Information Series 138

Asphalt Pavement Mix Production Survey

Reclaimed Asphalt Pavement, Reclaimed Asphalt Shingles, Warm-mix Asphalt Usage: 2009-2010

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16. Abstract
The asphalt pavement industry and its partners have maintained a focus on continuous product improvement, including versatility in application. The use of reclaimed asphalt pavement (RAP) in asphalt mixtures began in earnest in the 1970s in response to the oil embargo. Other improvements over the years include polymer-modified asphalt, Superpave PG binder specification and mix design procedures, stone-matrix asphalt (SMA), improvements in open-graded friction courses (OGFCs), and long-life asphalt pavement. Warm-mix asphalt (WMA), which was first used in the U.S. in 2004, has provided both enhancements in working conditions and numerous construction benefits. The recycling of asphalt shingles into plant-mix asphalt has grown rapidly in recent years. Such innovations have done much to improve performance, safety, and longevity. In many ways, they have also improved the economics of producing the material and/or the environmental aspects of material production.

Over the last 10 years, the asphalt pavement industry has seen unprecedented challenges in both economic and regulatory issues that have called for technical responses in order to maintain a competitive position in the marketplace. These responses have focused on ways of continually reducing emissions from asphalt production, improving working conditions, and conserving the natural resources – both virgin asphalt binder and aggregates – being used in pavement mixes.

In 2009 and 2010, the Federal Highway Administration contracted with the National Asphalt Pavement Association for a systematic survey of implementation/adoption of three key areas: reclaimed asphalt pavement (RAP), reclaimed asphalt shingles (RAS), and warm-mix asphalt (WMA). This document presents the results of that survey. The survey clearly shows that the asphalt pavement industry continues to improve its already outstanding record of environmental stewardship through its increasing use of RAP, RAS, and WMA. These technologies conserve raw materials; conserve energy; cut emissions from production and paving operations; and improve conditions for workers.

- RAP: The asphalt industry remains the country's number one recycler. About 96 percent of the contractors/ branches reported using RAP. The amount of RAP used in HMA/WMA was 56.0 million tons in 2009 and 62.1 million tons in 2010. Assuming 5 percent liquid asphalt in RAP, this represents over 3 million tons (19 million barrels) of asphalt binder conserved. Less than 1 percent of RAP was sent to landfills.
- RAS: Use of reclaimed asphalt shingles (both manufacturer's waste and tear-offs) increased from 702,000 to 1.10 million tons from 2009 to 2010, a 57 percent increase. Assuming a conservative asphalt content of 20 percent for the shingles, this represents 234,000 tons (1.5 million barrels) of asphalt binder conserved.
- WMA: Total tonnage of WMA is estimated at 19.2 million tons in 2009 and 47.6 million tons in 2010. This was a 148 percent increase. Plant foaming is used most often in producing WMA. Additives accounted for about 17 percent of the total WMA production in 2009 and 8 percent in 2010.

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Asphalt Pavement Mix Production Survey on Reclaimed Asphalt Pavement, Reclaimed Asphalt Shingles, and Warm-mix Asphalt Usage: 2009-2010

Introduction

Background

The asphalt pavement industry and its partners have maintained a focus on continuous product improvement, including versatility in application. The use of reclaimed asphalt pavement (RAP) in asphalt mixtures began in earnest in the 1970s in response to the oil embargo. During the 1980s, use of polymer-modified asphalt binder increased, and its use was furthered by the advent of the Superpave PG binder specification in the 1990s. The Superpave volumetric mix design procedure also began to be adopted during the early 1990s and has undergone many improvements since. Stone-matrix asphalt (SMA) was presented to the U.S. as a premium asphalt surfacing during the 1990s. The mix design procedure for open-graded friction courses (OGFCs) was improved during that time and today these materials provide safe, quiet riding surfaces all over the country. Long-life asphalt pavement structures are possible through the application of Perpetual Pavement design practices. Warm-mix asphalt (WMA), which was first used in the U.S. in 2004, has provided both enhancements in working conditions and numerous construction benefits. The recycling of asphalt shingles (RAS) into plant-mix asphalt has grown rapidly in recent years. Such innovations have done much to improve performance, safety, and longevity. In many ways, they have also improved the economics of producing the material and/or the environmental aspects of material production.

Over the last 10 years, the asphalt pavement industry has seen unprecedented challenges in both economic and regulatory issues that have called for technical responses in order to maintain a competitive position in the marketplace. These responses have focused on ways of continually reducing emissions from asphalt production, improving working conditions, and conserving the natural resources – both virgin asphalt binder and aggregates – being used in pavement mixes.

In 2009 and 2010, the Federal Highway Administration contracted with the National Asphalt Pavement Association for a systematic survey of implementation/adoption of three key areas: reclaimed asphalt pavement (RAP), reclaimed asphalt shingles (RAS), and warm-mix asphalt. This document presents the results of that survey.

Highlights

The survey clearly shows that the asphalt pavement industry continues to improve its already outstanding record of environmental stewardship through its increasing use of RAP, RAS, and WMA. These technologies conserve raw materials; conserve energy; cut emissions from production and paving operations; and improve conditions for workers.

