Regulatory	On-road - Light Vehicles & Trucks	20%	Emission Reduction in light duty vehicles with statewide OBD program	35,660	0%	15%	$3.1	$86	Mid	N	N	Y
Reduce VMT & increase vehicle occupancy, increase fuel efficiency	E&O	On-road - Light Vehicles & Trucks	10%	Reduction in VMT traveled by all light duty vehicles & Motor Cycles	17,830	0%	8%	($681)	($38,177)	mid	Y	Y	Y
Driver education outreach on how to save fuel	E&O	On-Road: all	5%	HAP emissions from Overall Fuel Savings for all on-road fleet	11,748	0%	5%	($108)	($9,158)	Short	N	Y	Y
Transit Oriented Development	Land Planning	On-Road: all	4%	Reduction in total VMT. (See CCAP report)	9,399	0%	4%	$0.0	$0	Long	Y	Y	Y
Expand Public Transit	Voluntary	On-road - Light Vehicles & Trucks	5%	Reduction in commuter VMT.	8,913	0%	4%	($220)	($24,686)	Long	Y	Y	Y

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Telecommuting & Working at Home via workplace policies	Voluntary	On-road - Light Vehicles & Trucks	2%	Reduction in HAP emissions per year.	4,119	0%	1.8%	($57.3)	($13,920)	Short	Y	Y	Y
State-wide No-Idling Regulation for all motor vehicles.	Regulatory	On-Road: all	50%	Reduction in idling of on-road Sector	3,065	0%	1%	($36)	($11,641)	Mid	Y	Y	Y
Anti-Idling campaign	E&O	On-Road: all	15%	Reduction in idling of on-road Sector	920	0%	0%	($3)	($3,187)	Short	Y	Y	Y
Increase carpool parking lots	Voluntary	On-road - Light Vehicles & Trucks	0.103%	Reduction in commuter VMT by doubling current number of available parking spaces	183	0%	0.078%	($21)	($114,016)	Long	Y	Y	Y
Statewide use of Reformulated Gasoline:	Fuel	On-Road: all	6%	Reduction in On-Road HAPs by adopting statewide RFG. Estimated emission reductions from MOBILE 6.2 model run	13,994	0%	6%	$ 26	$1,831	Mid	N	N	Y

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				& Connecticut's formulation of RFG.									
Emission Control Retrofits for older Heavy Duty Diesel Engines	Voluntary/incentives	On & Off-Road HDDE	5%	Reduction in PM emissions from On & Off Road Heavy Duty Diesel Engines	2,374	4%	3.2%	$ 17.25	$7,266	Mid	Y	N	Y
Transit Fuel Switching: purchase alternative fuel transit vehicles.	Voluntary	On-Road-Public Transit	10%	Of existing diesel buses convert to CNG or LPG	82	0%	0.04%	$3	$38,862	Long	Y	Y	Y

Appendix IV: Analysis of Land Use to Reduce VMT, by the Center for Clean Air Policy (CCAP)

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Appendix IV Part A: **List of Potential VMT Reduction Options in Maine, by CCAP,** August 30, 2006		
Measure, Description	**Target Sector**	**Location**
Transit Oriented Development	Light duty	Urban & older suburbs
Transit Oriented Development (TOD) integrates higher density development, within an easy walk of a major transit stop, with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding cars. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use.		
Infill & Brownfield Development	Light duty	Urban & abandoned suburban sites
Infill and brownfield policies attempt to guide development away from greenfield sites and city edges towards underutilized/abandoned properties within the urban core. These forms of compact urban development make use of existing infrastructure and relieve growth pressure placed on outlying areas. Brownfields can also occur outside of city center, for example closed factories, malls (sometimes called 'greyfields'), airports or military bases, which can host mixed-use development.		
Pedestrian Oriented Design	Light duty	Urban & Suburban
Pedestrian-oriented design (also known as New Urbanism and Traditional Neighborhood development) integrates both smart growth planning and urban design principles in order to improve the pedestrian environment by making walking easier, safer and more attractive. The creation of more walkable urban environments requires both larger scale planning efforts to promote higher density, mixed use and transit-oriented communities, and urban design features that promote safety and access to local services on foot.		Even in suburban areas, improving pedestrian connectivity can displace some car trips, e.g., by creating attractive walking paths between subdivisions and the back of strip malls.
Smart School Siting		Urban & older suburbs

Appendix IV Part A: **List of Potential VMT Reduction Options in Maine, by CCAP,** August 30, 2006		
Measure, Description	**Target Sector**	**Location**
Smart school siting policies are aimed at the retention of existing schools, or the construction of new schools within established communities. These policies can refocus development within existing urban areas and reduce the trend towards sprawling suburban regions fueled by the development of large schools at the urban edge. Reinvestment in existing local schools with pedestrian and bicycle access can result in greater accessibility for students and parents without the need for a motor vehicle.	Light duty & Heavy duty Buses	
Permitting & Zoning Reform	light duty	Urban and Suburban
Local ordinances can be a barrier to smart growth development by requiring, for example, the separation of uses and high parking minimums. By reforming statutes, local codes and ordinances and building codes state and local governments can facilitate the development of pedestrian oriented streets, traditional neighborhood developments, mixed uses, transit-oriented developments and improved parking design. These forms of urban development focus on reducing the orientation of new and existing communities away from the car towards walking, bicycling and public transit.		
Improved Transit Service	light duty	Urban and Suburban
Investment in existing transit services improves accessibility and can increase ridership levels, facilitating a reduction in the number of cars on the road, congestion levels and VMT. Investments in transit include increasing existing service levels, enhancing operational characteristics and providing incentives to encourage greater transit ridership.	Could increase Heavy Duty Bus emissions	Transit will have limited applications in very low density areas, but may be appropriate for some commuter applications, such as van pools.
Light Rail Transit	light duty	Urban, high density corridors
The key characteristics of light rail transit (LRT) include: electric rail cars operated on tracks in a fixed guide-way, location within part of a roadway or in completely separated rights-of-way, station-to-station service, stations located at intervals of approximately 0.5 to 1.5 miles, presence of parking facilities and local bus services. LRT has the flexibility to be implemented in either a corridor or on a system-wide basis.	could potentially displace some Heavy Duty Bus or Vans	Light rail typically requires high density to accommodate sufficient ridership.
Bus Rapid Transit	light duty	Urban, high density corridors

Appendix IV Part A: **List of Potential VMT Reduction Options in Maine, by CCAP,** August 30, 2006		
Measure, Description	**Target Sector**	**Location**
Bus Rapid Transit (BRT) refers to a permanent system of facilities, services and amenities that collectively improve the speed, reliability and identity of bus transit. BRT systems provide a roadway-based rapid transit alternative that mimic light rail in terms of high capcity vehicles, frequent service exclusive running ways, stations with pre-boarding fare collection, multiple door boarding to reduce station times, and low emissions technologies . BRT can be implemented more quickly and cheaply than LRT, but may not offer the same land use "anchor" or attractiveness to consumers.	Could increase Heavy Duty Bus emissions	Due to its lower cost, BRT may work at lower densities than LRT.
Bicycle Infrastructure & Initiatives	light duty	Urban & Suburban
Bicycle programs can include a variety of initiatives to increase safety and accessibility for cyclists. Program options may include but are not limited to promotion and education programs, bicycle lanes and bikeways, enhanced signage, improved connectivity with transit, bike lockers and work-place showers.	could potentially displace some Heavy Duty Bus or Vans	
Targeted Infrastructure Funding	light duty	Urban & older suburbs
State and local governments direct the investment of hundreds of millions of dollars of state and federal funding of transportation and other key infrastructure (schools, sewers, utilities, etc.). The reorientation of transportation and infrastructure spending towards efficient transportation and land use alternatives can enhance smart growth and air quality objectives. State and local governments can also use this 'power of the purse' to withhold funding from projects that do not conform to such policies, providing a strong disincentive for sprawling growth patterns. Some states direct growth by prioritizing infrastructure funding for preferred areas, as defined by local governments and/or state criteria. Other states have adopted fix-it-first policies to instruct state agencies to build upon and maintain existing assets before investments are made in new infrastructure. Leveraging funds that will be spent "anyway" may be one of the most effective means for state and local governments to reduce VMT and air pollution criteria pollutant emissions in addition to slowing the loss of natural and agricultural land to development.		
Road Pricing	All road vehicles	Major roadways

