Portland Cement Association

Concrete Overlay Opportunity Assessment

April 2013

Market Intelligence Group

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Concrete Overlay Market Potential

Overview

The National Concrete Pavement Technology Center (NCPTC) asked the Portland Cement Association (PCA) to assess the potential size of the United States' concrete paving overlay market. This report provides rough estimates regarding the potential of overlay volume, both nationally and regionally.

This report is divided into three sections. The first section estimates total paving activity. The second section estimates concrete overlay potential based on the impact of relative price movements and improving fiscal conditions. The final section ranks the states regarding paving potential.

Section 1: Size of Overlay Paving Market

The United States' road system is large. Not all roads, however, are candidates for repaving in a given year. The maximum annual overlay potential, concrete or otherwise, is estimated in a three step process, nationally and by state. The first step is to identify the size of the stock of roads, in terms of lane miles. In the second step, roads identified as in "good and worst" condition are excluded from the analysis since they are not in need of immediate repair. In the final step, stock of roads that are candidates for overlay are converted into annual paving activity. This represents the maximum annual overlay potential.

Stock of roads by class and paving material.

To estimate the size of the annual overlay market, the stock of paved lane miles must first be established. The United States roadway system is comprised of roughly 8.5 million lane miles, of which 5.6 million lane miles are paved. Interstates, major arterials, and minor arterials (primary road system) represent 27% of paved lane miles. Collector and local roads (secondary road systems) capture the largest share of paved inventory at 73% of total lane miles. Most regions share similar composition while the West has a slightly higher share of primary roads.

Road System by Class

Paved Lane Miles (2010)

Census Region	Interstate	Major Arterial	Minor Arterial	Collector	Local	Total
Northeast	39,152	45,114	67,818	122,857	473,662	**748,603**
South	95,733	187,508	194,204	445,151	1,330,443	**2,253,038**
Midwest	65,081	136,879	164,689	440,875	726,650	**1,534,174**
West	67,286	106,142	111,079	268,070	488,695	**1,041,271**
National	**267,251**	**475,643**	**537,790**	**1,276,952**	**3,019,450**	**5,577,086**

Source: FHWA --Tables HM-60, PCA

Road System by Class

Share of Network (2010)

Census Region	Interstate	Major Arterial	Minor Arterial	Collector	Local	Total
Northeast	5%	6%	9%	16%	63%	**100%**
South	4%	8%	9%	20%	59%	**100%**
Midwest	4%	9%	11%	29%	47%	**100%**
West	6%	10%	11%	26%	47%	**100%**
National	**5%**	**9%**	**10%**	**23%**	**54%**	**100%**

Source: FHWA --Tables HM-60, PCA

According to the Federal Highway Administration's (FHWA) data on lane miles by surface type, 5.3% of all paved roads employ a concrete surface nationally. While concrete is used to surface 29% of the total primary road system in the United States, it captures less than 3% of the secondary road system. The secondary road system is responsible for the lion's share of paved lane miles, which totals nearly 4.3 million, while the total primary road system equals to roughly 1.3 million lane miles.

For the purpose of this study, roads which are already paved in concrete are included alongside asphalt and composite pavements. Despite previously being captured, concrete stock should still be considered promotable as it could be overlaid with asphalt. Composite surfaces are a mix of hot mix asphalt (HMA) and portland cement concrete (PCC). Occasionally the pavements are initially constructed using a mix of both materials, but through industry consultation it is safe to assume this category represents original PCC pavement which has been rehabilitated with a HMA overlay. For analysis purposes, all composite lane miles are assumed to be asphalt.

Paved Lane Miles

Census	Total Primary Roads			Total Secondary Roads			Total Road System		
Region	Concrete	Composite	Asphalt	Concrete	Composite	Asphalt	Concrete	Composite	Asphalt
Northeast	7,714	64,068	78,784	5,716	95,701	489,295	13,430	159,769	568,079
South	43,485	60,025	365,701	31,439	93,975	1,619,950	74,925	154,000	1,985,651
Midwest	60,659	112,410	189,617	62,775	140,612	953,535	123,434	253,023	1,143,151
West	24,056	14,152	240,971	6,110	8,265	728,019	30,166	22,417	968,990
National	**135,914**	**250,656**	**875,073**	**106,041**	**338,553**	**3,790,798**	**241,955**	**589,209**	**4,665,871**

Source: FHWA --Tables HM-60, HM-51, (2008 Figures) PCA Analysis

Paving Shares

Census	Total Primary Roads			Total Secondary Roads			Total Road System		
Region	Concrete	Composite	Asphalt	Concrete	Composite	Asphalt	Concrete	Composite	Asphalt
Northeast	5%	43%	52%	1%	16%	83%	2%	22%	77%
South	9%	13%	78%	2%	5%	93%	3%	7%	90%
Midwest	17%	31%	52%	5%	12%	82%	8%	17%	75%
West	9%	5%	86%	1%	1%	98%	3%	2%	95%
National	**11%**	**20%**	**69%**	**3%**	**8%**	**90%**	**4%**	**11%**	**85%**

Source: FHWA --Tables HM-60, HM-51, (2008 Figures) PCA Analysis

Roads not considered for overlay in a given year.