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- WMA: Total tonnage of WMA is estimated at 19.2 million tons in 2009 and 47.6 million tons in 2010. This was a 148 percent increase. Plant foaming is used most often in producing WMA. Additives accounted for about 17 percent of the total WMA production in 2009 and 8 percent in 2010.

Reclaimed Asphalt Pavement

Although the widespread use of reclaimed asphalt pavement (RAP)in asphalt pavements began in the 1970s, and by the 1980s there had been some field trials with very high RAP contents, it is estimated that the average amount of RAP actually being incorporated in mixtures leveled off at about 12 percent by 2008 **(Copeland, Jones, & Bukowski, 2010)**. There were a number of reasons for this relatively low RAP content in mixtures. As recycling was starting, it was found that high RAP contents could result in increased "blue smoke" emissions from plants, because in certain types of plants the RAP was being fed directly into the path of the hot gasses and the RAP binder was being volatilized. Modern plant designs have evolved to effectively shield the RAP from direct contact with the flame. Also, in the 1980s, it was found that RAP could adversely affect the volumetric proportions of the resulting asphalt mixtures, especially the amount of fines in the mix. Recent practice has led to screening the RAP in order to size the material so that it can be more effectively proportioned into the mix. As the Superpave mix design procedure was initially developed, it did not include a method for incorporating RAP. As a result, agencies were reluctant to allow much, if any, RAP in Superpave mixes until a method could be identified to account for the recycled material. This was eventually accomplished in National Cooperative Highway Research Program (NCHRP) project 9-12, but the guidelines for RAP content were still relatively conservative. Recently, there has been a revival of interest in increasing RAP usage, and a new NCHRP project (9-46) is under way at the National Center for Asphalt Technology (NCAT) as well as efforts at the Federal Highway Administration.

The interest in increasing the amount of RAP used in mixtures occurred during the same time period that warm-mix asphalt was being introduced. There appears to be a synergism between the use of warm mix and increased RAP contents. In many cases, it appears that warm mix reduces the amount of initial oxidation in virgin liquid binder so that it interacts with the RAP binder more readily. With the rapid rise in petroleum prices in 2008 and the availability of improved technology to produce higher RAP content asphalt mixtures, the industry has recommitted itself to increasing the amount of RAP used.

Reclaimed Asphalt Shingles

The use of reclaimed asphalt shingles (RAS) in asphalt paving mixtures is not a new concept. Research into the use of shingle manufacturers' waste dates back the mid-1980s and permissive specifications for the use of waste shingles in paving began to appear in the early 1990s. The combination of a high asphalt binder content, high-quality fine aggregate, mineral filler, and fibers makes roofing shingles very compatible with asphalt pavement mixtures. The fact that the asphalt cement in shingles is generally harder than that employed in paving mixtures, and that the other ingredients impact the volumetric properties of the final mix, generally limits its incorporation in asphalt mixtures to 5 percent or less. However, even at a relatively lower RAS content, there is somewhere on the order of 15 to 20 percent binder replacement in the final paving mixture. Currently, 12 states allow the use of manufacturers' waste in asphalt mix and 10 states allow either manufacturers' waste or roofing tear-offs in their mixtures. It is estimated that there are 10 million tons of tear-off waste and 1 million tons of manufacturer waste available on an annual basis. If all these could be incorporated into asphalt paving mixtures, it would amount to approximately 1.8 million tons of asphalt binder replacement. Thus, there is great interest in utilizing waste asphalt roofing shingles in asphalt paving mixtures.

Warm-Mix Asphalt

Asphalt mix production plants were delisted as major sources of hazardous air pollutants by the Environmental Protection Agency (EPA) in 2002. In a quest for continuous improvement, the industry began looking for technologies that allowed for lowering temperatures during asphalt mix production and placement. This effort began in Europe as contractors searched for technologies that would help their countries achieve emissions reductions goals set by the Kyoto Agreement. In the U.S., warm-mix asphalt was initially seen as part of the industry's ongoing efforts to continually

reduce emissions and improve working conditions. Since then, numerous unanticipated construction benefits of warm mix have come to light, and many of these are as compelling as the environmental benefits.

After the first demonstration of warm mix in the U.S. in 2004, the number of technologies and the number of field trials grew at a very rapid rate. The National Asphalt Pavement Association (NAPA) and the Federal Highway Administration (FHWA) formed a technical working group to help facilitate the implementation of warm mix. In 2005, there were three technologies being marketed. This increased to over 20 by 2010. By 2010, over half of the states had specifications that permitted the use of warm-mix asphalt. FHWA predicts that this will increase to 47 states and all Federal Lands offices by the end of 2011. As will be shown in this report, the growth in warm-mix tonnage indicates that it will be the direction of the asphalt pavement industry in the future.

Great strides have been made in the implementation of warm-mix asphalt, the use of higher RAP contents in mixtures, and the use of roofing shingles in asphalt. A systematic approach to quantifying the progress of these technologies and the rate of their adoption was, however, lagging. Surveys of the industry needed to be conducted to capture progress on the implementation of RAP, RAS and WMA.

