

October 14, 2008

## Paving: The New Realities

### Overview

State Department of Transportation (DOT) executives frequently have to choose between concrete and asphalt paving materials for roads and highways. Changes in material markets have caused additional challenges in this decision making. Asphalt paving costs have increased 97% during the past 5 years and more than 30% during the past eighteen months, according to the Bureau of Labor Statistics. Regional shortages have materialized. These conditions reflect changes in the global economy that have increased the feed costs for asphalt and resulted in new refining practices that reduce liquid asphalt supply. Furthermore, these conditions may imply long-term structural trends and a permanent change in relative paving costs.

State Department of Transportation executives must consider these new paving cost realities in the context of competing population and demographic trends. Anticipated gains in the driving age population, for example, suggests a need to expand America's highway systems. At the same time, the aging of America's population will add to the burden of entitlement spending, such as Medicaid – potentially at the expense of state infrastructure funding.

PCA believes the combination of sustained high asphalt prices, challenging budgetary pressures, as well as the need to improve and expand highway infrastructure have created extremely favorable conditions for significant increases in concrete highway paving. The purpose of this Flash Report is to provide specifiers accurate information about the implications of sustained high oil prices on initial bid and life cycle paving costs and to assess the potential upside risk to PCA cement consumption projections.

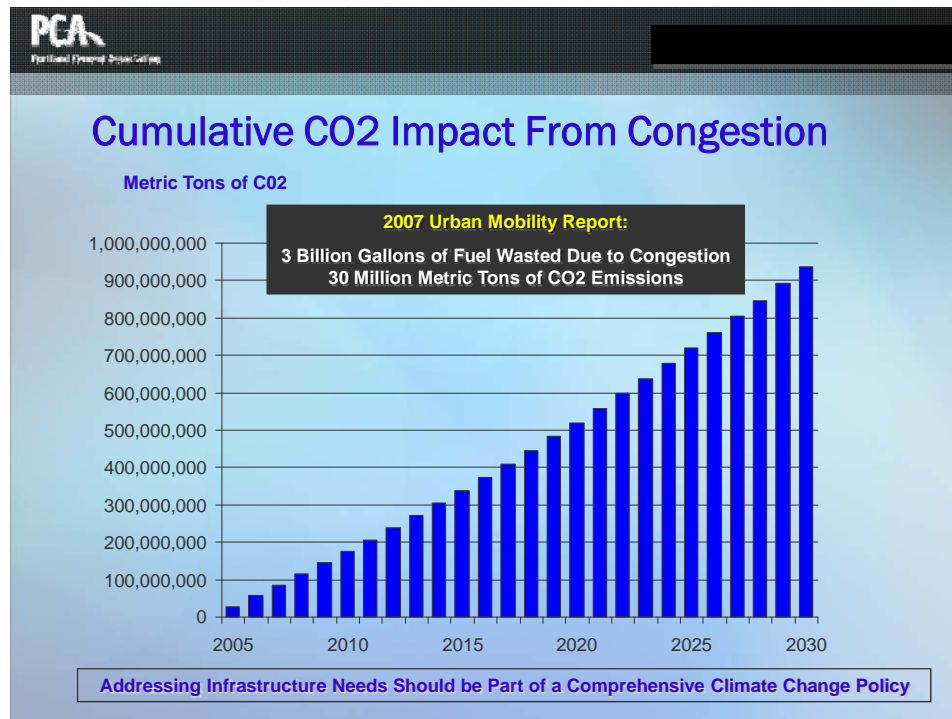
### **Point 1: Demographic trends suggest that nearly 50 million additional drivers will be on US roads by 2030.**

In the past 25 years, investment in highways and roads has not kept pace with demographic changes. This has led to increased traffic congestion, wasted fuel, higher CO2 emissions, wasted time, and increased logistical costs to the detriment of economic growth. According to the American Society of Civil Engineers, \$1.6 trillion is needed during the next five years to repair/and or rebuild the existing highway infrastructure to acceptable conditions.

Demographic changes forecasted for the next 25 years suggest the need not only to repair the United States' aging highway infrastructure, but to expand it as well. By 2030, the United States is expected to add 49 million licensed drivers, an increase of 24% over 2007 levels, vehicle registrations are expected to increase by 58 million vehicles, and total vehicle miles travelled is expected to increase 49%.