Appendix IV Part A: **List of Potential VMT Reduction Options in Maine, by CCAP,** August 30, 2006		
Measure, Description	**Target Sector**	**Location**
Road pricing applies a user fee to existing transportation infrastructure to more efficiently balance the supply and demand. The function of road pricing is twofold; it attempts to manage congestion levels while generating revenue used to maintain transportation networks. Some forms of road pricing initiatives utilize variable fees that are assessed based on the time of day, level of congestion or occupancy of the vehicle. Programs can focus on providing an incentive to shift trips to off-peak times, less congested routes, alternative modes of travel or higher occupancy vehicles. Further, new automated technologies have made tolling much less obstructive, allowing toll collection along the route which lessens the impact of congestion.		
Commuter Incentives	light duty	Urban and Suburban
Commuter incentive programs take advantage of a variety of options used to reduce single occupancy vehicle (SOV) trips for workplace travel. Employers can adopt programs that best suit the needs of their employee base, some methods include: subsidizing employees commuting costs with tax-free transit benefits; allowing the use of pre-tax dollars to pay for alternative commute costs; facilitating tele-work and alternative work schedule programs; providing incentives to carpool, vanpool, bicycle or walk; parking cash-out; and guaranteed ride home programs.		
Pay As You Drive Insurance	light duty	Urban and Suburban
Pay-As-You-Drive automobile insurance is a system where participants are assessed based on the number of vehicle miles traveled in combination with traditional risk based rates. PAYD goes beyond what current insurance companies are offering in premiums to low distance drivers. Shifting to this type of mileage-based auto-insurance system allows motorists to reduce their costs while encouraging them to drive less.		
Location Effiicient Mortgage	light duty	Urban & older suburbs
Location Efficient Mortgages (LEM) provide discounted mortgages to people who chose to buy a home in compact, mixed-use communities serviced by public transportation. In these communities, residents have the opportunity to walk, bike or take public transportation from their homes to stores, schools, recreation, and work. Lenders recognize that living in these types of communities reduces, if not eliminates, the homebuyers need to drive, thereby lessening the homebuyer's transportation and energy costs.		

Appendix IV Part A: **List of Potential VMT Reduction Options in Maine, by CCAP,** August 30, 2006		
Measure, Description	**Target Sector**	**Location**
Comprehensive Smart Growth Programs	light duty	Urban and suburban
Comprehensive smart growth programs employ multiple strategies and a coordinated approach to policy development to address the impacts of conventional growth patterns. Key elements needed to successfully implement smart growth policies include: comprehensive regional planning, regional cooperation, funding for efficient transportation alternatives, targeted infrastructure spending, incentives to redevelop the center city, elimination of regulatory or financial disincentives that encourage sprawl, and strong political leadership.	May also reduce some Heavy Duty VMT, but most efforts and studies haven't focused on freight.	
Municipal Parking Programs	light duty	Urban
Parking pricing and supply restrictions are two methods used to deter personal vehicle use, especially single occupancy vehicle (SOV) use, in areas with easily accessed transit alternatives. Parking supply restrictions, like parking pricing, encourage utilization of transit, cycling and walking. When designed in conjunction with other land use and pricing measures, parking pricing policies are one of the most effective ways to reduce VMT, congestion and air pollution. Policy makers must consider the extent to which parking initiatives deter urban development given the availability of free parking in suburban areas.		
Safe Routes to School	light duty,	Urban and Suburban
Safe routes to School programs encourage parents and children to walk and bike to school through the provision of safer pedestrian environments. By creating more walkable and bikeable communities, these initiatives help achieve air quality targets while promoting local health benefits. School zones, particularly at the urban edge where zones tend to be larger, are hot spots for vehicle exhaust during peak hours. Safe Routes to School programs, by reducing the number of vehicles, can help reduce peak concentration of vehicle emissions.	Heavy Duty Buses	
Fuel Tax	All road vehicles	All areas of state,

Appendix IV Part A: **List of Potential VMT Reduction Options in Maine, by CCAP,** August 30, 2006		
Measure, Description	**Target Sector**	**Location**
Fuel taxes are considered a form of user fees levied against drivers based on fuel consumption, and can serve as a financial incentive for consumers to reduce the number of vehicle miles traveled (VMT) and/or consider switching to a more fuel- efficient vehicle. Increasing the per-mile cost of driving with a fuel tax can affect both fuel consumption and efficiency. Further reductions in local and regional VMT can occur through the reallocation of gas tax revenues to fund investments in alternatives to single occupancy vehicle use. Increases in the gas tax can serve as a dedicated revenue stream for local transit systems that can fund service improvements and infrastructure investments.		greatest benefits in urban areas and older suburbs with more travel choices.
Freight Mode Shift	Heavy Duty Trucks	Major highways and interstate corridors
Intermodal freight is the transport of cargo containers via railways, ocean going vessels, inland ship/barge, ferries, and trucks. Intermodal ground freight transportation makes greater use of rail as an alternative to congested roadways and expanding highway systems. Intermodal infrastructure facilitates a greater use of railways that can help to maximize transportation efficiencies and offset rapid future growth in truck traffic. Rail offers a greater efficiency on a per ton mile basis than containers moved by truck over long distances, or through high volume corridors.		

Appendix IV Part B.1: Screening Analysis

TRANSIT ORIENTED DEVELOPMENT

Implementation Scale: Site Level
VMT Reduction Potential Rating: High
Feasibility/Ease of Implementation Rating: Medium

Transit Oriented Development (TOD) is becoming recognized as a viable form of growth management that addresses the needs of rapidly growing communities both large and small. As defined by the California Department of Transportation, TOD typically integrates "moderate to higher density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the auto. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use."[i]

TODs facilitate reduction in household automobile usage through the provision of both accessible transit alternatives and local employment and retail locations. The development of systematic TOD networks can change transportation behaviors at both local and regional scales. Analyses of the travel characteristics of California TODs conducted by Lund et al. indicate a 5.0 times greater rate of transit use for residents of TODs than those of comparable or adjacent locations. Similarly, transit use for office workers was 3.5 times greater for TODs.[ii]

Transit oriented development can result in local and regional benefits in addition to reductions in VMT and associated air pollutant emissions. There are many economic, social and transportation benefits including:

- increased mobility options for heavily congested regions
- improved mobility for segments of the population, such as youth and the elderly, without access to cars
- enhanced public safety through the development of more pedestrian oriented communities
- increased cost effectiveness of transit investment through improved ridership
- potential reductions household transportation costs of up to $3-4,000 per household annually[iii]
- preservation of agricultural and open space areas by redirecting greenfield development to urban areas
- increased local retail development and economic revitalization
- reduced public infrastructure costs through more efficient use of existing resources
- increased affordability of housing with increased densities and lower transportation costs
- rising property values and local tax revenues
- increased accessibility to housing options
- enhanced livability of communities through improvements in air quality, public health, accessibility to public spaces, commute times etc[iv]

VMT REDUCTION POTENTIAL

Local reductions in VMT of 20-30% result from increased transit use, walking and bicycling as modes of transportation. Achieving regional reductions - estimated at 5% for widespread TODs - would likely require locating new growth around multiple transit-accessible corridors.[v] Consequently, air pollution emissions and energy consumption decrease for households within TODs. Rates of greenhouse gas emissions have been shown to be 2.5 to 3.7 tons per year per household lower within TOD locations.[vi,vii]

A Canadian study found that the most significant emissions reductions occur by changing regional location, which reduces CO_2 emissions 21 - 58%, while changing the 3-Ds (density, diversity and design) alone (without the context of regional access) can reduce CO_2 emissions by 15 - 50%.[viii] Such savings from regional location are also seen in the well-cited Atlantic Station project (14-52%). Changing site design alone can also result in VMT savings of up to 6% (without changing mix of use, density or location).[ix]

While TOD is generically estimated to result in VMT reductions of 20-30 percent, it is important to note that this estimate is based on similar land use patterns differing only in access to transit. In practice, TOD will most likely be developed in conjunction with infill or smart growth policies. Therefore, site-specific VMT savings may exceed the generic 20-30 percent estimate. Also, since TOD will likely reduce the quantity of short vehicle trips taken (which contribute a greater proportion to mobile air toxics than indicated by proportional VMT), emission levels may drop by an even greater percentage than VMT (holding other things constant).