Objective

The objective of this survey was to estimate the quantities of reclaimed asphalt pavement and reclaimed asphalt shingles being used in asphalt mixtures, and to estimate the amount of warm-mix asphalt being produced in the U.S., by state and by market sector.

Scope

In order to accomplish this work, it was necessary to:

1. Design a survey that enabled an analysis of the quantities of RAP and RAS being used in asphalt mixtures as well as the total amount of warm-mix asphalt produced nationally.
2. Conduct a voluntary survey of asphalt mix producers throughout the U.S. This was done by posting a survey on a public Web site, notifying producers, and following up with verbal requests for information in locations where responses were low.
3. Estimate the total market in each state or territory by using data from responding State Asphalt Pavement Associations and the U.S. Census Bureau to determine a weighting factor for each state and reconciling the total U.S. asphalt mix tonnage with national estimates.
4. Summarize the information and prepare this report.

Survey Methods

The survey was conducted using a Web survey service called SurveyMonkey™. Once the draft survey was prepared and before it was posted, it was sent out for review by the NAPA Warm-Mix Asphalt Task Force and the NAPA Energy and Recycling Task Force. After the comments were received and revisions to the survey made, it was posted on SurveyMonkey. Producers were notified of the survey through several forums and electronic media. A notice was posted in NAPA's e-newsletter, *ActionNews*, informing members of the survey and asking for their participation. State Asphalt Pavement Associations participated by placing notices on their Web sites and in their newsletters. Announcements were made at NAPA meetings as well as at several state asphalt conferences. Asphalt mix producers then went to the Web site and completed the survey form. After the initial data were gathered and analyzed, anomalies in individual producer records were identified and reconciled.

The survey was broken into four sections for 2009 and 2010. These sections were General Information, Reclaimed Asphalt Pavement (RAP), Reclaimed Asphalt Shingles (RAS) and Warm-Mix Asphalt (WMA). Table 1 summarizes the questions asked in each section.

Table 1: Survey Question Summary

General Information	RAP & RAS	WMA
Number of Plants	Tons Accepted	Avg. % for DOT Tons
DOT Tons	Tons Use in HMA/WMA	Avg. % for Other Agency Tons
Other Agency Tons	Tons Used in Aggregate	Avg. % for Commercial & Residential Tons
Commercial & Residential Tons	Tons Used in Cold Mix	Chemical Additive %
	Tons Used in Other	Additive Foaming %
	Tons Landfilled	Plant Foaming %
	Avg. % for DOT Mixes	Organic Additive %
	Avg. % for Other Agency Mixes	
	Avg. % for Commercial & Residential Mixes	

Most surveys were completed online. An exception was that one multi-state contractor collected data from their different operations and submitted them in spreadsheet form.

Asphalt mix producers from 47 states and Puerto Rico completed the survey. The District of Columbia, New Mexico, North Dakota, and Nebraska are the only states/territories with no survey information. A total of 196 companies/branches with 1,027 plants are represented in the survey. Table 2 summarizes the number of companies/branches completing the survey.

A copy of the survey is included in Appendix A.

Review of Data and Follow-Up

Data from the online survey was imported into a spreadsheet and checked for accuracy and missing data. When anomalies in the data were noted, the person submitting the data was contacted to resolve the data.

Estimates of Missing Data

To determine the total amount of RAP, RAS, and WMA produced in each state and the nation, the total amount of asphalt mix produced in each state needed to be determined. Estimated tonnages were provided by state asphalt pavement associations in 28 states totaling about 265 million tons. This included seven state associations which supplied DOT tonnages and the total tonnage was estimated by dividing this by the percent of DOT tons provided by asphalt mix producers in that state who completed the survey. To estimate the total tons in the remaining states, relationships between the tonnages supplied by the associations and population, federal apportionment and miles paved were determined and compared. All relationships resulted in a power curve function with different factors each year. Figures 1 through 4 show the relationships between tons and population and federal apportionment since these resulted in less variation than miles paved. The relationship based on apportionment was selected since there was little difference from a population-based estimate and it was felt that tonnage would be more a function of available funds than of population. There is little difference in the total estimated tons between these predictors.