Without accelerated investment in highways traffic congestion will worsen leading to increases in wasted fuel, CO2 emissions and to overall cost to the nation's economy. If the trends of the past 25 years are sustained, PCA estimates the following by 2030 (see PCA's Highway Congestion Flash Report);

- Peak traffic delays facing the average commuter is expected to increase from 38 hours per year to nearly 50 hours per year in 2032.
- Wasted fuel accrued to congestion delays is expected to increase from more than 3 billion gallons in 2007 to 6.5 billion gallons in 2032.
- Annual emissions attributed to congestion delays increased from 27.2 million metric tons of CO<sub>2</sub> in 2007 to nearly 60 million metric tons by 2032.
- Wasted fuel, time, and higher transportation costs resulted in a cumulative cost on the economy of roughly \$150 billion annually.

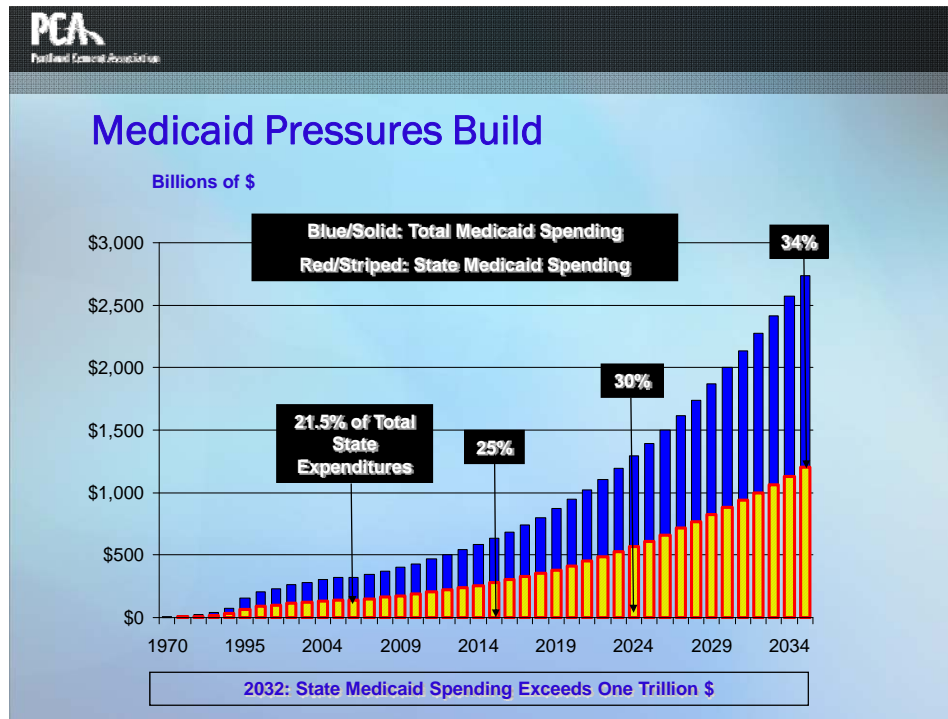


**Point 2: The “Aging of America” will require significant increases in entitlement spending, resulting in new state budget stresses.**

The need to accelerate highway investment, coupled with new budgetary pressures, suggest that states must re-assess how to best stretch scarce infrastructure investment dollars. Even with increases in federal funding, much of the responsibility to maintain and expand the nation’s infrastructure will inevitably fall on the shoulders of state and local governments. The updating and increasing existing highway infrastructure may be compromised by competing state entitlement responsibilities and diminished federal support.

- Currently, nearly 23% of total state spending is directed at Medicaid. As the population ages, Medicaid spending will increase. Medicaid spending is expected to account for 34% of total state spending by 2030 – potentially at the expense of highway and infrastructure spending.
- States are largely responsible for the expansion and maintenance of public highways.

- Increased federal support may not fill the potential shortfalls in necessary highway infrastructure spending. Revenues from federal gasoline taxes, which are fed into the Highway Trust Fund and used to support highway spending, remain at 18.4 cents per gallon and have not been increased since 1994. Since that time, construction costs have increased dramatically. Tax revenue from \$1 dollar of gasoline in 1994 that supported \$1 of highway spending now supports only 66 cents of highway spending – diminishing the effectiveness of federal support. Federal gasoline taxes are not scheduled for review until 2011. To overcome this shortfall, states must look into other ways to generate revenue. Gas taxes are only one way to fully fund infrastructure renewal at the local, state and federal levels. Fair user fees, public/private partnerships, and sales-tax sharing are all options that may materialize in the future.