In quantifying the potential impacts for Maine, it will be necessary to identify prime potential areas. Using Maine-specific data where possible, we will compare VMT profiles in expected TOD areas to both average areas and greenfield development areas to show the savings in both scenarios. Maine-specific information on number of trips, trips taken and mode split is essential for determining the VMT impacts of TOD. Note that TOD projects are often best evaluated on a case-by-case basis, rather than through a generic estimation framework.

FEASIBILITY

In the report *Shifting Gears*, released earlier this year by Natural Resources Council of Maine and Environment Maine, it recommends supporting transit-oriented development as one of 20 policies to reduce VMT and reduce the state's GHG emissions.[x] While market demand for TODs is no longer considered a barrier to implementation with the success of numerous TOD projects nationwide, these projects, however, continue to face many implementation challenges[xi] including:

- lack optimal development standards and systems to coordinate development processes
- no cohesive regulatory and policy framework
- difficulty obtaining financing for mixed use developments due to concerns of private lenders, lengthy approvals processes and limited public funding in many regions
- local tax structure often promote large scale retail development over residential land uses
- poor transit design often isolates the station area from the community (i.e. limited pedestrian access and large parking facilities)
- obtaining development approvals is often slow as local zoning may be unsupportive of transit
- local community opposition based on density, traffic and parking concerns
- parking challenges impact costs, financing and public support[xii]

- land aggregation is difficult, particularly, for urban and infill sites
- limited use of financial tools to (i.e., tax increment financing)
- information and expertise on implementation is limited

A variety of broad implementation strategies have been used to promote Transit Oriented Developments nationwide and could work in Maine. They include:

- supporting TOD Planning through the transfer of federal transportation funds to local governments for TOD planning and implementation
- abatement of taxes for TODs to aid market development for higher density, mixed use communities
- transit joint development which allows transit agencies to use, sell or lease land that will help generate ridership
- direct participation of local governments in financing and building TODs

OTHER RESOURCES & REFERENCES

California Department of Transportation- searchable database for 21 statewide TOD projects include information on stations, projects, processes photos and links to Caltrans:
http://transitorienteddevelopment.dot.ca.gov/

Caltrans- "Statewide Transit Oriented Development Study- Factors for Success in California" includes links to the executive summary, final report, technical appendices and supplementary report on parking and TODs:
http://transitorienteddevelopment.dot.ca.gov/miscellaneous/StatewideTOD.htm

Envision Utah- provides information on Envision Utah's Transit-Oriented Development initiatives:
http://www.envisionutah.org/trans_land.html

Orenco Station Development- contains access to information on housing options within the transit oriented community and access to virtual tours:
http://www.orencostation.com/home.htm

Reconnecting America- Center for Transit Oriented Development provides access to resources that promote the further market development of TODs:
http://www.reconnectingamerica.org/html/TOD/index.htm

San Francisco Bay Area Rapid Transit District- "BART Transit-Oriented Development Guidelines" includes information on building and planning successful TOD projects:
http://www.bart.gov/docs/BARTTOD.pdf

The Great American Station Foundation- website includes access to information, case studies and prominent reports on transit oriented developments:
http://www.transittown.org/

US Environmental Protection Agency- "Our Built and Natural Environment, a Technical Review of the Interactions between Land Use, Transportation and Environmental Quality":
http://www.epa.gov/livability/pdf/built.pdf

Appendix IV Part B2: Screening Analysis

Permitting & Zoning Reform

Implementation Scale: State or Regional
VMT Reduction Potential Rating: Medium to Low
Feasibility/Ease of Implementation Rating: Medium

Local regulations pose significant barriers to smart growth through the prohibition of mixed use and mixed income developments, and the fostering of automobile dependent forms of growth. Often regulations governing land development are outdated, as many planning statutes originated as early as the 1920s.[xiii]

By reforming statutes, local codes and ordinances and building codes state and local governments can encourage infill and brownfield development and facilitate the development of pedestrian oriented streets, traditional neighborhood developments, mixed uses, transit-oriented developments and improved parking design.[xiv] These forms of urban development focus on reducing the orientation of new and existing communities away from the car towards walking, bicycling and public transit. As a result, emissions of criteria air pollutants and greenhouse gases decline due to reductions in local VMT.

The types of permitting and zoning reforms that reflect smart growth principles vary widely, some of which include:

- traditional neighborhood development codes[xv]
- form-based zoning[xvi]
- live /work and mixed use codes
- transit area codes
- design regulations
- reduced parking requirements
- streamlined development approval process for smart growth projects
- performance criteria standards replacing zoning regulations
- rural zoning districts

Undertaking initiatives to reform land use regulations and encouraging the implementation of smart growth projects, can result in benefits to the community beyond air quality improvements, these can include:

- increased walkability of communities
- safe routes to schools
- creation of livable neighborhoods for aging populations[xvii]
- higher levels of daily physical activity
- decreased municipal infrastructure costs
- decreased exposure to congestion levels
- increased accessibility to a range of housing choices
- improved transportation choice
- greater diversity in urban design

VMT REDUCTION POTENTIAL

By removing the regulatory barriers to infill and brownfield development projects through permitting and zoning reform, governments can address local air quality and greenhouse gas concerns by reducing VMT and allowing for easier access to transit and pedestrian facilities. US Environmental Protection Agency assessments of selected infill developments indicate significant reductions in vehicle miles traveled, VOC and NOx emissions.[10] The environmental implications of school siting, for example, is just one area where the impacts of permitting and zoning ordinances are often overlooked. Setting large minimum acreage sizes for schools or requiring the development of schools on greenfields in new growth areas can lead to dramatic increases in VMT along with other social and economic impacts.

The potential for VMT reduction is rated medium to low, because removing barriers alone does not directly result in reductions, but it is a good initial step. There are no generic estimation techniques applicable to permitting and zoning reform. Once a specific policy is decided upon, then we can present estimate. For example, if permitting allows for TOD, then the TOD estimation procedure (as described) can be used. Other targets for reform will require alternative estimation techniques.

Likely relevant variables for Maine specific estimation include mode split, average trip quantities and lengths under alternative densities and land-use mixes etc.

FEASIBILITY

Maine's zoning and permitting ordinances typically vary by town and region. This lack of cohesiveness and guiding framework for tackling this issue often creates problems for smaller localities in dealing with the issues that come with urban and rural growth. Without the necessary tools, local governments are left on their own to tackle issues such as big box development, new housing, and even military base closures. While Maine's State government has done some work in the area of school siting (e.g., their Department of Education developed a primer on the topic called the *ABC's of School Site Selection*) other states can provide useful case studies for Maine in the larger context of zoning and permitting reform. For example, planning officials in Pennsylvania have introduced three new zoning districts for a primarily rural section of the township to address issues associated with traditional suburban development.[xviii] The districts include a Town Center district, Traditional Neighborhood Development (TND) district, and a Mixed-Use Corridor district. The Town Center and TND areas will include pedestrian-oriented street design and mixed housing styles that integrate into predominantly commercial and retail zones.

Regulations governing land use must take into consideration issues of private property and public opposition to restrictive zoning policies. Local governments need to attain a successful balance between community goals and individual property rights. An overly prescriptive approach can restrict organic growth processes. Zoning regulations should be grounded in the government interest in advancing public health and general welfare and not simply in aesthetics.[xix]

OTHER RESOURCES & REFERENCES

[10]US EPA (2001a), "Comparing Methodologies to Assess Transportation and Air Quality Impacts of Brownfields and Infill Development": http://www.epa.gov/livability/pdf/comparing_methodologies.pdf

American Planning Association- an overview of Enabling Legislation for Traditional Neighborhood Development Regulations from the 2001 APA National Planning Conference: http://www.asu.edu/caed/proceedings01/SITOW/sitow.htm

American Planning Association- a summary of "Growing Smart Legislative Guidebook: Model Statutes for Planning and the Management of Change" is available online and includes tools available to help state and local governments reform planning and zoning legislation: http://www.planning.org/growingsmart/summary.htm

Congress for New Urbanism- this site provides access to resources on new urbanism including a catalogue of smart growth model codes, state building codes, state enabling legislation and local regulations from across the United States:
http://www.cnu.org/
http://www.cnu.org/pdf/code_catalog_8-1-01.pdf

Local Government Commission- "An Executive Summary of Smart Growth Zoning Codes: A Resource Guide" provides an assessment of best practices in zoning codes to address issues such as traditional neighborhood development and transit oriented development: http://www.lgc.org/freepub/PDF/Land_Use/sg_code_exec_summary.pdf