Not all roads are candidates for repaving in a given year. Roads that have recently been paved or are in good condition are typically not candidates for repaving. These roads are excluded from our analysis. PCA used the International Roughness Index (IRI) data from the FHWA as a proxy for road quality. The IRI is a universal measurement used to evaluate the smoothness of a road.

	Road Conditions *Paved Lane Miles*		
Road Conditions	**Primary Roads 2010**	**Secondary Roads 2010**	**Total Road System 2010**
No Work Needed	952,758	677,477	1,630,235
Overlay Candidate	326,147	2,911,434	3,237,581
Needs Reconstruction	1,778	707,491	709,270
Total	**1,280,684**	**4,296,402**	**5,577,086**

Source: FHWA --Tables HM-64, PCA Analysis

	Road Conditions *Paved Lane Miles (%)*		
Road Conditions	**Primary Roads 2010**	**Secondary Roads 2010**	**Total Road System 2010**
No Work Needed	*74.4%*	*15.8%*	*29.2%*
Overlay Candidate	*25.5%*	*67.8%*	*58.1%*
Needs Reconstruction	*0.1%*	*16.5%*	*12.7%*

Source: FHWA --Tables HM-64, PCA Analysis

PCA divides the IRI data into eight cohorts measuring road quality.[1] Low IRI measurements imply good road quality. PCA excludes roads in the two lowest IRI cohorts and are referred in the above table as "No Work Needed". High IRI measurements imply poor road quality. PCA excludes roads in the two highest IRI cohorts and are referred in the above table as "Needs Reconstruction." The remaining four categories

[1] IRI units are grouped into eight cohorts: <60, 60-94, 94-119, 120-144, 145-170, 171-194, 195-220, and >220. Roads with a low IRI value are smoother and in better condition, requiring less maintenance. These grades can be appraised as "<60" being the best conditioned roads, likely the newest, with the lowest priority of maintenance to ">220" being the most need of repair/reconstruction. From FHWA's Highway Statistics table HM-64: *Length by measured pavement roughness, all systems*, PCA was able to distribute paved lane miles into the 8 IRI divisions. The limitation here was that there was only data for the primary road system and therefore did not include local or collector roadways. To find distributions for the secondary road system, PCA used averages derived from five individual state reports that focused on road conditions. It is also noted that IRI allowable tolerances can vary between road classes with interstates having a higher tolerance. For analysis purposes, all systems are assumed to be bound in the same IRI rating in regards to identifying resurfacing candidates. Given interstates' minor overall share, it is not expected to have a material impact on the analysis.

fall into “Overlay Candidates.” Approximately 58% of all paved lane miles qualify as potential overlay candidates. Of the primary road system, about 26% of lane miles are candidates for overlays, while approximately 68% of the secondary road system (Local and Collectors) fall into this category.

The four excluded IRI cohorts represent 42% of all lane miles in the U.S. PCA’s analysis assumes no overlay activity occurs among these IRI cohorts during a given year. This assumption may carry some upside risk. Some county and local officials carry out paving work on an “ad hoc” basis and may not completely reconstruct a road in one of the highest IRI categories.

Converting the stock of roads into annual paving activity.

In an ideal world, transportation agencies would “repave” all roads that deteriorate beyond a predetermined point. Budget constraints, however, force DOT’s to prioritize paving initiatives and only repair a small portion of their road stock in a given year. This impacts annual paving activity.

PCA’s estimates for repaving activity are based on analysis of Oman data. Complete and easily accessible Oman paving data was limited in many states for repaving activity. PCA assessed repaving activity for five states where the Oman database was considered most complete and easily accessible. These five states were combined using a weighted average and assessed against the total stock of DOT responsibilities to determine share of lane miles resurfaced annually. According to this analysis, roughly 6% of the stock of roads that are candidates for repaving, actually get repaved in a given year.

Repaving schedules are likely to vary depending upon the roads’ usage. PCA applied different re-pavement schedules to different road types. Repaving activity assumptions among different road types were based on the overall average of 6% of stock. Higher traffic roads probably need to be serviced more frequently. Local roads, that are used less, do not receive the same level of attention and repaving is more likely allowed to be postponed in lieu of higher paving priorities. PCA, as a result, assumes nearly 4% of local and collector roads need to get repaved annually. In contrast, higher use roadways, such as interstate roadways, need repaving more often. PCA assumes 8% of these roads are repaved annually. Following similar logic, other principle arterial and minor arterial are assumed to be repaved at a rate of roughly 7% and 6%, respectively.

These assessments are based on a rather small sample of state paving activity. PCA, as a result, performed two cross-checks on these results. Both cross-checks generally validate the conclusions reached using the Oman sample. For the total stock of roads, using the Oman data, PCA’s analysis implies repaving occurs every 23 years – 18 years for primary roads and 26 years for secondary roads.

Total System Repaving Activity

Estimated Lane Miles Repaved Annually

	Total Primary Roads			Total Secondary Roads			Total Roads		
	2000	**2010**	**2020**	**2000**	**2010**	**2020**	**2000**	**2010**	**2020**
Lane Miles	65,276	71,464	76,752	156,656	166,390	178,130	221,932	237,855	254,881
Percent of System Repaved Annually	*5.6%*	*5.6%*	*5.6%*	3.9%	3.9%	3.9%	4.3%	4.3%	4.3%

Source: PCA

Section 2: Concrete Overlay Potential

A simple approach toward estimating concrete overlay potential.