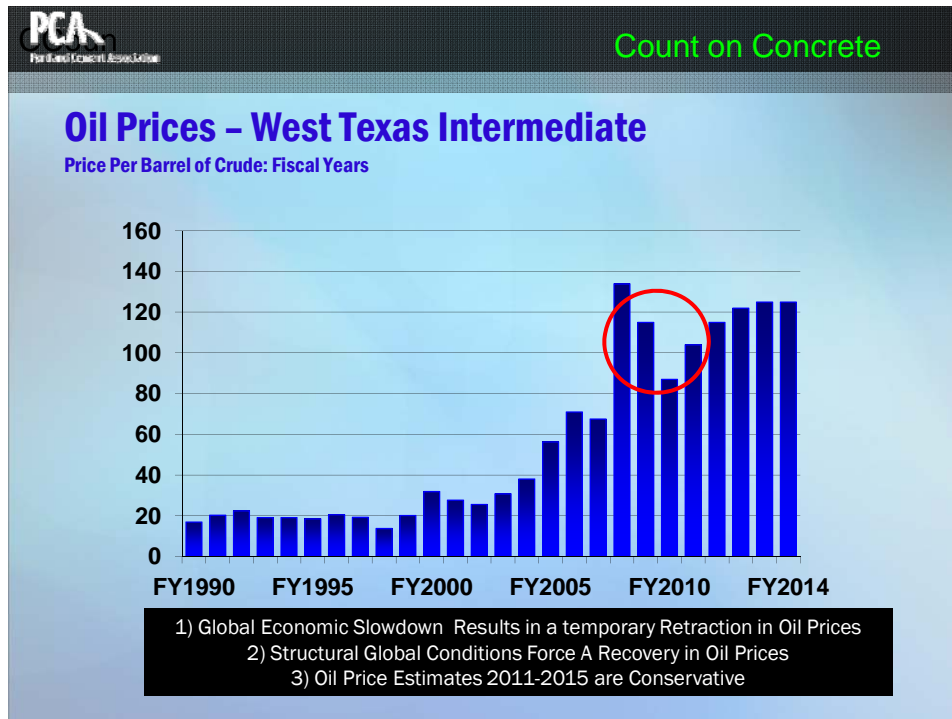
### Point 3: Structural changes in global oil markets imply that high oil prices may be a permanent condition.

Oil prices are highly volatile. While oil prices are expected to decline as the global economy weakens, PCA expects West Texas Intermediate (WTI) oil will remain very high compared to historical standards - even in the face of the current economic slowdown.<sup>1</sup> Once stronger world economic growth returns, PCA expects oil prices will fluctuate in the \$135 to \$115 per barrel range, with a yearly average of \$125 per barrel during 2011-2015.

Recent increases in oil prices reflect significant changes in global demand. World economic growth is no longer dictated by conditions in the United States, Western Europe, and Japan. Emerging markets are increasingly becoming a major driver in world growth conditions and oil consumption. While China dominates this sphere (accounting for roughly 10% of world oil consumption), it is a mistake to dismiss the strong growth conditions materializing among other emerging markets. Longer-term world economic growth is expected to be characterized by buoyant growth among developing and transitional economies – adding new demand pressures on oil prices.

<sup>1</sup>PCA's near-term oil price projections are significantly lower than the Energy Information Agency's estimates. Estimates may be biased in favor of asphalt.

Synchronized world economic growth has led to rapid increases in demand and reduced overall world excess oil production capacity. This diminished buffer implies that extraordinary occurrences, such as refinery outages, take a more meaningful economic toll on oil prices. Furthermore, international supply is constantly threatened by political instability, particularly in Iraq, Iran, Nigeria, and Venezuela. Faced with limited excess capacity, upward pressure on prices could emerge rapidly as a result of political instability in both OPEC and non-OPEC regions.



Despite the current economic downturn, it is likely that future economic growth among emerging economies will again result in strong and sustained increases in global oil demand. This could outstrip the ability of oil producers to increase production – leading to sustained high oil prices and amplifying the future escalation in asphalt prices.

**Point 4: Asphalt paving costs have increased dramatically.**

Asphalt paving materials represent a mix of aggregate (stone), sand or gravel, and crude refined Bitumen, also called “liquid asphalt.” Liquid asphalt is a sticky black residual obtained from the refining of crude oil and acts as the binding agent for asphalt. Since liquid asphalt is a residual from crude oil refining, as oil prices rise, liquid asphalt prices increase.

