Measure: Warm Mix Asphalt (E1, E1b, E19a)

This measure calls for the substitution for a lower GHG emissions form of asphalt (warm mix) for the more standard, hot mix, form.

Note: The 2010 update to the City's Greenhouse Gas Inventory does not include emissions from asphalt use in the City. Thus, this measure is not analyzed in the context of the City's 2012 or 2020 emissions reduction goals. There may still be cost and emissions reductions value in pursuing the substitution of hot mix with warm mix asphalt and this potential is discussed below.

Emission reduction potential by 2020:	1,420 tCO_2e/yr
Percentage of goal (2012):	N/A – not in inventory
Percentage of goal (2020):	N/A – not in inventory
Total annual average implementation costs:	$0
Entity that bears the costs of implementation:	N/A
Savings per tCO_2e:	$145
Net annual savings:	$61,000
Entities that realizes the financial return:	City of Tucson and private asphalt customers
Equitability (progressive/regressive, income/revenue neutral, etc):	Neutral
Potential unintended consequences:	Depends on durability of warm asphalt

Background information:

Warm mix asphalt (WMA) is an alternative to standard hot-mix asphalt, where different chemicals are used to allow asphalt to be made and applied at considerably lower temperatures of around 50-100 degrees F. Mixing and paving at lower temperatures translates to lower energy usage as well as lower volatile emissions in the paving process.

There are multiple WMA methodologies; at least 14 suppliers are currently marketing to the U.S. The WMA methodologies can be roughly grouped as those that use some type of organic additive or wax, those that use a chemical additive or surfactant, and those that use water for foaming.[1]

Description of Measure and Implementation Scenario:

We do not provide an implementation scenario relative to the City's emissions reduction goals. Use of warm instead of hot asphalt is a decision of the City's Transportation Department and the city's private asphalt customers.

Has the Measure been implemented elsewhere and with what result:

A commercial paving company first used Mead MestVaco's EVOTHERM (one of many warm mix asphalt technologies) in Escondido, CA in September 2009.[2]

At Boston's Logan Airport runways were resurfaced using warm-mix asphalt and this project was expected to result in the reduction of 3,600 tons of carbon dioxide compared to the use of hot mix asphalt.[3]

Energy/Emission analysis:

We did not conduct an emissions analysis relative to the City's 2012 goal as emissions from asphalt paving of road, parking, and other surfaces "were not included in either the Community or Government inventories. The inventory contents followed the format of the CACP model - energy use, transportation and waste, although if information was available, those emissions could be place in the "other" category. As per the design of the inventory, 1990-2008 data would be needed."[4]

However, using analyses contained in earlier work for the City by a University of Arizona student, the emissions savings potential of warm v. hot mix asphalt can be understood and considered in perspective to other measures being analyzed.

The approximate asphalt use in the United States is reported at 111.4 tons per 1,000 per capita.[5]

The Pima Association of Governments estimates that Tucson had a population of 546,549 in 2010. Using these values, Tucson asphalt use in 2010 would total 60,886 tons/year and may grow 1.89% per year (PAG population growth projection).[6]

Carbon dioxide emissions attributable to asphalt use have been reported by the National Asphalt Pavement Association, and amount to 0.023 tCO_2e per ton of hot mix asphalt.[7]

If Tucson uses 60,886 tons of hot mix asphalt per year for various purposes, the carbon intensity of this usage would total 1,400 tCO_2e/year.

Warm mix asphalt produces 20-40% less greenhouse gas emissions than does hot mix asphalt.[8] Using the mid-point of the 20-40% range, the savings from a complete conversion from hot mix to warm mix asphalt in Tucson would amount to .30 x 1,400 = 420 tCO_2e/year.

Climate Change Impact Summary in tCO_2e.

COT 1990 Citywide GHG emissions (baseline):	5,461,020
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:	NA – not counted in inventory

Economic analysis:

Measure Costs

There are no additional costs identified.

Measure Savings

The reported fuel savings from producing warm mix asphalt is typically 30-35%, which translates into an approximate cost savings of $1.00/ton or more.[9]

Therefore, for the total asphalt use in Tucson estimated at 60,886 tons/year, we estimate the City of Tucson's cost savings at $61,000/year.

The annual savings per tCO_2e would amount to ~$145.

Net Economic Impact

We do not apply the economic impact multiplier of 1.5 since asphalt has a strong local production component – so it is unlikely that the savings on asphalt would be spent in the local economy with a higher multiplier than asphalt. Net economic impact is estimated to be $61,000/yr.

Co-benefits:

Government and industry have identified multiple co-benefits of warm mix asphalt. They include:

1. Safer Environment For Employees (Emissions & Odors)
2. Reduced Greenhouse Gasses
3. Reduced Fuel Usage (Lowers Energy Costs 10-30%)
4. Compaction Aid

5. Can Pave In Cooler Weather And Still Obtain Density
6. Longer Haul Distances While Still Maintaining Workability
7. Extended Paving Season
8. Able To Pave Over Crack Sealant
9. Less Hardening Of Binder (Appearance & Longer Life)
10. Earlier Opening To Traffic[10]

Fuel savings on the WMA projects monitored thus far indicate that burner fuel savings of 20 to 35 percent are possible.

Equitability:

No significant effects.

Potential unintended consequences:

The use of coal-tar sealants on any asphalt surface, warm or hot mix, should be avoided due to increasing evidence of coal-tar toxicity. Asphalt pavement sealants are reported to provide “dramatically lower levels” of benzo(a)pyrene, a toxic chemical used in coal-tar sealants.[11]

Endnotes

[1] Asphalt Magazine. March 10, 2009. http://www.asphaltmagazine.com/singlenews.asp?item_ID=1679&comm=0&list_code_int=MAG01-INT.

[2] http://www.wesernemulsions.com/static/index.cfm?action=group&contentID=32.

[3] USA Today. 2009. "Clean landing: Boston airport lays green runway." http://www.usatoday.com/travel/flights/2009-09-20-boston-logan-green-runway_N.htm.

[4] Communication with Ms. Susanne Cotty, Pima Association of Governments. January 10, 2011.

[5] Nation Master. November 2009. http://www.nationmaster.com/graph/ene_bit_asp_con_for_non_use_percap-consumption-non-uses-per-capita.

[6] Pima Association of Governments. Population Estimates. http://www.pagnet.org/RegionalData/Population/PopulationEstimates/tabid/582/Default.aspx.

[7] National Asphalt Pavement Association. July 2009. "Environmental Alert." http://www.hotmix.org/index.php?option=com_content&task=view&id=449&Itemid=72.

[8] D'Angelo, J. et al. (2008) Warm Mix Asphalt: European Practice. US Department of Transportation. http://www.warmmixasphalt.com/submissions/68_20080223_FHWA-PL-08-007.pdf.

[9] Transportation Engineering and Road Research Alliance. June 2009. http://www.terraroadalliance.org/documents/terrafactsheet_wma_05.pdf.

[10] http://nwpma-online.org/resources/09Spring_WarmMixAsphalt_ShaunaTeclemariam.pdf.

11 "New doubts cast on safety of common driveway sealant." Chicago Tribune. January 15, 2011.