Given annual repaving levels, PCA estimates the potential volume of cement that could be used if concrete overlays were applied to the qualified roadways. Three market potentials for concrete overlays are offered based on market penetration assumptions. The ***maximum*** potential annual volume estimate of nearly 55 million metric tons by 2020 assumes ***all roads*** in the *IRI Overlay Candidates* subcategory are repaved with concrete overlays. Garnering only 10% of the overlay market implies nearly 5.5 million metric tons annually by 2020, and 6.0 million metric tons by 2030. Stated alternatively, every one percent increase in overlay market share translates into more than half a million metric tons of cement consumption.

To convert lane miles into potential concrete/cement volumes, overlay thickness for each road type must be assigned. To this end, PCA conducted a survey of concrete paving engineers and regional promotion executives. Based on the survey results, and further discussion with concrete paving experts, overlay thickness assumptions by class of road was determined. Overlay thickness for interstates through arterial classes are assumed to be 10 inches in depth, while collector and local roads were assumed six and four inches, respectively. Calculations for the amount of cement tons per lane mile were applied to the amount of final paved lane miles for each of the specified road types. Overall, the weighted average overlay depth is six inches.

Total Roads Concrete Overlay Potential

Estimated Overlay Cement (Metric Tons) Volume Potential By Market

	Total Primary Roads			Total Secondary Roads			Total Road System		
United States	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
100% Market Share	18,588,680	19,971,388	21,298,044	33,162,557	35,472,789	37,669,012	51,751,237	55,444,176	58,967,056
10% Market Share	1,858,868	1,997,139	2,129,804	3,316,256	3,547,279	3,766,901	5,175,124	5,544,418	5,896,706
1% Market Share	185,887	199,714	212,980	331,626	354,728	376,690	517,512	554,442	589,671

Source: PCA

Estimated Overlay Cubic Yards of Concrete (000s) Potential By Market

	Total Primary Roads			Total Secondary Roads			Total Road System		
United States	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
100% Market Share	81,790	87,874	93,711	145,915	156,080	165,744	227,705	243,954	259,455
10% Market Share	8,179	8,787	9,371	14,592	15,608	16,574	22,771	24,395	25,946
1% Market Share	818	879	937	1,459	1,561	1,657	2,277	2,440	2,595

Source: PCA

Estimated Overlay Square Yards of Concrete (000s) Potential By Market

	Total Primary Roads			Total Secondary Roads			Total Road System		
United States	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
100% Market Share	490,741	527,245	562,268	875,492	936,482	994,462	1,366,233	1,463,726	1,556,730
10% Market Share	49,074	52,724	56,227	87,549	93,648	99,446	136,623	146,373	155,673
1% Market Share	4,907	5,272	5,623	8,755	9,365	9,945	13,662	14,637	15,567

Source: PCA

This approach to market potential offers one simple conclusion – the concrete overlay market potential is very large. Furthermore, this approach puts into perspective the huge size of the overlay market and points out that caution should be used in assigning market share targets to judge promotion successes.

Concrete does not play in the entire overlay market.

There is a ceiling in terms of concrete's market share potential. While some successes have occurred, concrete typically does not compete well in the three inch or less overlay market due to cost, convenience, and/or other technical factors. Data regarding the usage of overlays by depth for the entire road system is limited. Using Oman data, PCA identified projects with three or more hot mix asphalt (HMA) items. Projects with multiple HMA items indicate a potential thickness greater of at least four inches. Compared against total paving activity, the difference implies the size of three inches or less market.

Using this approach, PCA estimates that the "three inches or less" overlay market captures roughly one third of the primary and interstate overlay market. Unfortunately, Oman largely does not cover local roads in most states. As a result, no data exists for this segment. Local road usage of less than three inch asphalt overlays is considerably more prevalent than among primary roads and interstates. Based on our discussions with various paving experts, PCA assumes two thirds of local roads are comprised of three inches or less overlays. These roadways are excluded from concrete paving potential. This assumption carries considerable risk given the size of the local road market in terms of paving activity and concrete overlay potential.

Promotable Concrete Overlay Potential

Estimated Overlay Cement (Metric Tons) Volume Potential By Market

	Total Primary Roads			Total Secondary Roads			Total Road System		
United States	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
100% Market Share	12,392,453	13,314,258	14,198,696	11,054,186	11,824,263	12,556,337	23,446,639	25,138,521	26,755,033
10% Market Share	1,239,245	1,331,426	1,419,870	1,105,419	1,182,426	1,255,634	2,344,664	2,513,852	2,675,503
1% Market Share	123,925	133,143	141,987	110,542	118,243	125,563	234,466	251,385	267,550

Source: PCA

Estimated Overlay Cubic Yards of Concrete (000s) Potential By Market

	Total Primary Roads			Total Secondary Roads			Total Road System		
United States	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
100% Market Share	54,527	58,583	62,474	48,638	52,027	55,248	103,165	110,609	117,722
10% Market Share	5,453	5,858	6,247	4,864	5,203	5,525	10,317	11,061	11,772
1% Market Share	545	586	625	486	520	552	1,032	1,106	1,177

