Measure: Vehicle Maintenance and Behavior Education Program (T10)

This measure concerns a Vehicle Maintenance and Behavior Education Program (hereafter Program) to improve the fuel efficiency of vehicles registered in the City through fuel-efficiency education and tire-inflation inspection regulations.

The education component targets are the fuel efficiency and vehicle maintenance cost benefits of ensuring that vehicle tires are not under-inflated, engines are optimally working, and driving behaviors are adopted that improve fuel efficiency.

The regulations component targets the practices of professional vehicle maintenance businesses and fleet managers in order to ensure they include monitoring of fuel-saving conditions (particularly tire inflation) when vehicles are serviced.

Vehicle miles traveled (VMTs) in Tucson are estimated to be 93% gasoline-fueled and 7% diesel-fueled.This measure's goal is a 5% improvement of existing vehicles' fuel efficiency for 35% of the gasoline-powered vehicle miles traveled in Tucson. The measure would begin in 2011 and aim to maximize its fuel efficiency impacts to 35% of gasoline-fueled VMTs as soon as possible. .

Emission reduction potential 2020:	41,856 tCO_2e
Percentage of goal (2012):	NA
Percentage of goal (2020):	1.85%
Total annual average implementation costs:	$100,000
Entity that bears the costs of implementation:	City of Tucson
Cost/Savings per tCO_2e 2011-2020:	Savings $436/tCO2e
Net annual savings 2011-2020:	$16.8 million
Entity that realizes the financial return:	Vehicle owners
Equitability (progressive/regressive, income/revenue neutral, etc):	Likely neutral but could be progressive if fuel and maintenance savings accrue disproportionately to lower income households as expected
Potential unintended consequences:	Shift of citizen $$ expenditures from auto fuels and maintenance to other uses or savings

Background information:

Vehicles with under-inflated tires experience up to a 3.3% fuel efficiency penalty (based on each pound per square inch of under-inflation resulting in a 0.3% reduction). It is estimated that the average US vehicle has tires that are underinflated by 10-11 PSI.[1]

The State of California's Air Resources Board estimated in 2009 that 38% of vehicles in the state have "severely underinflated tires" at 6 PSI or more under full inflation, which is part of the rationale for its tire inflation regulations of 2010 (see below).[2]

Other vehicle maintenance techniques can also dramatically affect fuel efficiency, including repairing or replacing faulty oxygen sensors (40% effect), using the correct motor oil weight (1-2% effect) and optimal engine tuning (average 4% effect).[3]

Driving techniques alone can significantly affect fuel efficiency. The US government's Fuel Economy website estimates the efficiency differences of various techniques as follows:[4]

- Sensible rather than aggressive driving: 5-33%
- Observing speed limits: 7-23% (each 5 miles per hour over 60 increases the effective price per gallon of gasoline by 24 cents, assuming a pump cost of $2.87; other estimates are that for every 5 mph above 55, 10% of fuel economy is lost[5])
- Remove excess weight from vehicles: 1-2% for each 100 pounds
- Avoid excessive idling, use cruise control, and use overdrive gears: (no data)

So-called "hypermilers," who drive with a goal of maximizing fuel efficiency, as reported by many drivers of hybrids and recent vehicle models with clearly visible real-time fuel economy gauges, have obtained up to 62% higher than expected fuel use.[6]

Various opportunities exist for drivers to learn about the potential efficiencies from better maintenance and driving habits. None, however, are facilitated or required by the City of Tucson or State of Arizona at the present time – they require interest in the topic by the individual. Arizona's vehicle emissions programs periodically ensure that vehicles in urban areas are sufficiently tuned for maximum performance (low emissions translates into low fuel usage).

According to the State of Arizona's Environmental Quality Division, the emissions test initial failure rates in Pima County ranged from 10% to 12% over the three years 2007-2009. In 2009, vehicles built in the 1990s failed at rates ranging from 6-18% while vehicles built in the 2000s failed at less than 10%. Vehicles built in the 1980s represented 9% of tested vehicles but 20% of failures; 1990s vehicles represented 45% of tests and 44% of failures; vehicles built in the 2000s represented 43% of tests but

only 28% of failures.[7] These failure rates illustrate that potential exists to improve fuel efficiency by an educational program regarding the higher fuel costs and GHG emissions of driving un-tuned vehicles.

Status Quo/Business as Usual:

Information about the merits of fuel-efficient vehicle ownership is available on internet sites and in various print publications. However, given that the information has been available for many years and millions of gallons of fuel remains wasted, it cannot be expected that the waste will be solved without specific actions by the City.