University of Wisconsin Extension- provides an example of "A Model Ordinance for a Traditional Neighborhood Development" was adopted by the Wisconsin State Legislature in 2001:
http://www.wisc.edu/urpl/people/ohm/projects/tndord.pdf

US Department of Energy- the Smart Communities Network website provides examples of Smart Land Use Codes/Ordinances that have been adopted my state and local governments: http://www.sustainable.doe.gov/landuse/lucodtoc.shtml

Appendix IV Part B.3: Screening Analysis

BUS RAPID TRANSIT

Implementation Scale: Regional or Corridor
VMT Reduction Potential Rating: Medium to High
Feasibility/Ease of Implementation Rating: Medium

Bus Rapid Transit (BRT) consists of a variety of components used to enhance the level of service relative to traditional public transportation systems. BRT integrates a variety of technologies to provide public transportation services that are appropriate to the market for which they are designed. BRT can be broadly defined as "[a] permanent system of facilities, services and amenities that collectively improve the speed, reliability and identity of bus transit".[xx] BRT systems provide a roadway-based rapid transit alternative that combines high levels of service, intelligent transportation systems (ITS) and low emission vehicle technologies.

The focus of BRT improvements is often beyond the buses themselves and aims to improve overall system performance. Operational systems integrate some or all of the following elements:

- *running ways*- vehicles can operate in exclusive transit-ways, HOV lanes, expressway or general traffic
- *stations*- are attractive, easily accessible and well integrated into the community
- *vehicles*- most often are rubber tired, high capacity, quiet and make use of available low emissions technologies
- *service*- is higher frequency all day service based on headway times, fewer stops and integrated with local service to reduce waiting times
- *intelligent transportation systems (ITS)*- include advanced digital technologies such as transit signaling priority and global positioning systems (GPS) used to provide real time service information
- *fare collection*- pre-boarding fare collection machines, smart cards and multiple door boarding reduce station times
- *route structure*- simple often color-coded routes provide direct rides, with fewer required transfers[xxi]

BRT enhances the quality of transit service available to the public, making public transportation a more attractive transportation alternative. Traveling by transit uses significantly less energy and produces less pollution per person per mile than the equivalent trip by private vehicle. In addition, BRT provides transportation benefits that may make it preferable to light rail or traditional bus service. The benefits attributable to BRT may include:

- lower economic and environmental costs associated with BRT than with automobile infrastructure facilities
- lower capital cost than rail projects
- reduced commute times
- increased transit ridership
- expanded transit accessibility in suburban regions that lack the density to make rail transportation an effective option
- implementation that can be quick and incremental
- fuller use of existing infrastructure through the use of pre-existing running ways
- adequate capacity for high volume transportation corridors

- enhanced system flexibility allows for a variety of service options in a range of urban and suburban environments
- easily integrated into transit and pedestrian oriented developments
- promotes development and redevelopment in station areas

There are currently more than 20 BRT systems in full operation or under development in the United States and Canada.

VMT REDUCTION POTENTIAL

Traveling by transit uses significantly less energy and produces less pollution per person per mile than the equivalent trip by private vehicle. BRT enhances the quality of transit service available to the public, making public transportation a more attractive transportation alternative. Developing a complementary land use pattern and creating accessibility for bicycles and pedestrian movement along the transit system is critical in achieving the greatest long term benefits from public transportation -- benefits in terms of level of ridership, displacement of vehicle trips to public transit and reduction in emissions. Some other benefits of BRT include the fact that compared to a Light Rail Transit (LRT) line or a metro line, the BRT corridor is significantly less expensive and involves less construction time. BRT is typically estimated to cost $1-10 Million/km versus $20-220 million/km for metro or rail[xxii]; further the planning and construction time is typically 12-18 months versus 3-30 years for metro.[xxiii]

BRT systems have significant potential to reduce VMT as they provide a flexible alternative to personal vehicle use that consumers strongly prefer to regular bus service. Bus rapid transit policy thus effects reductions by impacting mode split. Mode split shifts away from automobile use as more transportation choices become viable. BRT can be implemented regionally or on individual corridor basis. BRT also potentially improves air quality by displacing older, heavily polluting buses. There may also be some air quality benefits from improved traffic flow, but these congestion impacts would likely have to be modeled to get an accurate estimate.

Quantifying the impacts for Maine will require emissions data on potentially replaced bus fleet, new buses emission data, current transit ridership, expected increases in ridership, and if possible, estimated congestion improvements.

FEASIBILITY

The feasibility exists for the development BRT corridors in Maine. In fact, in *Destination Tomorrow*, the PACTS Long Range Regional Transportation Plan recommends "BRT as a strategy for maintaining capacity on key arterials through ITS technology and by making roadway operational improvements".[xxiv] The effectiveness of a BRT system must be considered relative to other available transit options. The needs of the individual community will dictate whether BRT is the most appropriate alternative. The Center for Transportation Excellence has outlined several questions that should be considered in assessing the appropriateness of a BRT system,[xxv] they include:

- What is the goal?
- What are the current deficiencies in the system and what alternatives are available to solve them?
- Who is the system trying to attract?
- Is a large right of way acquisition a potential option?

- Are transit efforts aligned with other efforts?

The answers to these questions may indicate whether BRT is the most effective transit investment option. BRT systems are often considered an alternative to costly light rail transit investments. LRT has substantially higher capital costs due to infrastructure requirements, particularly the need for an imbedded track structure and the purchase of light rail vehicles. This makes BRT an attractive investment option for smaller medium-sized cities, with costs ranging from 40 to 70 percent of LRT estimates.[xxvi] In those urban areas where there may be a limited difference in potential BRT vs. LRT ridership, BRT is often a more cost effective option. Additionally, BRT can also add an element of service flexibility that facilitates use in suburban locations that LRT cannot provide with a fixed guideway system.

OTHER RESOURCES & REFERENCES

Center for Transportation Excellence- BRT 101 provides the basics of BRT information including definitions, characteristics and comparisons to other modes of transportation:
http://www.cfte.org/trends/brt.asp#1

Federal Transit Association- includes information on a variety of BRT projects, resources and program evaluations:
http://www.fta.dot.gov/initiatives_tech_assistance/technology/2381_ENG_HTML.htm

Federal Transit Administration- "Characteristics of Bus Rapid Transit for Decision-Making for Decision-Making" details major elements of BRT systems, system performance, and benefits:
http://www.fta.dot.gov/documents/CBRT-DecisioMaking.pdf

Institute for Transportation and Development Policy- "Sustainable Transport: a Sourcebook for Policy Makers in Developing Cities", module 3b of the guidebook discusses Bus Rapid Transit and is one of 20 modules aimed at providing policy tools for developing cities:
http://www.itdp.org/STe/STe4/readSTe4/BRT.PDF

Journal of Public Transportation- an issue dedicated to Bus Rapid Transit:
http://www.nctr.usf.edu/jpt/pdf/JPT%205-21.pdf

National BRT Institute- provides links to a variety of BRT resources and projects including TRB/APTA powerpoint presentations**:**
http://www.nbrti.org/

Transit Cooperative Research Program- "Report 90 Bus Rapid Transit, Volume 1: Case Studies in Bus Rapid Transit", includes an overview of the findings of fourteen North American and twelve international BRT examples:
http://gulliver.trb.org/publications/tcrp/tcrp_rpt_90v1.pdf
"Report 90 Bus Rapid Transit, Volume 2: Implementation Guidelines", a detailed report on the technological, operational and financial components of BRT systems:
http://trb.org/publications/tcrp/tcrp_rpt_90v2.pdf

United States General Accounting Office- "Bus Rapid Transit Shows Promise" provides a comparison of capital and operating costs for Light rail and BRT systems, as well as possible funding mechanisms for BRT projects:
http://www.apta.com/research/info/briefings/documents/d01984.pdf

WestStart-CalStart- "Vehicle Catalog: a Compendium of Vehicles for Bus Rapid Transit Service" contains a summary of BRT vehicles in production by international and national manufacturers:
http://www.gobrt.org/vehiclecatalog.pdf

Appendix IV Part B.4: Screening Analysis

TARGETED INFRASTRUCTURE FUNDING

Implementation Scale: State
VMT Reduction Potential Rating: High
Feasibility/Ease of Implementation Rating: Medium to Low

State governments direct the investment of billions of dollars of state and federal funding of transportation and other key infrastructure (schools, sewers, utilities). The reorientation of transportation and infrastructure spending towards efficient transportation and land use alternatives can enhance smart growth and air quality objectives. States can also use this 'power of the purse' to withhold funding from projects that do not conform to such policies, providing a strong disincentive for sprawling growth patterns.[xxvii,xxviii,xxix]

Targeting infrastructure funds to existing urban and suburban areas can help redirect growth inward, thereby relieving development pressures on greenfield areas at the urban fringe. Some states direct growth by prioritizing infrastructure funding for preferred areas, as defined by local governments and/or state criteria. Similarly, some states have adopted fix-it-first policies to instruct state agencies to build upon and maintain existing assets before investments are made in new infrastructure.[xxx]

Targeted infrastructure funding can help states to grow in a more compact manner and provides greater accessibility and mobility options for individuals. Funding to enable and support denser development may be one of the most effective means for state and local governments to reduce VMT and criteria pollutant emissions in addition to slowing the loss of natural and agricultural land to development.