Source: PCA

Estimated Overlay Square Yards of Concrete (000s) Potential By Market

	Total Primary Roads			Total Secondary Roads			Total Road System		
United States	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**	**2010**	**2020**	**2030**
100% Market Share	327,161	351,496	374,846	291,831	312,161	331,487	618,991	663,657	706,333
10% Market Share	32,716	35,150	37,485	29,183	31,216	33,149	61,899	66,366	70,633
1% Market Share	3,272	3,515	3,748	2,918	3,122	3,315	6,190	6,637	7,063

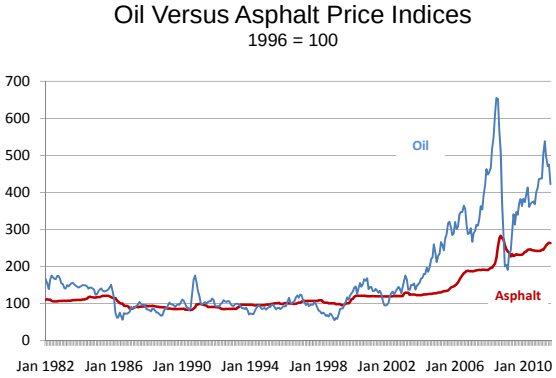
Source: PCA

Based on these assumptions, the overlay market in which concrete actually competes is much smaller than the entire overlay market. While PCA estimates the total 2010 paving overlay market comprised of 242 thousand lane miles, concrete only competes for roughly 106 thousand lane miles. Based on this logic, the maximum concrete paving potential at 100% penetration of the greater than three inch overlay market is slightly more than 25 million metric tons in 2020, compared to 55 million metric tons for the total overlay market. If a 10% market of promotable potential can be obtained, PCA estimates concrete overlays would contribute an additional 2.5 MMT of annual cement demand. The point here is that concrete does not compete in ***all*** paving arenas.

Promotion expectations, as a result, should be based only on promotable arenas of potential success. PCA estimates that the current concrete share of the promotable overlay market is roughly 1.6%.[2] This is a soft number and can vary considerably by state from 0% to as high as 4%. Even after factoring out arenas that concrete overlays do not compete, the concrete overlay market potential is very large.

Concrete's overlay potential will be helped by an improving competitive position.

PCA expects market share gains in the overlay market will be achieved in the coming years. This assumes the continuance of promotion education and advocacy successes that have been achieved in recent years and allows for changes in the relative price of concrete versus asphalt. Keep in mind, recent budget cuts have forced some regional promotion groups to reduce paving efforts—possibly adding downside risks to our projections.



Source: Bureau of Labor Statistics, Producer Price Indices

Between 2000 and 2009 asphalt prices increased 89%. Concrete prices increased 47% during the same period. PCA estimates that concrete/asphalt paving cost parity for new urban roads was reached in 2009.[3] Since 2009 asphalt prices have increased 20%. Concrete prices have not increased. This implies concrete holds a relative cost advantage among certain types of roadways.

PCA expects oil based products will increase in price more rapidly than concrete during the next 10 years, perhaps longer. Asphalt prices are highly correlated to the price of oil. Crude oil is the principal feedstock for asphalt. Therefore, oil price movements are reflected in asphalt costs. While other factors contribute to asphalt pricing, such as the use of cokers at oil refineries, roughly 60% of long-term asphalt price increases are accounted for by oil price changes.

Currently, oil prices are high by historical standards and are expected to rise further as global demand increases. Oil prices are expected to experience a long term rise because the global economy is undergoing structural change. Emerging and lesser developed economies account for a greater proportion of global GDP growth, and as a result, are placing greater demand for commodities.

Once stronger world economic growth returns, oil prices are expected to ramp up quickly. The Energy Information Agency (EIA) agrees with this scenario for world growth and the resulting impact on world oil prices.[4] According to the EIA's base case scenario, oil prices are expected to rise from $91 per barrel currently and reach $145 per barrel by 2025 and nearly $216 per barrel by 2035[5].

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[2] This estimate is based on The National Concrete Technical Center's estimate of 10 million square yards of concrete overlays for 2012. PCA converts this into lane miles based on a five inch depth used by NCPTC. These lane miles are then divided by the promotable arena. This yields the existing market share estimate.

[3] PCA Market Intelligence, Paving: The New Realities. 2011. http://www.cement.org/econ/pdf/PavingRealities1111.pdf

[4] The EIA is a United States' federal government agency (the old Department of Energy)

Correlation analysis between annual percent changes in oil prices and the six month lagged annual percent change in asphalt prices suggest asphalt prices rose 7% for every 10% increase in oil prices during the past 10 years. Based on this analysis and EIA's oil price projections, asphalt product prices could be expected to rise roughly 8% by 2015, 48% by 2025 and 81% by 2035.