An additional factor in reducing waste are technologies in newer vehicles that provide feedback to drivers on the fuel efficiency of their driving habits and/or tire inflation conditions. However, these systems will remain a small part of the overall vehicle inventory in the City for several years to come.

Description of Measure and Implementation Scenario:

The Program's goal can be stated two ways:

> (1) An reduction of xx million gallons of gasoline annually from vehicle fuel usage in the City via vehicle maintenance and usage strategies, or
>
> (2) An x% increase in fuel efficiency annually during yy% of VMTs through vehicle maintenance and usage strategies.

This measure uses the second approach, and is projected to save about four million gallons of gasoline per year when achieving 5% efficiency improvement for 35% of gasoline-fueled VMTs (93% of VMTs in Tucson).

The tire inflation regulation – that all tires will be inspected for inflation levels during any professional work on a vehicle and fixed as necessary – **is projected to comprise 70%** of the measure's effects. This projection is based on the assumption that the measure's tire inflation inspection regulation will cause 25% of vehicles to experience a 3% improvement in MPG because of inflating underinflated tires.

The remaining 30% of the emission reductions are projected to come through education and marketing the many reasons to ensure a vehicle is performing optimally, including the fact that tires and other components last longer, and that driving behavior adjustments can save drivers money, improve safety and lessen environmental impacts.

Specific data assumptions and projections are shown in Table 1. Vehicle miles traveled and related tCO2e emission projections for 2015 and 2020 were provided by PAG,[8] intervening years were extrapolated by Westmoreland Associates. The Program's

projected effects reflect gasoline VMTs only (93% of total VMTs) since diesel usage is a very small part of the private vehicle sector targeted by the Program.

Table 1: Program Fuel Savings Assumptions and Projections

Year	Vehicle Miles Traveled (gasoline, in billions)	Gasoline Saved by Program (millions of gallons)	tCO2e Saved by Program (thousands)
2012	4.32	4.02	36.6
2013	4.41	4.09	37.2
2014	4.51	4.16	37.9
2015	4.60	4.24	38.5
2016	4.70	4.31	39.2
2017	4.80	4.38	39.8
2018	4.90	4.46	40.5
2019	5.00	4.53	41.2
2020	5.10	4.61	41.9
Totals	42.3	39.4	353.5

Assumptions:

Program achieves 5% MPG improvement over 35% of gasoline-powered vehicle miles traveled in Tucson starting in 2012.

The Program will combine education and regulations:

- Vehicle owners will learn about the multiple benefits of vehicle maintenance for improved fuel economy and reduced maintenance costs beginning with driver's education courses and including traditional media, social media, driver testing (including influencing the State of Arizona to include fuel economy improvement strategies in driver's license tests), vehicle registration procedures, vehicle sales and repair sites, and all other reasonable means.

- Vehicle repair and fleet management operations will be encouraged or required to perform low-cost vehicle fuel economy checks such as tire inflation levels as part of maintenance procedures.

Has the Measure been implemented elsewhere and with what results:

Research did not find any similar measures in US states or municipalities.

The **State of California's** tire inflation regulation, which took effect 1 September 2010, requires the state's automotive maintenance industry to check the tire inflation of every vehicle it services. The regulation was projected to eliminate 700,000 metric tons of GHGs by reducing the state's fuel consumption by 75 million gallons per year.[9]

The Portland, OR, Climate Action Plan (2009) includes an objective of increasing the average fuel efficiency of privately owned vehicles to 40 MPG by 2030 (and improving performance of the roadway system), but does not include a program to help drivers improve their existing vehicle fuel economy among the actions to be completed before 2012.[10]

Burlington, VT, includes "pump up your tires" among the ten ongoing behavior recommendations for what citizens can do in support of a Climate Action Plan, but Burlington does not have a program that supports vehicle maintenance or driving behaviors for higher fuel efficiency.[11]

The **City of Boulder, CO, Climate Action Plan** includes a strategy that "all programs and initiatives will be designed to reduce vehicles miles traveled (and) purchase more efficient vehicles," and its transportation programs include "improve fuel economy of the public and private fleets," but none of the nine policy recommendations include improving existing vehicles' fuel efficiency.

Boulder's primary adopted strategy is to "support the Transportation Division's programs that reduce vehicle miles traveled." The City conducts a periodic Travel Diary Survey to update information, especially of selected populations, regarding travel behaviors – this system could be adapted to help the City of Tucson understand the effectiveness of its Vehicle Maintenance and Behavior Education Program on driving habits.