By reducing the growth of new urban greenfield areas through targeted infrastructure spending additional benefits can be achieved, including:

- reduced pressure on agricultural, open space and environmentally sensitive areas
- more efficient use of funds through greater inter-departmental coordination
- lowered infrastructure costs
- revitalization of downtown areas
- more efficient transit operation with higher development densities

VMT REDUCTION POTENTIAL

Targeted infrastructure funding is another option for which it is difficult to develop a priori quantification methods. A fix-it-first approach would lead to more dense urban development, sustaining transit, reducing travel demand, and shifting mode split towards public transit (assuming options are available). These effects can be estimated by looking at the relationship between urban density and VMT, and also the impact of infill growth versus greenfield growth. If the targeted infrastructure funding prevents greenfield development, this option will likely significantly reduce VMT growth.

Developing a Maine-specific quantification requires a comprehensive understanding of the infrastructure likely to be targeted. After the targets are selected, appropriate travel demand and density data will have to be gathered.

FEASIBILITY

Maine already has a successful case study in this area through its State Housing Authority. By scoring projects based on a number of criteria including transit availability, it encourages smarter development by sending a message to developers and local governments that this is the way development should be need to be done if it is to receive State funding.

To build on this success, other barriers to the implementation of targeted infrastructure funding programs that will perhaps need to be overcome in Maine include:[xxxi]

- contradictory government policies that promote smart growth principles while maintaining incentives supporting uncontrolled growth
- lack of political leadership to co-ordinate land use, transportation and environmental decisions
- local level regulations that do not effectively support smart growth goals
- resistance by local decision makers to implement state policies to actively redirect growth
- vague comprehensive plans with limited guidance on how to achieve goals or measure progress towards them

Massachusetts provides a good example of the potential effectiveness of a targeted infrastructure funding program. The Office of Commonwealth Development (OCD), which directs smart growth policies in the housing, transportation, energy and environment agencies, coordinates the allocation of $2 billion in state and federal funding to direct development in areas supported by pre-existing infrastructure.[xxxii] One of the central OCD initiatives is the *Commonwealth Capital* policy which strives to coordinate capital spending programs to ensure consistency between development projects and sustainable development principles. Specifically, it has developed a set of criteria that prioritize housing, transportation and parks funding for projects that promote efficient land use, travel alternatives and petroleum conservation. Commonwealth Capital serves as a tool to influence municipal land use practices by rewarding municipalities engaged in smart growth planning. The state has also introduced a *Fix-It-First Policy* which prioritizes maintenance of existing infrastructure over new construction. Fix-It-First has extended to transportation policy focusing on repairing the state's existing roads and highways and enhancing opportunities for transit and non-motorized transportation options.

New Jersey provides another good case study. In 2002, Governor James McGreevy issued *Executive Order 4* establishing the Smart Growth Policy Council.[xxxiii] The council's mandate was to ensure that State transportation and infrastructure funding, inter-departmental procedures, programs, and projects were consistent with the State Plan and smart growth principles. The state plan placed a high priority on investments in areas with existing infrastructure that would help create more compact growth patterns.

OTHER RESOURCES & REFERENCES

National Governors Association- a policy issue brief, "Fixing It First: Targeting Infrastructure Investments to Improve State Economies and Invigorate Existing Communities": http://www.nga.org/cda/files/0408FIXINGFIRST.pdf

http://www.nga.org/cda/files/0408FIXFIRSTCHART.pdf

1000 Friends of Maryland- "Smart Growth: How is Your County Doing?" provides an overview of issues faced in Maryland counties with the implementation of their Priority Funding Areas:
http://www.friendsofmd.org/data/smartgrowth.pdf

US Environmental Protection Agency- Redeveloping brownfields with federal transportation funding:
http://smartgrowth.org/pdf/brownfields_tea21.pdf

Appendix IV Part B.5: Screening Analysis

COMPREHENSIVE SMART GROWTH

Implementation Scale: State or Regional
VMT Reduction Potential Rating: Medium to High
Feasibility/Ease of Implementation Rating: High

Comprehensive Smart Growth Programs at both state and local levels of government have arisen in response to community concerns over the social, economic and environmental costs of building road-centered, automobile-dependent, low density developments in North America over the last 50 years. The principles of smart growth provide a framework through which decisions as to how and where communities grow can be viewed.[xxxiv]

Comprehensive smart growth programs employ multiple strategies and a coordinated approach to policy development to address the impacts of conventional growth patterns. The creation of regulatory bodies to ensure the coordination and implementation of smart growth plans and policies helps ensure that branches of the government do not adopt contradictory initiatives. Key elements needed to successfully implement smart growth policies include:

- comprehensive regional planning
- regional cooperation
- funding for efficient transportation alternatives
- targeted infrastructure spending
- incentives to redevelop the center city
- elimination of regulatory or financial disincentives that encourage sprawl
- strong political leadership

MPO studies from around the country show smart growth policies have the potential to reduce regional and statewide VMT reductions by 3-25 percent, as seen in the table below. The VMT savings from these analyses result from a combination of transit improvements, land use modifications and complementary policies such as open space protection and measures (including in some cases, congestion pricing, zoning, etc). With the exception of Sacramento's Blueprint project however, the savings may not fully capture micro-scale trips, trip-chaining and/or induced travel.

Regional VMT Reductions from Smart Growth and Transit

Study Location	Regional VMT Reduction (from business-as-usual)	Implementation Timeframe
Albany[xxxv]	**7 - 14%**	2000 – 2015
California[xxxvi]	**3 - 10%**	2000 – 2020
Portland[xxxvii]	**6 - 8%**	1995 – 2010
Puget Sound[xxxviii]	**10 - 25%**	2005 – 2050
Sacramento[xxxix]	**15-25%**	2005 – 2050
Salt Lake City[xl]	**3%**	2000 – 2020

The successful implementation of comprehensive smart growth programs reduces congestion and VMT, which improves air quality and provides environmental, social and economic co-benefits. Environmental benefits include:[xli]

- reducing the rate of land use change, habitat loss and fragmentation
- improving levels of water pollution resulting from surface water runoff
- protecting ground water resources
- reducing levels of air pollutant deposition

Social benefits include:

- reduced rates of obesity by increasing levels of physical activity[xlii]
- fewer health related impacts of vehicle emissions[xliii]
- reduced climate change impact on health[xliv]
- greater social equity due to improved transportation and housing choices[xlv]

Researchers at Rutgers University estimate that smart growth strategies, relative to conventional growth patterns, can yield an economic savings of $250 billion over the next 25 years.[xlvi] Developers, new home buyers and commercial tenants, as well as local and state governments would reap these savings. Additional benefits include:

- decreased expenditure on public infrastructure i.e. roads, sewers, schools[xlvii]
- lower private costs for transportation i.e. fuel, car insurance
- reduced costs of congestion to individuals and businesses[xlviii]
- lower public and private health care expenditures

VMT REDUCTION POTENTIAL

By adopting a multi-faceted policy approach – including shifting regional development patterns to more centrally-located communities – comprehensive smart growth programs effect emissions reductions through changes in mode split, number of trips taken and average trip length.

The scale associated with any particular smart growth program will greatly influence the expected impacts. Comprehensive region-wide programs may yield regional reductions of 20 percent. Overall reductions associated with this program are expected to be significant.