Overlay Potential & Relative Cost Impacts

Cement (Metric Tons)

	Market Size		*Cost Factors*	*Market Impacts*		
Year	Overlay Potential	Promotable Potential	Relative Cost	Annual Demand (MT)	Competitive Arena Market Share	Overall Potential Share
2012	52,475,041	23,779,016	118	376,794	1.6%	0.7%
2017	54,327,194	24,626,888	116	798,537	3.2%	1.5%
2020	55,444,176	25,138,521	119	1,113,728	4.4%	2.0%
2025	57,260,735	25,971,465	126	1,666,966	6.4%	2.9%
2030	58,967,056	26,755,033	135	2,283,597	8.5%	3.9%

Cubic Yds of Concrete (000s)

Year	Overlay Potential	Promotable Potential	Relative Cost	Annual Demand (Yds^3)	Competitive Arena Market Share	Overall Potential Share
2012	230,890	104,628	118	1,658	1.6%	0.7%
2017	239,040	108,358	116	3,514	3.2%	1.5%
2020	243,954	110,609	119	4,900	4.4%	2.0%
2025	251,947	114,274	126	7,335	6.4%	2.9%
2030	259,455	117,722	135	10,048	8.5%	3.9%

Square Yds of Concrete (000s)

Year	Overlay Potential	Promotable Potential	Relative Cost	Annual Demand (Yds^2)	Competitive Arena Market Share	Overall Potential Share
2012	1,385,341	627,766	118	9,947	1.6%	0.7%
2017	1,434,238	650,150	116	21,081	3.2%	1.5%
2020	1,463,726	663,657	119	29,402	4.4%	2.0%
2025	1,511,683	685,647	126	44,008	6.4%	2.9%
2030	1,556,730	706,333	135	60,287	8.5%	3.9%

Source: PCA, BLS, EIA

With these rising asphalt prices, concrete's market share should grow. Using Oman data, PCA estimated that concrete's market share increases 0.14% for every 1% rise in relative asphalt prices. PCA assumes concrete prices rise in-line with inflation – or 2% annually. Our calculations also take into consideration the impact of NESHAP on cement and concrete prices by introducing a one-time increase in 2015 reflecting cement plant compliance costs. PCA uses this correlation equation and projects expected market share gains for the overlay market. These market share gains are then applied to promotable concrete overlay paving activity, or paving activity in excess of three inches in depth. PCA then applies its overlay thickness assumptions to each class of roadway to arrive at tonnage estimates.

[5] Energy Information Agency's "Long Term Energy Outlook", December 5, 2012.

Based on this approach, and assuming that the only factor that changes in the future is the relative price of concrete/asphalt, PCA estimates that the overlay share will increase from 1.6% in 2012 to 3.2% in 2020 and 8.5% in 2030. This translates to roughly 375,000 metric tons in 2012 to 1.1 million metric tons in 2020, and nearly 2.3 million metric tons in 2030.

The improvement of government fiscal conditions could add to overlay potential.

PCA's projections are based on converting the stock of roads into paving activity by estimating stock repaving schedules. PCA estimates roughly 6% of all roads get repaved annually. The data used to formulate this assessment covers 2008-11, a period of time when state, local and county budgets were stressed due to the harsh economic downturn. Overall paving activity was depressed during this period of time. The repaving schedules used to translate road stock into paving activity, as a result, may carry upside risk in the context of improving fiscal conditions.

An analysis of longer term state discretionary spending on state construction spending reinforces this assessment. Prior to the recession, state governments spent roughly 2.4% of discretionary budget on construction activity. During the recession this figure dipped to 1.7%. PCA analysis reveals that at least some of the decline in state discretionary construction spending is attributed to ARRA as states swapped ARRA dollars for programs that would have been funded by the state – even in the context of difficult budgetary times. In any case, this suggests a period of neglect. Road quality would be expected to decline during this period. [6] If 2.4% transportation spending is the norm, and the recession average was 1.7%, this suggests the generation of pent-up paving demand has been generated during the recession.

This suggests that estimates on converting the stock of roads into paving activity based on a time of difficult budget conditions may lead to an underestimation of repaving schedules on a long-term basis. Using longer term state discretionary spending on construction, PCA estimates roughly 7.5% of all roads get repaved annually under "normal" fiscal conditions. Furthermore, repaving schedules could move even higher shortly after fiscal surpluses emerge as transportation agencies attend to pent-up demand. Since ARRA funding supported paving activity during the downturn, and this spending seems to have been concentrated on more highly travelled roads, it is likely that greater pent-up demand for repaving activity was generated among local roads.

Total System Repaving Activity

Estimated Lane Miles Repaved Annually (Based on Variable Churn Rate)

	Total Primary Roads			Total Secondary Roads			Total Roads		
	2010	2020	2030	2010	2020	2030	2010	2020	2030
Lane Miles	71,464	97,862	94,201	166,390	227,124	218,091	237,855	324,986	312,292
Percent of System Repaved Annually	*6.1%*	*7.6%*	*6.8%*	4.1%	5.3%	4.7%	4.6%	5.8%	5.2%

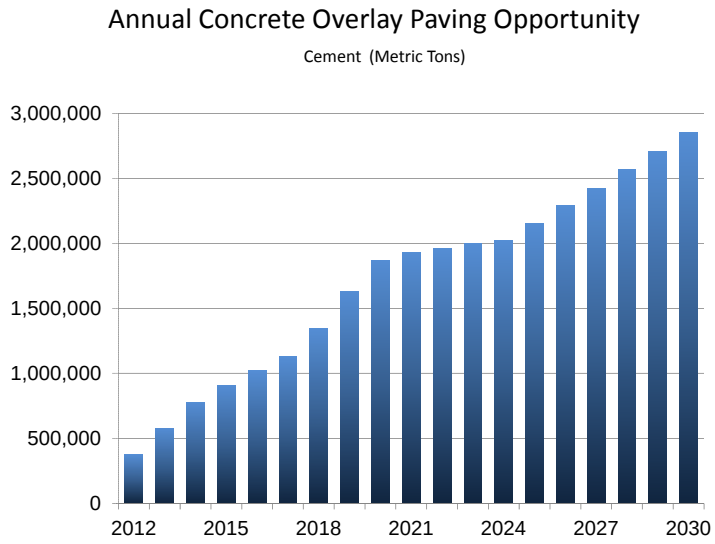
Source: PCA

While fiscal surpluses have already emerged among some states, PCA expects state governments, on a national basis, will achieve surplus conditions for fiscal 2015 and beyond. Furthermore, PCA's correlation analysis suggests a three year lag between the movement in home prices and local government revenue. Home prices began turning upward in 2012. Based on this correlation, this suggests that local government revenues begin to improve in fiscal 2016.