Boulder's "GO Boulder" program (GO stands for Great Options) was created as a management program for the improvement of citizen transportation behaviors; it received a grant in 2009 to develop a "one less car" campaign that would help citizens reduce vehicle miles traveled.[12]

Energy/Emission analysis:

This analysis assumes the following for the ten years 2011-2020:

- An average of 4.38 million gallons of vehicle fuels are saved, based upon MPG improvements of 5% for 35% of vehicle miles traveled, starting in 2012.[13]
- Combustion of one gallon of gasoline results in 19.7 pounds of CO_2 emissions.[14]
- The gasoline gallons saved were not produced in the City of Tucson (in other words, the emissions involved in the fuel's production and distribution (upstream lifecycle) are not also saved from the City's GHG inventory).

Climate Change Impact Summary in tCO_2e

COT 1990 Citywide GHG emissions (baseline):	5,461,020 tCO_2e
MCPA 7% reduction target for COT:	5,078,749
2012 BAU GHG emissions projection:	7,000,000
2020 BAU GHG emissions projection:	7,343,141
GHG emissions reduction to meet 7% goal (2012):	1,921,251
GHG emissions reduction to meet 7% goal (2020):	2,264,392
Contribution of this Measure in 2020:	41,856

Economic analysis:

Measure Costs

The Program is estimated to cost $100,000 per year for part-time administration, educational tool development and regulatory development and administration. Costs would likely be borne by local governments and/or donors/partners.

It is reasonable to expect program funding would be possible through vehicle maintenance surcharges (for example, a 0.5% tax on vehicle maintenance services) and sales of educational materials.

It is possible that regulations supporting the Program's goal could increase consumer costs of vehicle maintenance, depending on the nature of the regulations and the ability of vehicle maintenance providers to absorb the additional tire inflation check/fix requirements into fixed prices for oil changes, tire changes, full-service fueling, or other services that might trigger checks for optimal fuel performance.

Measure Benefits

The Program's success would result in savings to consumers in two ways:

- Reduced fuel costs
- Reduced maintenance costs

Reduced fuel costs are estimated at $157.2 million over nine years, or about $17.5 million per year, based on the Westmoreland fuel price projections for Tucson.[15]

Reduced maintenance costs start with properly inflated tires. Studies show vehicle-installed tire pressure monitoring systems can extend tire life by 4,700 miles,[16] or, viewed another way, 10-11% under-inflation reduces tire life 18%.[17] These potential tire cost savings are not counted as financial benefits in this analysis, but could be substantial.

Net Economic Impact

Net fuel expenditure savings to Tucson citizens: $157.2 million less $1,000,000 Program costs over ten years (starting 2011) = $156.2 million.

The benefits to Tucson citizens per tCO_2e reduced is projected at $489 in 2020, and $446 over the Program's nine years.

Using the economic impact multiplier for savings, the net economic impact in 2020 is projected to be $30.6 million. Net economic impact over the life of the program is projected to be $234.2 million.

Co-benefits:

The Program's co-benefits could include the following:

- Reduced auto accidents and therefore lower insurance rates due to less aggressive driving and improved vehicle maintenance
- Less traffic congestion because of less aggressive driving habits.
- Reduced auto expenses from the extended life of vehicle components such as tires and other components of existing vehicles (for example, one fuel efficiency tip is the use of synthetic motor oil that has benefits aside from efficiency).

Equitability:

There is no definitive data to determine the equitability of the proposed Program; programmatic equitability would only be measurable by surveys of people affected after the Program's implementation. However, pre-implementation surveys could be used to refine the Program's focus and techniques to maximize benefits to lower income citizens.

The Program will possibly have a stronger effect on the vehicle maintenance and driving decisions of people for whom money and time are scarce, as they are more likely to neglect vehicle maintenance. The higher emissions testing failure rates of older vehicles indicate that older vehicles are more likely to not be optimally tuned for fuel efficiency.

All income levels are able to maintain tire inflation levels or adjust driving behaviors at next to zero cost. Lower income citizens who saved on both gasoline and maintenance costs (e.g. tire replacement costs) would be saving more of their disposable income than high income drivers, who may be more likely to perform maintenance without education or regulations in any case.

If the Program as proposed were expanded to include financial rebates to citizens for "eco-modifications" to existing vehicles,[18] those rebates could include an income-qualifier to ensure the rebates would primarily accrue to lower income households.

Potential unintended consequences:

If successful, the Program will reduce expenditures on total vehicle operations, especially fuel costs but also maintenance, which may have a positive effect on the Tucson economy, depending on how people spend their savings.