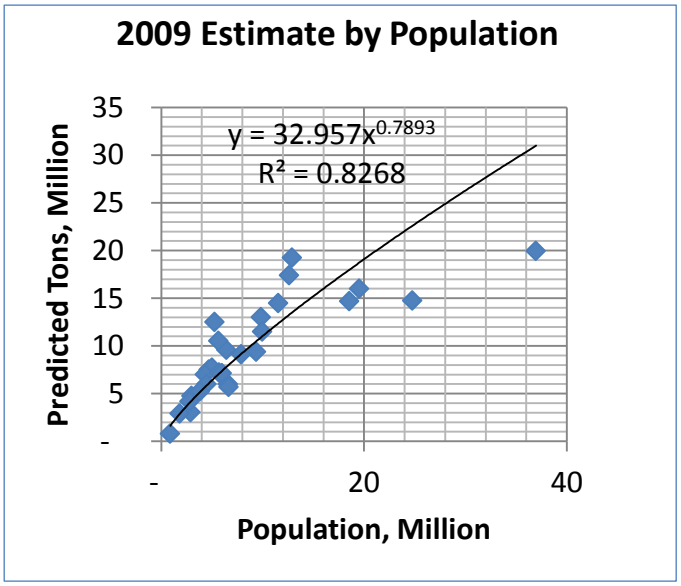

Figure 1: 2009 Asphalt Mix Tons by Population

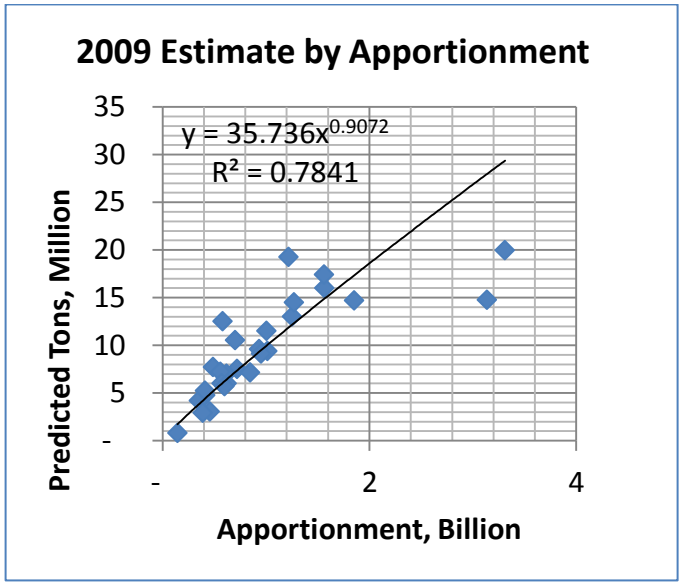

Figure 2: 2009 Asphalt Mix Tons by Federal Apportionment

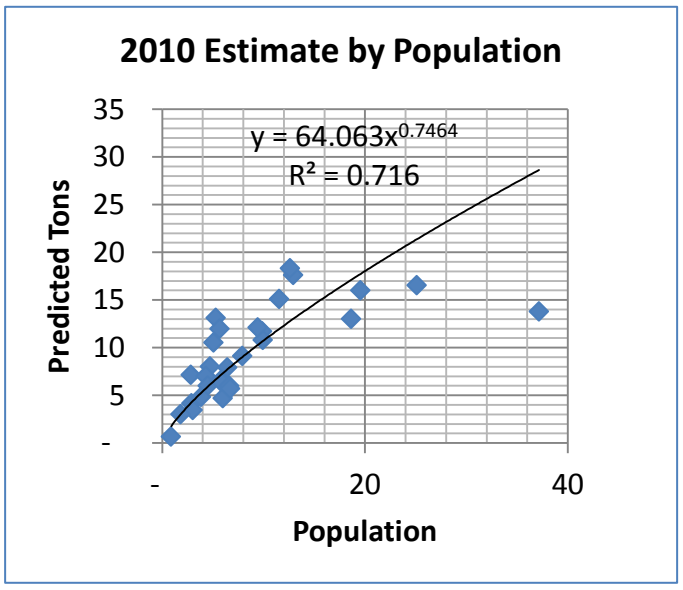

Figure 3: 2010 Asphalt Mix Tons by Population

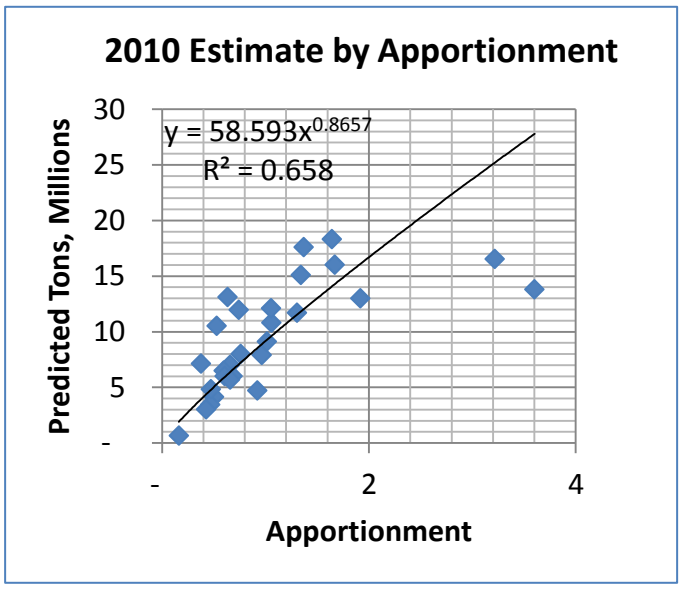

Figure 4: 2010 Asphalt Mix Tons by Apportionment

General Information

State Responses

Figure 5 summarizes the number of plants represented by the companies/branches responding to the survey. Asphalt mix producers from 47 states and Puerto Rico completed the survey. The District of Columbia, New Mexico, North Dakota, and Nebraska are the only states/territories with no survey information. A total of 196 companies/branches with 1,027 plants are represented in the survey. Table 2 summarizes the number of companies/branches completing the survey.