[6] Please note: The latest IRI road quality data available is 2008. The recession began in 2007. The impact of state and local fiscal duress was only beginning and it is unlikely that IRI data reflects the possibility of erosion in road quality.

Baseline conclusions for the United States' concrete overlay market.

PCA projects the relative price of concrete versus asphalt will improve on a sustained and significant basis in the years ahead. This will result in market share gains. In addition, fiscal heath will eventually return to state and local governments. PCA's baseline estimate includes calculations that reflect an improved competitive position and more aggressive paving schedules than has materialized over the past several years. PCA times the more aggressive repaving activity according to our assessments regarding fiscal recovery at the state and local levels. According to this approach, concrete overlays translate into 2.0 million metric tons in 2020, and nearly 3.0 million metric tons in 2030.



Concrete's overlay potential, based on past relative price movements, will probably understate its true potential.

Estimating the market potentials are typically based on rigid statistical correlations based on historical calculations. The future market potential for concrete overlays is probably much greater than the raw relative price movements calculations suggest. The preceding projections allow only the relative prices of asphalt and concrete change and assume all other factors that influence material specifiers remain unchanged. At issue is the equation for translating asphalt price movements into market share gains.

Mechanically, the projections that translate asphalt relative price movements into market share gains are sound. At issue, however, are PCA concerns regarding the equation that translates asphalt price movements into market share movements. PCA expected a stronger market share sensitivity to asphalt price increases than the actual regression revealed. Our expectations for a higher sensitivity are based on concrete's parity with asphalt among some roads in 2009 and that asphalt prices have far outpaced those of concrete since that time. It was also our perception that material specifiers have been growing more sensitive to budget constraints, and hence more sensitive to relative material price trends.

Furthermore, the regression analysis used to formulate this equation suggests a weak correlation between price and market share. This implies that either the pricing mechanism is somehow being distorted, or non-price factors play a significant role in the ***historical*** relationship between concrete's paving market share and the relative price of concrete/asphalt.

PCA believes both price distortions and non-price practices have been in play historically. The pricing mechanism, for example, is distorted when DOT and material specifier practices are present in the regional markets. These include:

- Recognition lags regarding the trend and fundamentals impacting the price of asphalt and concrete.
- Lack of use, or improper use, of life cycle cost assessments.
- Lack of alternative bid/alternative design practices.
- Improper equivalent design practices based on material performance.
- The use of asphalt price escalators.

Non-price practices may also characterize regional paving markets thereby diminishing market share's sensitivity to price changes. These include:

- Existence of powerful asphalt political lobbyists at the state and local level.
- DOT/paving material specifiers comfort and experience in the use of asphalt relative to concrete overlays.

PCA translates ***future*** asphalt price movements into market share gains based on ***past*** correlations. It is likely that the past correlations will underestimate future correlations if continued progress is made on price distortions and non-price factors via industry advocacy efforts and education. Such a scenario is likely. If so, the market potential could be considerably higher.

The foundation for even stronger overlay potential is already being set in place.

The sustained and significant expected improvement in the relative price of concrete versus asphalt is the concrete industry's key leverage point in gaining share in the overlay market. The equation that translates relative asphalt price movements into market share movements is essentially a market share price "elasticity" equation. Abstractly, promotional efforts focus on raising DOT's sensitivity to these relative cost realities – or increase the elasticity.

Recognizing that price distortions and non-price factors may influence the ability of the concrete industry to best leverage its growing cost advantages over asphalt, PCA and its allies have already begun engagement nationally and on a prioritized state basis to reduce constraints that hinder a stronger reaction to expected improvements in the relative price of concrete versus asphalt. MIT research on LCCA, for example, has been leveraged at the national and regional level. At the national level, progress has been made regarding the usage of material specific escalation rates in LCCA formulas at the GAO, OMB and FHWA. At the regional level, initiatives have been undertaken in many states to educate material specifiers regarding the long-term dynamics of relative price movements and the consequences of policy inertia. Local technical education efforts are also proceeding. Advocacy efforts aimed at reducing market impediments are also ongoing. In part, these efforts are supported by MIT research and leveraged locally. These efforts have been amplified by compelling national and regional advertizing campaigns.

Taken together, and given some impressive successes thus far, these efforts seem to indicate that much stronger sensitivity to relative price movements in the future is likely. These assessments support the possibility that even greater market share gains, and cement volume, could be attached to the concrete

overlay market potential. How much upside risk potential depends on the tactics undertaken and the degree to which they are supported by the industry.