Smart growth involves a comprehensive package of options, requiring either modeling or a top down estimate to get a feel for the associated emissions reductions. For the illustrative calculation, we will examine various smart-growth packages that seem likely based on input from key Maine sources. Once the likely scenarios are determined, impacts on relevant variables will be estimated to determine expected changes in VMT and air quality.

FEASIBILITY

Getting smart growth policies implemented in any town, region or state is a difficult and challenging task and Maine is no different. Barriers typically include:[xlix]

- lack of public participation in the planning process
- prevalence of 'not in my back yard' (NIMBY) attitudes
- inconsistency between local plans and land use regulations
- land use regulations that continue to discourage smart growth e.g., large lot sizes
- state and federal transportation infrastructure spending policies often pull investments to previously undeveloped areas, with transportation spending often focusing on new highways
- finance redevelopment in the urban core is often difficult and more expensive
- mixed use developments face complex and time consuming approval processes

GrowSmart Maine's Model Town Community Project will be an important first step in demonstrating how smart growth can be implemented in Maine.[l] Through leadership, technical expertise, and public involvement this pilot project will provide a concrete example to other towns on how to manage growth in a more sustainable manner. This project will also bring to light the specific implementation barriers that Maine communities are facing and hopefully provide strategies to overcome them.

For a comprehensive smart growth program to take hold in Maine however, leadership and guidance will need to come from the top and the State Planning agency will need to play a critical role. Given Maine's size, its positive track record for inter-governmental discourse, and its apparent openness to new ideas, the feasibility of developing and delivering such a program is promising.

OTHER RESOURCES & REFERENCES

American Planning Association- policy guide of smart growth includes the APA adopted definition of smart growth, description and history of the issues and APA smart growth policy motions and their outcomes:
http://www.planning.org/policyguides/smartgrowth.htm

Brookings Metropolitan Policy Program – "Redefining the challenges facing metropolitan America and promoting innovative solutions to help communities grow in more inclusive, competitive, and sustainable ways." The website includes reports, commentary and analysis:
http://www.brookings.edu/metro/metro.htm

Canadian Mortgage and Housing Corporation- "Greenhouse Gas Emissions from Urban Travel: Tool for Evaluating Neighborhood Sustainability", highlights the importance of macro scale urban structures on greenhouse gas emissions reductions
http://www.cmhc.ca/publications/en/rh-pr/socio/socio050.pdf

Center for Clean Air Policy- "Two for the Price of One: Smart Growth and Clean Air," a background primer for a policy forum hosted by CCAP and LGC in December 2004, provides an overview of 1) Clean Air Act structure and the federal policy framework as it relates to the implementation of smart growth and other state and federal air quality and transportation policies and programs, 2) transportation planning and emissions modeling, and 3) implementation of land use and air quality policies and programs.
http://www.ccap.org/transportation/smart_two.htm

Fannie Mae Foundation- "Retracting Suburbia: Smart Growth and the Future of Housing", a report highlighting the way housing can be used to support smart growth policies:
http://www.fanniemaefoundation.org/programs/hpd/pdf/hpd_1003_danielsen.pdf

Georgia Tech – Released in 2004 the Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality (SMARTRAQ) study illustrates the relationship between urban form, transportation and health. The study emphasized the connection between areas of higher residential and employment density, mixed land uses and street connectivity with lower levels of VMT and air pollution emissions and elevated levels of physical activity and transit use.
Strategies for Metropolitan Atlanta's Regional Transportation and Air Quality
http://www.smartraq.net/

Metro-region- information on the Portland regional 2040 Growth Concept, adopted as part of the Region 2040 growth plan in 1995, in addition to other regional land use initiatives: http://www.metro-region.org/article.cfm?articleID=231

National Center for Smart Growth Research and Education- provides information on smart growth research at the University of Maryland, including information on the state's past and present smart growth policies: http://www.smartgrowth.umd.edu/index.htm

Smart Growth America- "Measuring Sprawl and its Impact: The Character & Consequences of Metropolitan Expansion", a report that evaluates and measures urban sprawl and its impacts, including the sprawl index which ranks major US cities: http://www.smartgrowthamerica.org/sprawlindex/sprawlindex.html

Smart Growth Network- "Getting to Smart Growth I & II: 100 Policies for Implementation", outlines 10 principles of smart growth and policies that can be used to implement them:
http://www.smartgrowth.org/pdf/gettosg.pdf
http://www.smartgrowth.org/pdf/gettosg2.pdf

US Environmental Protection Agency- "Our Built and Natural Environment, a Technical Review of the Interactions between Land Use, Transportation and Environmental Quality. In the report, the U.S. EPA summarizes technical research on the relationship between the built and natural environments, as well as current understanding of the role of development patterns, urban design, and transportation in improving environmental quality.
http://www.epa.gov/livability/pdf/built.pdf

Appendix IV Part C: CCAP Detailed Analysis

TARGETED INFRASTRUCTURE FUNDING

Implementation Scale: State
VMT Reduction Potential Rating: High
Feasibility/Ease of Implementation Rating: Medium to Low

CONTEXT

Characteristic patterns of urban growth and development in post-WWII North America have created cities and regions that heavily depend on cars to meet transportation needs. Land use functions (residential, commercial, employment) are estranged from one another, origins and destinations are farther apart, infrastructure design is oriented toward the automobile, and low population densities are not conducive to public transportation. With the automobile as the only realistic mode of transportation, commuters are faced with increased driving distances and congested roadways. This has resulted in increasing VMT, deteriorating urban air quality and human health, increased greenhouse gas emissions, limited transportation and housing choices, inefficient use of infrastructure, and ultimately, communities that are less able to meet the needs of their residents.

Smart growth has emerged as a viable alternative growth strategy that can develop healthy and sustainable urban environments. The central tenet of smart growth is the return to more compact communities that are more walkable, more livable and less reliant on the automobile for daily transportation needs. A comprehensive smart growth effort that includes such measures as targeted infrastructure funding and transit-oriented development will reduce VMT and the resulting air toxics and greenhouse gas emissions, as well as promote physical activity (e.g., more walking, biking), improve public health, and preserve open space resources and wildlife habitat.

TARGETING INFRASTRUCTURE INVESTMENT

State governments direct the investment of billions of dollars of state and federal funding of transportation and other key infrastructure (schools, sewers, utilities). The reorientation of transportation and infrastructure spending towards efficient transportation and land use alternatives can enhance smart growth and air quality objectives. States can also use this 'power of the purse' to withhold funding from projects that do not conform to such policies, providing a strong disincentive for sprawling growth patterns.[li,lii,liii]

Targeting infrastructure funds to existing urban and suburban areas can help redirect growth inward, thereby relieving development pressures on greenfield areas at the urban fringe. Some states direct growth by prioritizing infrastructure funding for preferred areas, as defined by local governments and/or state criteria. Similarly, some states have adopted fix-it-first policies to instruct state agencies to build upon and maintain existing assets before investments are made in new infrastructure.[liv]

Targeted infrastructure funding can help states to grow in a more compact manner and provides greater accessibility and mobility options for individuals. Funding to enable and support denser development may be one of the most effective means for state and local governments to reduce VMT and criteria pollutant emissions in addition to slowing the loss of natural and agricultural land to development.

By reducing the growth of new urban greenfield areas through targeted infrastructure spending additional benefits can be achieved, including:

- reduced pressure on agricultural, open space and environmentally sensitive areas
- more efficient use of funds through greater inter-departmental coordination
- lowered infrastructure costs
- revitalization of downtown areas
- more efficient transit operation with higher development densities

Further, by targeting public investments to redevelopment areas local governments "can reduce risk by creating more upside potential for loan collateral".[lv] In other words, enhancing the value of these areas through public investment will make it a more palatable risk for developers and lending institutions.

FEASIBILITY IN MAINE

Maine is projected to grow nearly twice as fast is this decade than in the previous one. Channeling this growth into existing areas will significantly reduce the rate of VMT growth. Targeting infrastructure funding to built-up areas is consistent with the recommendations in the Brooking Report, *Charting Maine's Future: An Action Plan for Promoting Sustainable Prosperity and Quality Places*.[lvi] Brooking's recommends a variety of measures to help combat sprawl and encourage smarter development including large bond investments in existing town centers; the proposed *Maine Quality Places Fund* for example, promotes community revitalization and land and farm conservation.