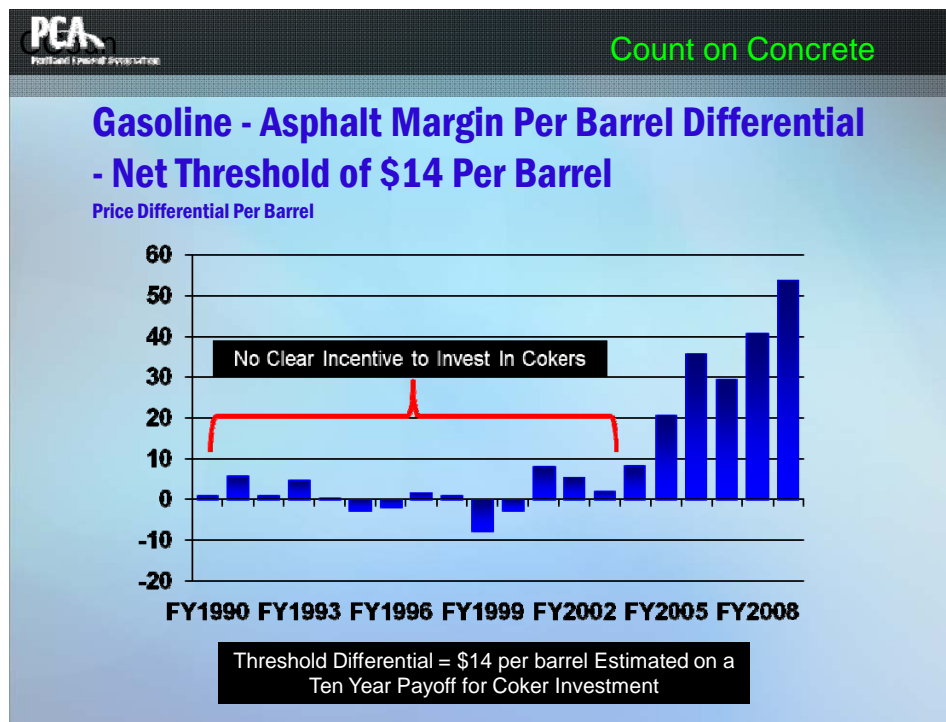
Since 2003, oil prices have increased 350%. Heavy crude oil is a feedstock to asphalt and oil price increases are an important reason explaining increases in asphalt prices. Liquid asphalt has increased 250% during the past five years and has led to a doubling of total asphalt paving costs, according to the Bureau of Labor Statistics. These increases have stressed state DOT budgets – forcing many to cut back on paving projects and important infrastructure improvement programs – to the eventual detriment of commuters, the environment, and commerce.

Going forward, a future run-up in asphalt prices will be increasingly determined not by higher oil prices but by unfolding changes in oil refining practices which has led to a reduction in heavy crude production.

### Point 5: Emerging changes in refining practices will lead to a significant reduction in future liquid asphalt supply.

The price run-up in gasoline, diesel and other fuels (light crude products) has resulted in large margins for these products. In response, crude oil refineries in the United States have made the long-term decision to shift production to light crude products and away from lower margin heavy crude products, such as liquid asphalt. To shift production, plants supplement existing refining processes with equipment called “cokers.” The cokers increase the refinery’s ability to produce more higher margin, light crude products, such as gasoline, per barrel of oil. Refineries with cokers installed produce less lower-margin residual products such as liquid asphalt.

Based on a ten-year investment payback to make installing cokers viable, PCA estimates the threshold margin differential between light and heavy crudes is roughly \$14 to \$15 per barrel. Currently the margin differential is \$67 per barrel. As a result, United States refineries plan to invest in 23 new coker projects by 2014. Of these, 16 projects are expected to be installed at refineries that currently produce liquid asphalt. In the context of sustained high margin differentials between light and heavy crude products as well as government mandated ultra-low sulfur diesel requirements, crude refiners may add even more cokers in the years ahead.



Announced new coker capacity additions are expected to reach 467,800 million barrels per day by 2014 – reducing United States liquid asphalt supply by more than 31% from 2006 levels. This translates into more than 10 million metric tons of reduced asphalt supply.

### Point 6: Shortages further price escalation will characterize the future asphalt market.

The installation of cokers and the shift in refining practices resulted in regional shortages of asphalt in 2007. According to a report by Nustar, the third largest domestic liquid asphalt producer, the United States faced an asphalt supply shortage of roughly 24,000 barrels per day (bpd) -- contributing to the

recent run-up in asphalt prices. Asphalt supply conditions were tightest in the East Coast region (45,000 bpd short fall), followed by the South Western region (6,100 bpd short fall), and the Mountain region (2,500 bpd shortfall).