Section 3: State Rankings of Overlay Paving Potential

PCA was also tasked to rank states in terms of market potential. To this end, PCA performed a four step state-by-state ranking process that included both quantitative and qualitative factors. Using proxies, PCA ranked states by the repaving market size, ability to spend, willingness to employ concrete overlays and existence of market impediments. Initial estimates were then vetted among regional experts before final results were determined.

Repaving Market Size

Ranking for the repaving market size was determined based on the stock of miles and road quality. Total lane miles in need of repaving were based on target overlay IRI cohorts. This proxy captures relative market size and advances states with large opportunity in terms of high stock of lane miles as well as substantial repaving needs.

Repaving Market Size - Top States (2020)

	State	Lane Miles		State	Lane Miles
1	Texas	21,225	11	Michigan	7,122
2	California	19,928	12	Tennessee	7,096
3	Florida	13,525	13	Minnesota	7,027
4	Georgia	9,612	14	Virginia	6,410
5	North Carolina	9,387	15	Washington	6,307
6	Pennsylvania	8,707	16	Arizona	5,904
7	Illinois	8,625	17	Indiana	5,836
8	New York	8,534	18	Missouri	5,616
9	Ohio	8,229	19	Alabama	5,531
10	Wisconsin	7,647	20	Colorado	5,272

Source: PCA

Ability to Spend

Ranking for states' ability to spend was a two-fold process. First, states were ranked by their overall fiscal health. Second, states were ranked by the level of commitment toward spending on transportation. PCA assigned equal weights to each estimate to form an overall "ability-to-spend" ranking.

State fiscal health rankings were based on fiscal deficits as reported by the Center on Budget and Policy Priorities.[7] States are ranked based on projected 2013 FY budget deficits. For states that have closed their deficits, ranks are determined by current spending levels relative to past peaks. This identifies states that are not running a deficit due to extreme expenditure cuts, possibly at the expense of transportation funding. The proxy serves as a guide for states that run the risk of future transportation budget cuts.

[7] CBPP-*States Continue to Fell Recession's Impact* http://www.cbpp.org/cms/index.cfm?fa=view&id=711

State commitment to transportation spending was ranked based on average transportation funding dollars per lane mile. Using National Association of State Budget Officers' Expenditures *Report,*[8] spending volumes were assessed based on general funds, federal funds, gas taxes, bonds, and ARRA funding sources. These expenditures were then overlaid with Florida DOT highway construction cost estimates[9] to determine agency funding by lane mile. The proxy serves to show relative transportation funding commitments to identify states that prioritize highway funding.

Ability To Spend

Ranks Based on States With Most Favorable Fiscal and Transportation Funding Positions

Overall Rank	State	Fiscal Rank	Transportation Funding Rank	Overall Rank	State	Fiscal Rank	Transportation Funding Rank
1	Massachusetts	6	1	10	Virginia	22	3
2	West Virginia	1	12	11	Florida	20	8
3	Rhode Island	8	5	12	Montana	1	37
4	North Dakota	1	19	13	Vermont	25	2
5	Michigan	4	18	14	Kansas	11	24
5	Utah	10	9	15	Colorado	7	32
6	Texas	1	27	15	Delaware	1	41
7	Maryland	16	7	16	Idaho	4	38
8	Indiana	1	31	17	Missouri	13	25
9	Wyoming	1	33	18	Connecticut	26	6

Note: States with similar paving dynamics will share same rank

Source: PCA

Willingness to adopt concrete overlay

State ranking for willingness to adopt concrete overlays was also a two-fold process. First, states were ranked based on existing concrete paving market shares derived from Oman data. The metric assumes states that traditionally have higher concrete market share would be more willing to adopt concrete overlays. Second, states were ranked based on results of a PCA survey of paving engineers at ACPA, NRMCA and PCA regional chapters when asked the question: "How would you rate the willingness of state, county and local officials to perform concrete overlays in the specified state?" PCA assigns equal weights to each estimate to form an overall "willingness-to-adopt" ranking.

[8] State Expenditure Report – NASBO. Table 38 http://www.nasbo.org/publications-data/state-expenditure-report. Expenditure series compiled from 2000-2012 reports.

[9] Florida DoT Highway Generic Construction Cost Model. ftp://ftp.dot.state.fl.us/LTS/CO/Estimates/CPM/summary.pdf

Willingness To Adopt Concrete Overlay

Ranks Based on States With Most Favorable Government Acceptance

Overall Rank	State	Government Willingness Rank	Concrete Market Share Rank	Overall Rank	State	Government Willingness Rank	Concrete Market Share Rank
1	Iowa	2	1	11	West Virginia	15	16
2	Oklahoma	3	5	12	Minnesota	26	12
3	Texas	10	2	13	Wyoming	14	22
4	Nebraska	10	3	14	Michigan	36	10
5	Illinois	1	11	14	Mississippi	15	24
6	North Dakota	5	9	14	Pennsylvania	9	28
7	Missouri	10	7	17	North Carolina	15	25
8	Colorado	4	15	18	Kansas	42	8
9	Indiana	7	17	19	Wisconsin	34	14
10	South Dakota	27	4	20	Hawaii	37	13

Note: States with similar paving dynamics will share same rank

Source: PCA

Existence of Policy Impediments

State ranking for the existence of market impediments assesses state paving procurement policies. Current state paving procurement policies were assessed. These policy assessments were limited to the use of life-cycle cost assessments, the existence of asphalt price escalators, as well as practices regarding the use of alternative design and bidding. PCA assigned weights to the importance of each paving procurement policy. The greatest importance was assigned to the use of life-cycle cost assessments (45% weight), followed by the existence of asphalt price escalators (30%), and then practices regarding the use of alternative design and bid (25%).