Maine already has a successful case study in the area of targeted investment through its State Housing Authority. By scoring projects based on a number of criteria, including transit availability, the program sends a message to developers and local governments that this is the way development should be done if it is to receive State funding, thereby encouraging smarter development.

To build on this success, Maine should remove other possible barriers to the implementation of targeted infrastructure funding programs including:[lvii]

- contradictory government policies that promote smart growth principles while also maintaining incentives supporting uncontrolled growth at the same time
- lack of political leadership to co-ordinate land use, transportation and environmental decisions
- local regulations that do not effectively support smart growth goals
- resistance by local decision makers to implement state policies to actively redirect growth
- vague comprehensive plans with limited guidance on how to achieve goals or measure progress towards them

Another avenue for Maine would be to follow the example of recent efforts in California. With over $40 billion dollars in bonds passed in late 2006, efforts are underway to ensure that these bonds and their implementation plans are allocated in such as way as to decrease VMT, GHGs and petroleum dependence. It has been suggested that few governors "have been in as powerful — and enviable — a position to shape California's future growth".[lviii] In fact, even though the State government does not typically have a direct role in the growth patterns of its cities it "does 'set the table' for growth through spending decisions, especially on transportation projects".[lix] While half of the bond money, $20 billion through proposition 1B, is for transportation projects, only $1 billion of this has been allocated for specific projects. Other bond money that could be used to support this effort include the $5.4 billion open space and parks bond (Proposition 84) and the $2.9 billion housing bond (Proposition 1C). The latter already specifically sets aside $850 million for building projects in redevelopment areas and $300 million for TOD projects. State and local officials are working hard to ensure that all the bond monies will help target development into areas with rich transportation choices and that support efficient development patterns.

Massachusetts provides a good example of the potential effectiveness of a targeted infrastructure funding program. The Office of Commonwealth Development (OCD), which directs smart growth policies in the housing, transportation, energy and environment agencies, coordinates the allocation of $2 billion in state and federal funding to direct development in areas supported by pre-existing infrastructure.[lx] One of the central OCD initiatives is the *Commonwealth Capital* policy which strives to coordinate capital spending programs to ensure consistency between development projects and sustainable development principles. Specifically, it has developed a set of criteria that prioritize housing, transportation and parks funding for projects that promote efficient land use, travel alternatives and petroleum conservation. Commonwealth Capital serves as a tool to influence municipal land use practices by rewarding municipalities engaged in smart growth planning. The state has also introduced a *Fix-It-First Policy* which prioritizes maintenance of existing infrastructure over new construction. Fix-It-First has extended to transportation policy focusing on repairing the state's existing roads and highways and enhancing opportunities for transit and non-motorized transportation options.

New Jersey provides another good case study. In 2002, Governor James McGreevy issued *Executive Order 4* establishing the Smart Growth Policy Council.[lxi] The council's mandate was to ensure that State transportation and infrastructure funding, inter-departmental procedures, programs, and projects were consistent with the State Plan and smart growth principles. The state plan placed a high priority on investments in areas with existing infrastructure that would help create more compact growth patterns.

Implementing these targeted measures, as seen in the case studies, typically requires a high level champion who can navigate many barriers. For instance, since local decision makers are often resistant to the State setting (more) requirements on funding, the State needs to present a solid vision for the future that local leaders, and the public, can get behind. And while Maine does not have the billion dollars in bonds that California is currently grappling with, the State should leverage what money it does have to make changes where it can. Infrastructure typically has a 50 to 100 year lifespan, so small changes in current infrastructure spending will make a big difference over time.

VMT REDUCTION POTENTIAL

Targeted infrastructure funding is an option for which it is difficult to develop a priori quantification methods. Still, the difficulties in predicting a specific level of VMT reduction should not prevent a fix-it-first approach from forming the core of any comprehensive plan to manage VMT. Enhancing existing infrastructure rather than building new infrastructure would lead to more dense urban development, sustaining transit, reducing travel demand, and shifting mode split towards public transit (assuming options are available).

Although it is difficult to estimate the impact TIF has in isolation, the effects of a comprehensive policy can be generally estimated by looking at the relationship between urban density and VMT, and also the impact of infill growth versus greenfield growth. If the targeted infrastructure funding prevents greenfield development, this option will likely significantly reduce VMT growth.

Developing a Maine-specific quantification requires knowledge of the infrastructure likely to be targeted, understanding of the suite of complementary policies, and estimates of development diverted from greenfield projects. Thus, TIF is better suited to after-the-fact (ex post) analysis.

OTHER RESOURCES & REFERENCES

National Governors Association- a policy issue brief, "Fixing It First: Targeting Infrastructure Investments to Improve State Economies and Invigorate Existing Communities":
http://www.nga.org/cda/files/0408FIXINGFIRST.pdf
http://www.nga.org/cda/files/0408FIXFIRSTCHART.pdf

1000 Friends of Maryland- "Smart Growth: How is Your County Doing?" provides an overview of issues faced in Maryland counties with the implementation of their Priority Funding Areas:
http://www.friendsofmd.org/data/smartgrowth.pdf

US Environmental Protection Agency- Redeveloping brownfields with federal transportation funding:
http://smartgrowth.org/pdf/brownfields_tea21.pdf

Appendix IV Part C: CCAP Detailed Analysis

TRANSIT ORIENTED DEVELOPMENT

Implementation Scale: Site Level
Feasibility/Ease of Implementation Rating: Medium
VMT Reduction Potential Rating: High

CONTEXT

Characteristic patterns of urban growth and development in post-WWII North America have created cities and regions that heavily depend on cars to meet transportation needs. Land use functions (residential, commercial, employment) are estranged from one another, origins and destinations are farther apart, infrastructure design is oriented toward the automobile, and low population densities are not conducive to public transportation. With the automobile as the only realistic mode of transportation, commuters are faced with increased driving distances and congested roadways. This has resulted in increasing VMT, deteriorating urban air quality and human health, increased greenhouse gas emissions, limited transportation and housing choices, inefficient use of infrastructure, and ultimately, communities that are less able to meet the needs of their residents.

Smart growth has emerged as a viable alternative growth strategy that can develop healthy and sustainable urban environments. The central tenet of smart growth is the return to more compact communities that are more walkable, more livable and less reliant on the automobile for daily transportation needs. Transit-oriented development (TOD), which focuses development and transportation investments, along with other smart growth policies reduce VMT, mitigate the public health impacts of air pollution, promote physical activity (e.g., more walking, biking), reduce greenhouse gas emissions, and preserve open space resources and wildlife habitat.

WHAT IS TOD?

Transit Oriented Development is becoming recognized as a viable form of growth management that addresses the needs of rapidly growing communities both large and small. As defined by the California Department of Transportation, TOD typically integrates "moderate to higher density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the auto. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use."[lxii]

TODs facilitate reduction in household automobile usage through the provision of both accessible transit alternatives and local employment and retail locations. The development of systematic TOD networks can change transportation behaviors at both local and regional scales. Analyses of the travel characteristics of California TODs conducted by Lund et al. indicate a 5.0 times greater rate of transit use for residents of TODs than those of comparable or adjacent locations. Similarly, transit use for office workers was 3.5 times greater for TODs.[lxiii]

Transit oriented development can result in local and regional benefits in addition to reductions in VMT and associated air pollutant emissions. There are many economic, social and transportation benefits including:

- increased mobility options for heavily congested regions
- improved mobility for segments of the population, such as youth and the elderly, without access to cars
- enhanced public safety through the development of more pedestrian oriented communities
- increased cost effectiveness of transit investment through improved ridership
- potential reductions in household transportation costs of up to $3-4,000 per household annually[lxiv]
- preservation of agricultural and open space areas by redirecting greenfield development to urban areas
- increased local retail development and economic revitalization
- reduced public infrastructure costs through more efficient use of existing resources
- greater affordability of housing with increased densities and lower transportation costs

- rising property values and local tax revenues
- increased accessibility to housing options
- enhanced livability of communities through improvements in air quality, public health, accessibility to public spaces, commute times etc[lxv]

IMPLEMENTING TOD IN MAINE

Maine has a sparse population relative to its land area, with just 41 residents per square mile. Maine's population density ranks 38th among all states, and it is the least dense of the six New England states. Consequently, public transportation is not prominent in Maine and the state possesses a relatively high cost per resident of constructing and maintaining highway infrastructure. In 2000, vehicles traveled an estimated 14.2 billion miles on Maine roads, a 20 percent increase over 1990 levels. Over the next 20 years, it is estimated that the amount of VMT in Maine will increase more than 18 percent, to 17 billion.[lxvi]

While this growth in VMT is not unique to New England, Maine's landscape is. The state's small and medium-sized towns are widely interspaced between forest, farm and coastal landscapes that, while beloved by residents and visitors alike, create a land use and transportation planning challenge. How do you promote in-fill development, provide alternatives to single occupant vehicle driving and sustain cost-effective transit within these low density transportation corridors? Over the last two decades, despite greater relative spending on transportation, rapid growth in low-density development (e.g., strip malls), rural VMT and congestion have increased, exacerbating air pollution and greenhouse gas emissions from mobile sources. The environmental impacts are particularly harmful to Maine's sensitive ecosystems.