---

**Pierce County, Washington: A sudden and severe shortage of liquid asphalt has reduced 2008 planned chipsealing on Pierce County roads from about 70 lane miles to 22. The asphalt product became unavailable from any local source at any price, due to a sudden halt in manufacturing at the Tesoro refinery in Anacortes. Pierce County Road Operations manager Bruce Wagner, said "The production of liquid asphalt has become less profitable than other crude oil products like gasoline and diesel fuel, so they stopped making it. We have to do more with less the rest of this year."**

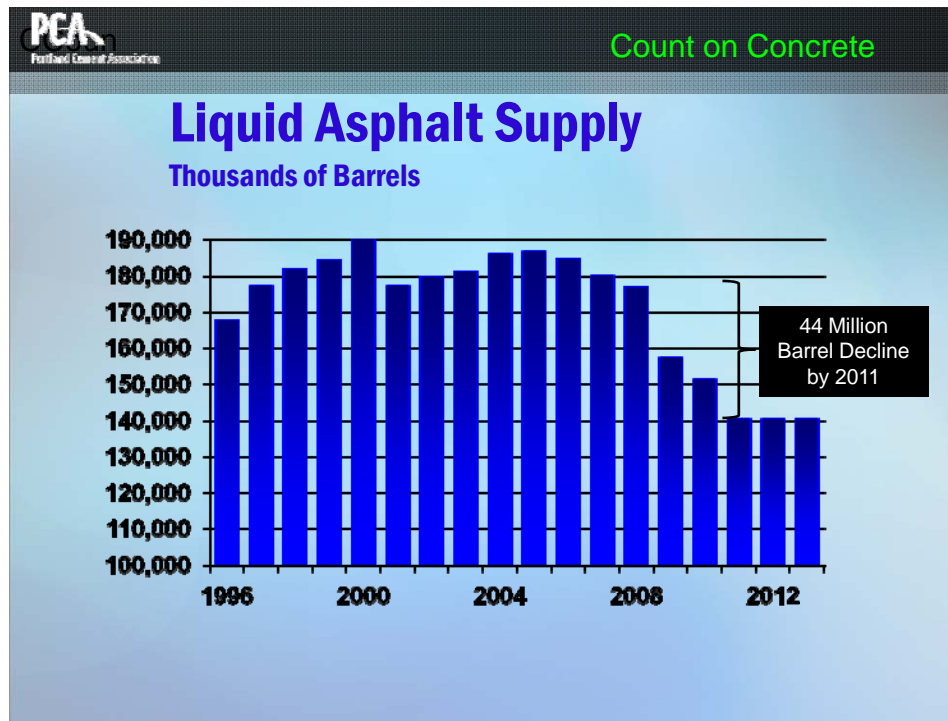
---

As refineries bring more cokers on-line, asphalt supply problems will magnify. Near term, liquid asphalt supply reductions may be masked by weak paving demand. According to PCA estimates, coker expansions will reduce liquid asphalt supply by roughly 4 million metric tons by 2010. The current economic slowdown is expected to worsen state budget conditions during

<b>Current United States Coker Capacity Projects at Asphalt Producing Refineries</b>										
<b>- Firm and Probable Expansions</b>										
<b>Company</b>	<b>Refinery</b>	<b>Start-Up</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Frontier	Cheyenne, Wyoming	2007	1.4	4.3	4.3	4.3	4.3	4.3	4.3	4.3
Cenex	Laurel, Montana	2007	2.5	15.0	15.0	15.0	15.0	15.0	15.0	15.0
Frontier	El Dorado, Kansas	2008	----	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Sinclair	Sinclair, Wyoming	2008	----	3.3	20.0	20.0	20.0	20.0	20.0	20.0
Holly	Artesia, New Mexico	2009	----	----	20.8	25.0	25.0	25.0	25.0	25.0
Sinclair	Tulsa, Oklahoma	2009	----	----	16.6	28.5	28.5	28.5	28.5	28.5
Marathon	Garyville, Louisiana	2010	----	----	----	36.7	44.0	44.0	44.0	44.0
Marathon	Catlettsburg, Kentucky	2010	----	----	----	30.8	37.0	37.0	37.0	37.0
Conoco Phillips	Wood River, Illinois	2010	----	----	----	21.7	65.0	65.0	65.0	65.0
Hunt	Tuscaloosa, Alabama	2010	----	----	----	3.7	11.0	11.0	11.0	11.0
Marathon	Detriot, Michigan	2010	----	----	----	3.3	20.0	20.0	20.0	20.0
Valero	St. Charles, Louisiana	2010	----	----	----	1.7	10.0	10.0	10.0	10.0
BP/Husky	Toledo, Ohio	2011	----	----	----	----	20.8	25.0	25.0	25.0
Atofina Petrochemicals	Port Arthur, Texas	2011	----	----	----	----	41.7	50.0	50.0	50.0
BP	Whiting, Indiana	2011	----	----	----	----	46.7	80.0	80.0	80.0
Conoco Phillips	Wood River, Illinois	2013	----	----	----	----	----	----	17.5	30.0
Total Thousands of Barrels Per Day			3.9	25.6	79.8	193.6	392.0	437.8	455.3	467.8

2008-2010 – resulting in the potential for reductions in public paving activity. As a result, the supply reductions in liquid asphalt may not become immediately apparent.