Lowest Concrete Overlay Impediments

Overall Rank	State	Overall Rank	State
1	Arkansas	6	Colorado
1	Iowa	6	Louisiana
1	Michigan	6	Oregon
1	Nebraska	6	Washington
1	Texas	6	Wisconsin
2	Utah	7	California
3	Ohio	7	Florida
4	Indiana	7	Georgia
4	Kansas	7	Minnesota
5	South Dakota	7	Montana

Note: States with similar paving dynamics will share same rank

Source: PCA

Existence of Other Market Impediments

As part of the survey executed by PCA, respondents were asked the biggest hindrance to increased adoption of concrete overlays. While funding limitations proved to be a pervasive theme, much insight was given into why concrete has underperformed in the concrete-asphalt competitive arena. For instance, traffic handling concerns in many areas make concrete overlays less feasible than their asphalt alternative for some local roads.

Existing concerns regarding transportation agencies' culture were confirmed by survey responses and revealed that in many regions, officials are comfortable with asphalt overlays and do not have the proper knowledge of their concrete counterparts. In some states an established asphalt culture exists and concrete overlays are often viewed as new and untested technology. Responses also indicate there may be a lag of understanding the changing cost dynamic of asphalt versus concrete. Concerns also exist regarding contractors. While contractors may be plentiful, in some regions they are not uniformly well versed in the use of concrete for overlays. Their lack of knowledge, therefore, could impede the employment of concrete as a material of choice. None of these potential impediments are included in our analysis.

Potential Promotion Risks

Survey results revealed potential downside risks to PCA projections regarding the concrete overlay paving market. First, material specifiers are the least receptive and educated regarding the use of concrete overlays the more local the level of the specifier (state versus county versus local specifier).

Attitude of Concrete Overlay Adoption
By Level of Government

Agency	Favorable	Neutral	Unfavorable
State	26%	54%	20%
County	12%	27%	62%
Local	0%	54%	46%

Source: PCA Survey

Second, it is possible that county and local government pavement departments have experienced greater fiscal adversity during the recession due to less support from ARRA and their lessened ability to tap bond markets. As a result, the potential exists that road quality has eroded greatest among these roads – reflected in greater pent-up paving demand. Finally, county and local roads constitute the largest arenas for future potential paving volumes.

These assessments are supported by PCA's survey. Attitudes of government decision makers towards concrete overlays are believed to be the most favorable at the state level and subsequently become less favorable through each more local level of government. Up to 80% of state DOTs are believed have a neutral-to-favorable willingness to perform concrete overlays. County governments are believed to be the least receptive with only 39% of the responses favorable-to-neutral and an overwhelming 62% belief that county agencies are unwilling to adopt concrete overlays. Local governments are largely neutral to unfavorable in regards to concrete overlays.

The less favorable opinions held by County and Local governments are disconcerting given their large inventory of roads, particularly minor arterials and collectors. The sentiment, particularly at the county and local level, is that concrete overlays are considered a "new, untried technology" represents a

downside risk. The lack of state codes & standards may foster this sentiment. The stock of roads held by county and local agencies totals more than 60% of the concrete overlay potential.

Higher initial paving costs of concrete and equivalent thinner designs for asphalt overlays were cited as reasons for the less favorable opinion. It is also believed that state governments have a more favorable opinion due to successes of past promotion efforts.

In terms of regional variance, the South and Midwest appear to have the most favorable perceptions of concrete overlays while the West has the least agreeable opinion. A more unfavorable opinion in the West is not surprising given the higher proportion of rural roads in which concrete overlays would have difficulty overcoming asphalt's comparable advantage in design builds. Conversely, the strong Midwest share could suggest more likely acceptance of concrete overlays in markets that already engage in traditional concrete paving.

State Rankings Conclusions

PCA combines its assessments on the paving market size, ability to spend, willingness to adopt concrete overlays, and the existence of policy impediments to form its state-by-state rankings.

Market Ranking

Overall Rank		Willingness Rank	Impediment Rank	Ability Rank	Volume Rank
1	**Texas**	3	1	7	1
2	**Michigan**	14	1	5	11
3	**Indiana**	9	1	9	17
4	**Colorado**	8	1	16	20
5	**Iowa**	1	1	22	23
6	**Missouri**	7	13	19	18
7	**Kansas**	18	1	15	28
7	**Pennsylvania**	14	21	21	6
9	**Illinois**	5	21	31	7
10	**Nebraska**	4	1	28	34
11	**Florida**	40	13	12	3
12	**North Dakota**	6	21	4	41
13	**Georgia**	24	13	32	4
14	**Utah**	36	1	5	32
15	**Minnesota**	12	13	37	13
16	**North Carolina**	17	21	33	5
17	**New York**	23	21	25	8
17	**Virginia**	31	21	11	14
19	**California**	29	13	36	2
20	**Washington**	20	13	33	15

Note: States with similar paving dynamics will share same rank

Source: PCA