Given that vehicle fuel expenditures have a very low local economic multiplier, the economic effect of saving fuel is likely to be positive rather than negative regarding fuels. Thus, we have applied the 1.5 economic impact multiplier to fuel savings.

However, reduced auto repair expenditures are not likely to have a lower local multiplier than what the maintenance savings would be spent on, and may have a negligible or even negative local economic impact.

Endnotes

[1] US EPA, Fuel Economy website: www.fueleconomy.gov/feg/maintain.shtml. For original data see: Oak Ridge National Lab, "Owner Related Fuel Economy Improvements," prepared by Energy and Environmental Analysis Inc., 2001, at: http://www.fueleconomy.gov/feg/pdfs/OwnerRelatedFuelEconomyImprovements.pdf.

[2] California Environmental Protection Agency, Air Resources Board, "Tire pressure check will save money, gas and lives," news release 26 March 2009, at: http://www.arb.ca.gov/newsrel/2009/nr032609b.htm.

[3] US EPA / Department of Energy, Fuel Economy website: www.fueleconomy.gov/feg/maintain.shtml.

[4] US EPA / Department of Energy, Fuel Economy website: http://www.fueleconomy.gov/feg/driveHabits.shtml. The Ecomodder website offers 108 driving techniques to improve fuel efficiency at: http://ecomodder.com/forum/EM-hypermiling-driving-tips-ecodriving.php.

[5] Joshua Zumbrun, "How to Increase your Gas Mileage," Washington Post, 6 August 2006, at: http://www.washingtonpost.com/wp-dyn/content/article/2006/08/03/AR2006080301403_2.html.

[6] Joshua Zumbrun, "How to Increase your Gas Mileage," Washington Post, 6 August 2006, at: http://www.washingtonpost.com/wp-dyn/content/article/2006/08/03/AR2006080301403_2.html.

[7] State of Arizona Department of Environmental Quality, Air Quality Vehicle Emissions report 2007-2009, at: http://www.azdeq.gov/environ/air/vei/download/032410stats.pdf.

[8] Provided by PAG's Senior Air Quality Planner Suzanne Cotty on behalf of PAG's planning staff, January 2011.

[9] The final regulation order by the CA Air Resources Board is available at: http://www.arb.ca.gov/regact/2009/tirepres09/tirefinalreg.pdf.

[10] City of Portland and Multnomah County, "Climate Action Plan 2009," p. 45, at: http://www.portlandonline.com/bps/index.cfm?c=49989&a=268612.

[11] City of Burlington VT, Climate Action Plan website, "Live A Greener Life," at: http://burlingtonclimateaction.com/what-you-can-do/live-a-greener-life/.

[12] City of Boulder, "Community Guide to Boulder's Climate Action Plan – 2009/2010 Progress Report," at: http://www.bouldercolorado.gov/files/Environmental%20Affairs/climate%20and%20energy/Community_Guide/CAP_Guide-2010-final_with_council_justified.pdf. See also the

GO Boulder website: http://www.bouldercolorado.gov/index.php?option=com_content&task=view&id=8774&Itemid=2973; and the Boulder Climate Action Plan of 2006 at: http://www.bouldercolorado.gov/files/Environmental%20Affairs/climate%20and%20energy/cap_final_25sept06.pdf.

[13] The diesel/gasoline consumption ratio was provided by Pima Association of Governments Air Quality program, and is used in the PAG's GHG Inventory 2010.

[14] US EPA, "Emission Facts: Average Carbon Dioxide Emissions Resulting from Gasoline and Diesel Fuel," at: http://www.epa.gov/oms/climate/420f05001.htm.

[15] Prices are based on the following assumptions: Tucson gasoline prices are 5% below the national projection by the Electrification Coalition; diesel prices are 16% above the Tucson price. These assumptions closely reflect current prices of $2.75 per gallon for gasoline and $3.19 for diesel at the beginning of 2011.

[16] California Air Resources Board, " ARB clarifies requirement of tire inflation rule", Jan. 2010, at: http://www.arb.ca.gov/newsrel/newsrelease.php?id=81.

[17] Nitrogen Tire Inflation website, "Go Green With Nitrogen Tire Inflation," 11 May 2009, citing NHTSA studies, at: http://tirenitrogen.typepad.com/tirenitrogen/2009/05/index.html.

[18] A list of 65 potential modifications is available at: http://ecomodder.com/forum/fuel-economy-mpg-modifications.php.