Beyond 2010, the magnitude of looming asphalt shortages are likely to become more severe. Two key factors account for this assessment: First, paving requirements are likely to recover as the economy recovers and state fiscal balances improve. Second, the trend toward increased implementation of delayed cokers by refineries will continue unabated unless the margins on liquid asphalt improve dramatically – that means even higher asphalt prices. Currently, the spread between light and heavy



crude (liquid asphalt) is roughly \$67 per barrel. Such increases in asphalt prices will probably only be narrowed in the context of large, sustained shortages. Even if the light-heavy crude price spread is eventually eliminated, it will only arrest the trend toward coker installations and continued decline in asphalt supply

### **Point 7: Liquid asphalt import supply will likely become more expensive and unreliable.**

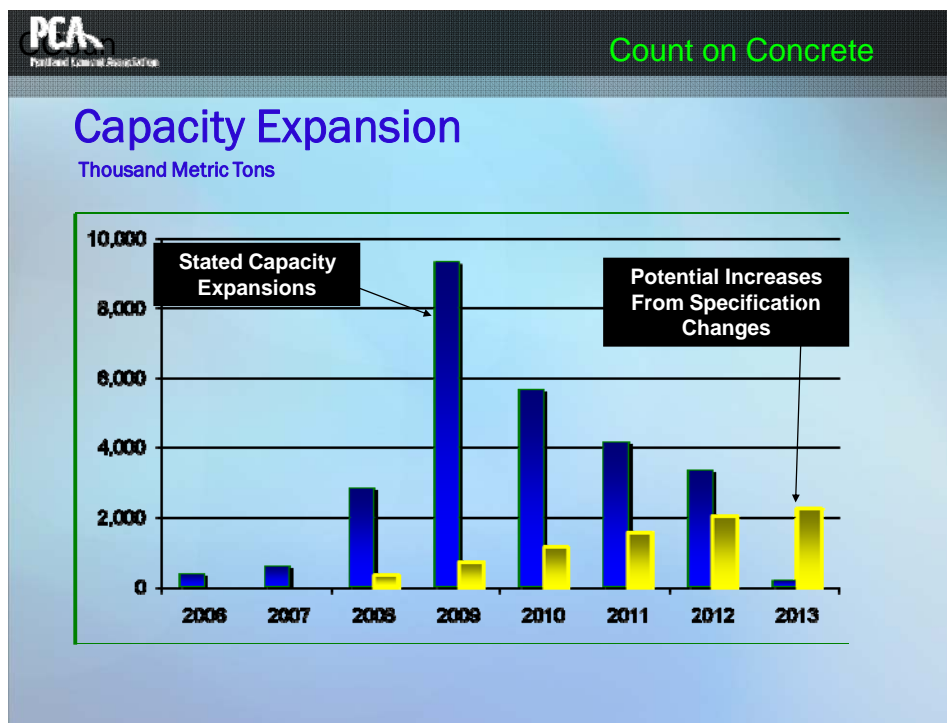
Future potential domestic shortages in liquid asphalt cannot be “cured” by increased reliance on imports. Historically, 94% of United States liquid asphalt consumption has been supplied domestically and roughly 2 million metric tons imported. PCA estimates a 10 to 12 million metric ton shortfall in liquid asphalt supply will materialize by 2014. This implies that imports would need to increase by at least five fold to close the potential gap between consumption requirements and domestic supply.

The trend toward increased use of cokers is not just a United States phenomenon – it’s global. All independent analysis surveyed by PCA suggests a reduction in world asphalt supply in the years ahead. Supply changes are expected to materialize in the context of world economic growth and growing non-U.S. paving requirements. The availability of foreign sources of liquid asphalt supply is expected to be squeezed, resulting in the potential for high import prices and unreliable supply. High and volatile freight rates add uncertainty to the reliability of import supply. During 2004-2005, roughly two-thirds of United States’ liquid asphalt imports were sourced from Venezuela. Using petroleum exports as a political tool,

the Chavez government has imposed asphalt export restrictions. In 2007, liquid asphalt imports from Venezuela accounted for only 35%. Political uncertainty to Venezuelan asphalt supply remains likely for the foreseeable future. Overall, 2007 liquid asphalt imports declined by 21% from 2006 levels, despite high asphalt prices and shortages in the United States – perhaps an indication of the future vulnerability of reliance on imported liquid asphalt supply.