Table 2: No. of Companies/Branches Completing Survey in State

Number of Companies/Branches Completing Survey in State	Number of States
1	9
2	13
3	5
4	4
≥ 5	17
Total States Completing Survey	48

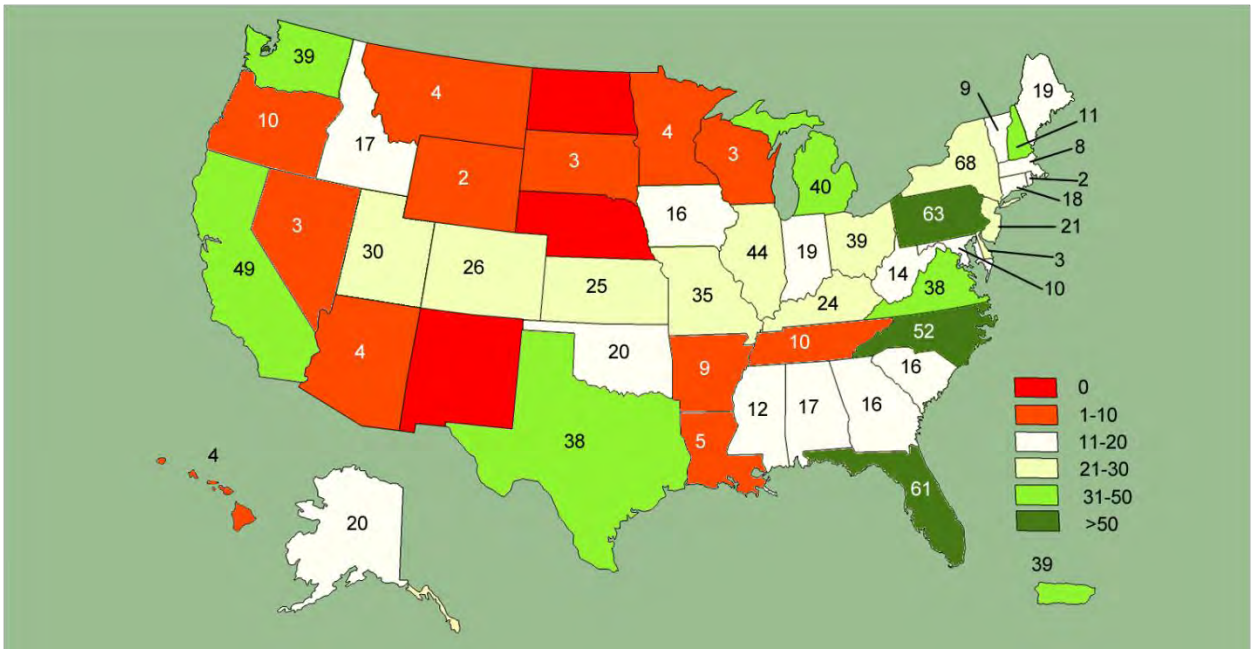

Figure 5: Number of Plants Represented by Companies/Branches Responding to Survey

Figures 6 and 7 provide another perspective of the response to the survey based on the percent of the tons reported in each state to the total estimated tons. The returned survey results represent about 34 percent of the total US tonnage. If we assume there are 4,000 plants in the US, the survey represents about 25 percent of the plants.