The report *Shifting Gears*, released by Natural Resources Council of Maine and Environment Maine, recommends supporting transit-oriented development as one of 20 policies to reduce VMT and reduce the state's GHG emissions.[lxvii] With the success of numerous TOD projects nationwide, the market demand for TODs is no longer considered a barrier to implementation. Still, these projects continue to face many implementation challenges[lxviii] including:

- lack optimal development standards and systems to coordinate development processes
- no cohesive regulatory and policy framework
- difficulty obtaining financing for mixed use developments due to concerns of private lenders, lengthy approvals processes and limited public funding in many regions
- local tax structure often promote large scale retail development over residential land uses
- poor transit design often isolates the station area from the community (i.e. limited pedestrian access and large parking facilities)
- obtaining development approvals is often slow as local zoning may be unsupportive of transit
- local community opposition based on density, traffic and parking concerns
- parking challenges impact costs, financing and public support[lxix]
- land aggregation is difficult, particularly, for urban and infill sites
- limited use of financial tools (i.e., tax increment financing)
- information and expertise on implementation is limited

A variety of broad implementation strategies have been used to promote Transit Oriented Developments nationwide and could work in Maine. They include:

- supporting TOD Planning through the transfer of federal transportation funds to local governments for TOD planning and implementation
- abatement of taxes for TODs to aid market development for higher density, mixed use communities
- transit joint development which allows transit agencies to use, sell or lease land that will help generate ridership
- direct participation of local governments in financing and building TODs

Further, in October 2006, the Brooking's Institution, released a report titled, *Charting Maine's Future: An Action Plan for Promoting Sustainable Prosperity and Quality Places*.[lxx] In it they recommend a variety of measures to help combat sprawl and encourage smarter development including, among others, large bond investments in existing town centers and providing incentives for towns to cooperate regionally. Maine's traditional town centers are the ideal place to plan for new development in efforts to help absorb

projected population growth. The proposed *Maine Quality Places Fund* and the Community Enhancement Fund could be important investment vehicles to help encourage measures such as TOD. The former is suggested to promote community revitalization and land and farm conservation, while the latter is suggested to provide grants to reform building codes, provide visioning assistance and planning tools for towns and provide incentives to encourage multi-city and regional-scale planning.

VMT REDUCTION POTENTIAL OF TOD IN MAINE

Generally, increases in transit use, walking and bicycling lead to local reductions in VMT of 20-30% from TOD. Achieving regional reductions - estimated at 5% for widespread TODs - would likely require locating new growth around multiple transit-accessible corridors.[lxxi] Consequently, air pollution emissions and energy consumption decrease for households within TODs. Rates of greenhouse gas emissions have been shown to be 2.5 to 3.7 tons per year per household lower within TOD locations.[lxxii,lxxiii]

A Canadian study found that the most significant emissions reductions result when development occurs in central regional locations, as opposed to more remote locations. Improving regional location can reduce CO_2 emissions 21 - 58%, while changing the 3-Ds (density, diversity and design) alone (without the context of regional access) can reduce CO_2 emissions by 15 - 50%.[lxxiv] Such savings from regional location are also seen in the well-cited Atlantic Station project (14-52%). Changing site design alone can also result in VMT savings of up to 6% (without changing mix of use, density or location).[lxxv]

While TOD is generically estimated to result in VMT reductions of 20-30 percent, it is important to note that this estimate is based on similar land use patterns differing only in access to transit. In practice, TOD will most likely be developed in conjunction with infill or smart growth policies. Therefore, site-specific VMT savings may exceed the generic 20-30 percent estimate. Also, since TOD will likely reduce the quantity of short vehicle trips taken (which contribute a greater proportion to mobile air toxics than indicated by proportional VMT), emission levels may drop by an even greater percentage than VMT (holding other things constant).

The reductions achieved from TOD in Maine will likely not meet the general estimates for either the local or regional areas however. Because Maine has fewer areas with population densities high enough to support transit and few destinations that are transit accessible, impacts in Maine will likely be lower than the general estimates.

Maine has three characteristics that reduce VMT savings from TOD--relatively low population density, ease of vehicle travel, and modest transit networks. For these reasons, overall use of transit in Maine is estimated to be only 0.5 percent of all trips taken. Within urban areas such as Portland, greater transit options and more transit accessible destinations lead to increased transit use--over 1.5 percent. According to PACTS modeling, areas within the city that have better transit options show an even greater level of transit use—approximately three percent on average. At the best locations, with good transit access and centrally located mixed-use development TOD's should expect a 3-5 percent improvement in mode split, with another 10 percent VMT savings possible through centralized location (i.e. shorter trip lengths). Of course, the actual impact of any TOD will be determined by location and development characteristics.

Standard assumptions regarding scale (5,000 trips per day), and trip length, combined with Maine and Portland transit characteristics predict the following VMT and emissions savings:

Transit Oriented Development	VMT Reduction (%)	CO2 (annual metric tons)	N2O (annual metric tons)	CH4 (annual metric tons)	Annual Fuel Cost Savings	Annual Fuel Savings (Gallons)
Total	**14%**	502	0.036	0.107	$102,200	51,100

Transit Oriented Development	NOx	PM-10	PM-2.5	SO2	CO	VOC
Annual Emission Reductions (Tons)	1.972	0.092	0.067	0.108	29.886	3.910
Tons Per Day	0.005	0.000	0.000	0.000	0.082	0.011

As urban density increases, and as more origins and destinations become transit accessible, the VMT reductions associated with TOD in Maine will increase.

OTHER RESOURCES & REFERENCES

California Department of Transportation- searchable database for 21 statewide TOD projects include information on stations, projects, processes photos and links to Caltrans:
http://transitorienteddevelopment.dot.ca.gov/

Caltrans- "Statewide Transit Oriented Development Study- Factors for Success in California" includes links to the executive summary, final report, technical appendices and supplementary report on parking and TODs: http://transitorienteddevelopment.dot.ca.gov/miscellaneous/StatewideTOD.htm

Envision Utah- provides information on Envision Utah's Transit-Oriented Development initiatives:
http://www.envisionutah.org/trans_land.html

Orenco Station Development- contains access to information on housing options within the transit oriented community and access to virtual tours:
http://www.orencostation.com/home.htm

Reconnecting America- Center for Transit Oriented Development provides access to resources that promote the further market development of TODs:
http://www.reconnectingamerica.org/html/TOD/index.htm

San Francisco Bay Area Rapid Transit District- "BART Transit-Oriented Development Guidelines" includes information on building and planning successful TOD projects:
http://www.bart.gov/docs/BARTTOD.pdf

The Brookings Institution- *Charting Maine's Future: An Action Plan for Promoting Sustainable Prosperity and Quality Places, October 2006***:**
http://www.brookings.edu/metro/maine

The Great American Station Foundation- website includes access to information, case studies and prominent reports on transit oriented developments:
http://www.transittown.org/

US Environmental Protection Agency- "Our Built and Natural Environment, a Technical Review of the Interactions between Land Use, Transportation and Environmental Quality":
http://www.epa.gov/livability/pdf/built.pdf

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[i] Cal Trans (2002) "Statewide Transit-Oriented Development Study Final Report": http://transitorienteddevelopment.dot.ca.gov/PDFs/Statewide%20TOD%20Study%20Final%20Report%20Sept.%2002.pdf

[ii] Lund et al. (2004) "Travel Characteristics of Transit-Oriented Development in California" http://www.csupomona.edu/%7Erwwillson/tod/Pictures/TOD2.pdf

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