**Point 8: Dramatic expansion of cement capacity insures reliability of paving supply.**

The cement industry’s dramatic \$6.5 billion capacity expansion has increased the reliability of a concrete supply for paving purposes. During 2006-2013, the cement industry will add 26 million metric tons of new clinker capacity – or roughly 28.5 million metric tons of cement capacity (allowing for gypsum and limestone additions). This investment will increase domestic capacity by more than 25% and dramatically reduce the industry’s dependence on imports.



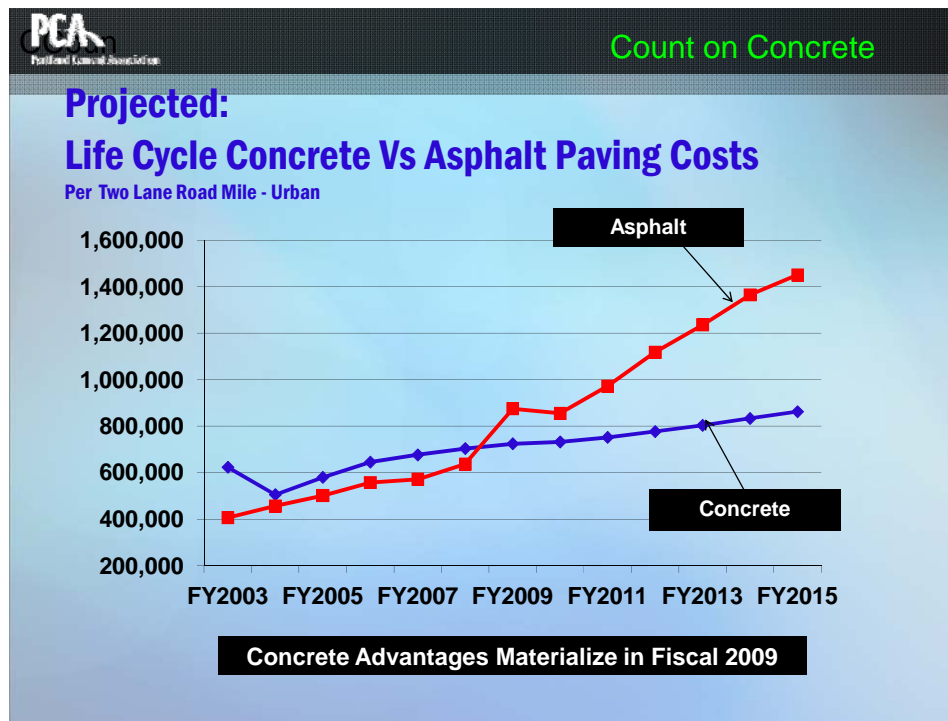
**Point 9: Concrete’s life cycle paving cost advantages compared to asphalt are likely to improve considerably in the future.**

The need to accelerate highway investment, coupled with new budgetary pressures, suggests that states must re-assess how to best stretch scarce infrastructure investment dollars. When roadways are viewed as a long-term public investment, life cycle paving cost analysis is used to provide estimates on the expected cost involved in paving and maintaining roadways during a long period of time.

Concrete road systems are more durable and require fewer resurfacings and lower maintenance costs during the lifetime of a road compared to asphalt roads. According to various state DOT records, asphalt pavements require resurfacing at an average age of 9.9 years, and in some cases, as short as 6 years. That implies 3 to 5 resurfacings during a 30-year time horizon. In contrast, the average age of a concrete pavement before any need for maintenance is 25 to 30 years or longer. That implies ONE resurfacing during a 30-year time horizon.

Even with concrete’s sustainability advantages, some estimates of life cycle costs favored asphalt over concrete. Using DOT software to calculate life cycle costs for a one-mile “standard” two lane roadway, PCA calculates asphalt paved roads enjoyed an \$80,000 advantage compared to a concrete paved road in fiscal 2005 – roughly a 13% savings. Given the “old” realities, it is understandable asphalt paved roads accounted for 94% of all state and local roads. Past comparisons of asphalt versus concrete, however, are irrelevant. Structural changes in the global economy and refining practices have created new paving realities

The new paving realities now show that comparative life cycle cost assessments favor concrete in the context of higher asphalt prices. Using DOT software to calculate life cycle costs for a one-mile “standard” two lane roadway, PCA calculates concrete paved roads currently enjoy more than a \$150,000