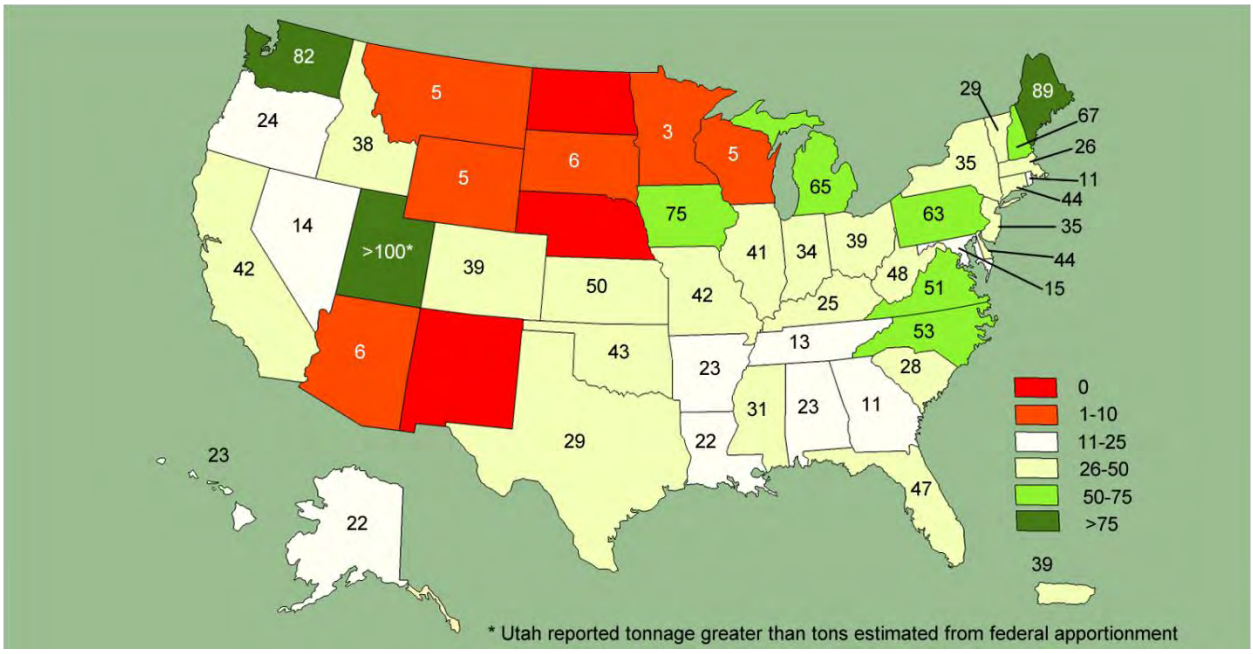

Figure 6: 2009 Reported tons as a percent of estimated total tons

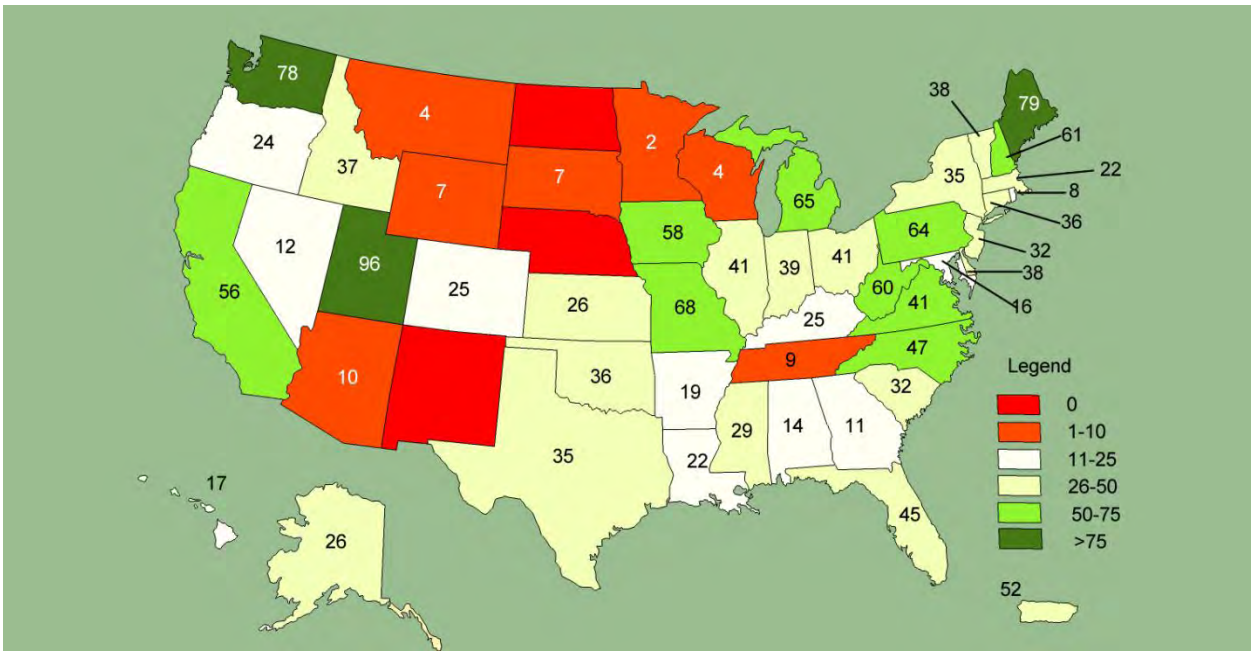

Figure 7: 2010 Reported tons as a percent of estimated total tons

Responder Profile

The survey represents 1,027 plants. The average tons per plant are 121,000 and 117,000 for 2009 and 2010, respectively. Figure 8 shows the number of plants separated by different user/producer group regions.

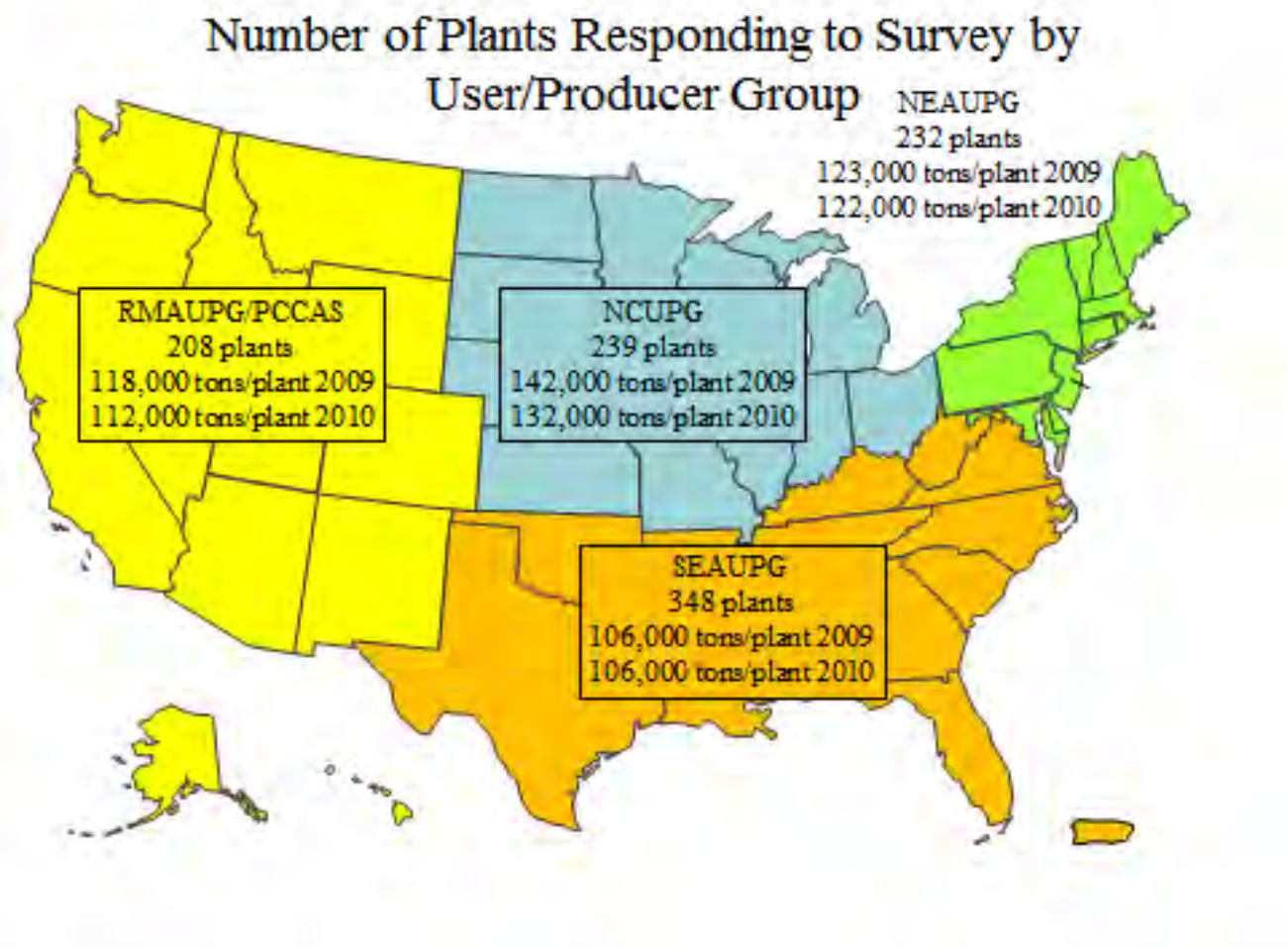

Figure 8: Number of plants responding to survey by User/Producer Group regions.

Table 3: Summary of Estimated and Reported Plant-mix Asphalt Tons by State

State	Tons, Millions			
	2009		2010	
	Estimated	Reported	Estimated	Reported
Alabama	7.50	1.75	8.00	1.09
Alaska	3.67	0.82	4.41	1.15
Arizona	7.50	0.42	7.14	0.71
Arkansas	3.05	0.71	4.15	0.78
California	19.97	8.44	13.79	7.68
Colorado	7.72	3.00	10.52	2.62
Connecticut	4.96	2.20	5.01	1.79
Delaware	0.79	0.35	0.65	0.25
District of Columbia	1.62	-	1.81	-
Florida	14.70	6.91	13.00	5.81
Georgia	13.00	1.39	11.70	1.34
Hawaii	1.73	0.40	1.91	0.33
Idaho	3.00	1.13	3.09	1.14
Illinois	19.25	7.81	17.60	7.17
Indiana	9.60	3.28	7.90	3.06
Iowa	4.74	3.54	3.45	1.99
Kansas	4.17	2.08	7.12	1.85
Kentucky	7.00	1.72	7.00	1.74
Louisiana	6.00	1.30	6.00	1.30
Maine	1.80	1.61	2.03	1.60
Maryland	7.20	1.07	6.50	1.06
Massachusetts	6.00	1.54	6.00	1.34
Michigan	11.50	7.49	10.80	7.03
Minnesota	12.50	0.42	13.10	0.29
Mississippi	4.62	1.45	4.79	1.41
Missouri	7.13	3.02	4.70	3.19
Montana	3.78	0.19	3.99	0.17
Nebraska	2.96	-	3.09	-
Nevada	3.11	0.43	3.57	0.43
New Hampshire	1.86	1.25	1.94	1.18
New Jersey	9.33	3.28	9.09	2.87
New Mexico	3.78	-	3.84	-
New York	16.00	5.65	16.00	5.54
North Carolina	9.37	4.95	12.11	5.66
North Dakota	2.55	-	2.70	-
Ohio	14.50	5.69	15.10	6.23
Oklahoma	5.74	2.47	5.99	2.16
Oregon	5.22	1.27	4.81	1.16
Pennsylvania	17.40	10.97	18.30	11.66
Puerto Rico	2.49	0.97	1.44	0.75
Rhode Island	2.07	0.22	2.34	0.19
South Carolina	6.23	1.77	6.14	1.98
South Dakota	2.73	0.16	2.96	0.22
Tennessee	7.95	1.07	7.87	0.73
Texas	14.77	4.23	16.54	5.73
Utah	3.14	3.71	3.35	3.23
Vermont	1.74	0.51	2.12	0.80
Virginia	9.10	4.64	10.90	4.51
Washington	5.70	4.65	5.70	4.46
West Virginia	2.90	1.40	3.00	1.79
Wisconsin	10.52	0.50	11.96	0.50
Wyoming	2.77	0.15	2.83	0.20
Total	358.43	123.98	359.85	119.87