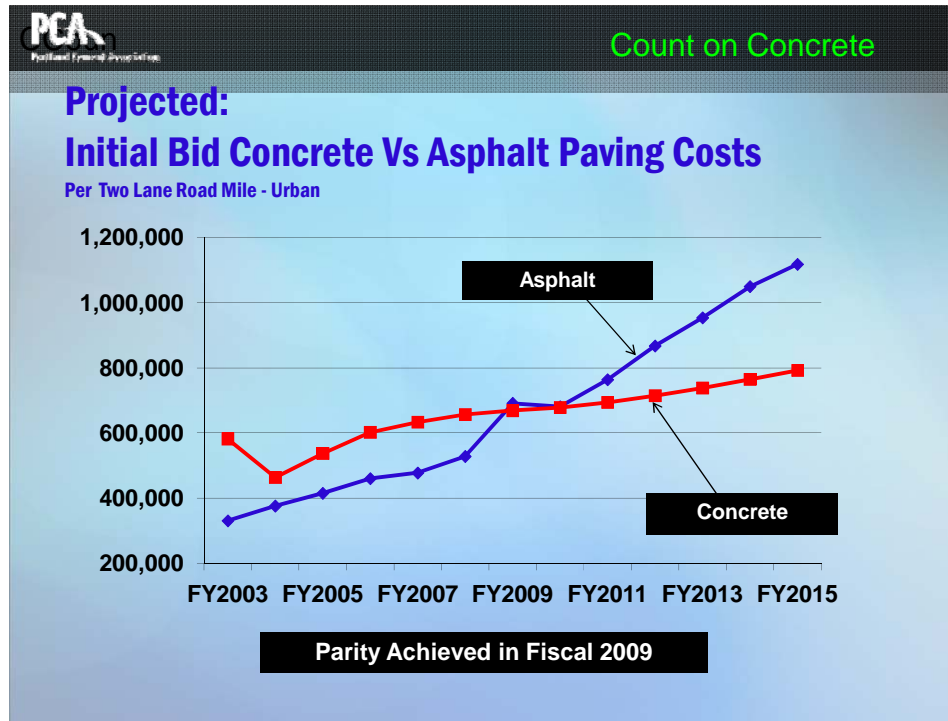


advantage over an asphalt paved road – roughly a 17% savings. As the supply dynamics facing the asphalt industry continue to unfold, PCA estimates concrete’s life cycle cost advantage per one-mile “standard” two lane roadway will increase to nearly \$590,000 – roughly a 41% savings.

**Point 10: Concrete’s “initial bid” paving cost have reached parity with asphalt and are likely to improve considerably in the future.**

Faced with the strain to meet short-term state budget objectives, state DOT executives sometimes place more emphasis on the initial bid paving cost of a new road. Initial bid costs have long favored paving roads with asphalt. Using DOT software to calculate initial bid costs for a one-mile “standard” two lane roadway, PCA calculates asphalt enjoyed a \$120,000 cost advantage over a concrete paved road in 2005 – roughly a 23% advantage.

The new paving realities, however, have already taken hold. Fiscal 2009 initial bid costs are currently near parity. Allowing for the structural supply changes facing asphalt, comparative initial bid costs will increasingly favor concrete paved roads. Using DOT software, PCA estimates by 2015 concrete paved roads will enjoy a \$325,000 initial bid cost advantage over asphalt for a one-mile “standard” two lane roadway – roughly a 29% savings.



**Point 11: Concrete paved roads could save state DOTs billions of scarce dollars in state spending.**

During 2008-2015, approximately 14.9 million additional licensed drivers will be on United States’ roadways. If congestion levels are to be maintained at 2007 levels, more than 75,000 highway lane miles must be added annually. Given the supply challenges facing asphalt, if all roads in 2015 were paved with concrete, state governments would save \$12.2 billion in initial costs. During the road’s life cycle, the savings resulting from paving with concrete compared to asphalt would total nearly \$22.1 billion dollars. The cumulative initial paving cost savings during the 2009-2015 is estimated at \$49.1 billion dollars and the cumulative 30-year life cycle cost savings would total roughly \$103.4 billion dollars.

**Point 12: Conclusion**

State Department of Transportation executives frequently have to choose between concrete and asphalt paving materials for roads and highways. In the past, paving cost estimates favored asphalt – resulting in 94% of all paved highways. New paving realities are now in place – reflecting changes in global oil demand and new refining practices that reduce liquid asphalt production. The new paving realities now show that comparative life cycle and initial bid cost assessments will increasingly favor concrete over asphalt in the foreseeable future. If expansion of new highways keeps pace with demographic changes, roughly 75,000 new lane miles will be paved annually. Every 10% increase in concrete paved roads’ share of the new highways translates into as much as 5.5 million metric tons of cement consumption.