Note: Shaded rows indicate states where the state asphalt pavement association provided data used to compute total estimated value. A relationship between tons and federal apportionment was used to estimate the total tons for states where no data was available on total tons.

Reclaimed Asphalt Pavement

Table 4 summarizes the RAP data from the survey. Based on the total estimated tons received and the amount used for all purposes, including landfilling, there was an excess of 2.5 and 1.8 million tons in 2009 and 2010, respectively, out of a total of 67.2 and 73.5 tons, respectively.

Table 4: Summary of RAP data

		Reported Tons Million		Total Estimated Tons Million	
		2009	2010	2009	2010
	Companies/branches Reporting Using RAP	189	189		
	Tons Accepted	23.2	24.0	67.2	73.5
	Tons Used in HMA/WMA	20.1	21.6	56.1	62.1
	Tons Used in Aggregate	1.5	1.6	6.2	7.3
	Tons Used in Cold Mix	0.4	0.4	1.5	1.6
	Tons Used in Other	0.1	0.07	0.7	0.8
	Tons Landfilled	0.06	0.001	0.1	0.004
	Avg. % for DOT mixes	12.5%	13.2%		
	Avg. % for Other Agency mixes	14.0%	15.2%		
	Avg. % for Commercial & Residential	17.5%	18.0%		
	National Average All Mixes Based on % Reported For Different Sectors	15.6%	17.2%		
	National Average All Mixes Based on RAP Tons Used In HMA/WMA	16.2%	18.0%		

Figure 9 shows the estimated total tons of RAP used in HMA/WMA, aggregate, cold mix, other, and landfilled. The majority of RAP is used in HMA/WMA followed by aggregate and cold mix. It is estimated that less than 0.1 percent was sent to landfills in both 2009 and 2010.

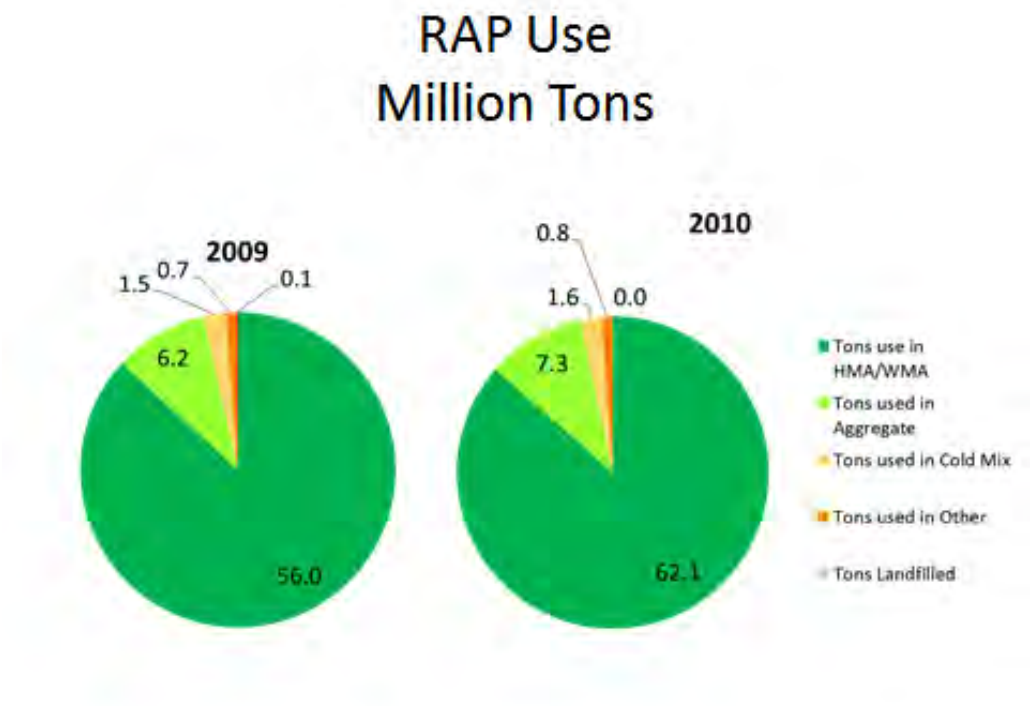

Figure 9: RAP tons by final use.

Figure 10 shows the total estimated amount of RAP used in the different sectors. These values were calculated using the average percentages of RAP reported for the different sectors and adjusted to account for the difference in reported RAP tons and the tons calculated from the percentage by sector.

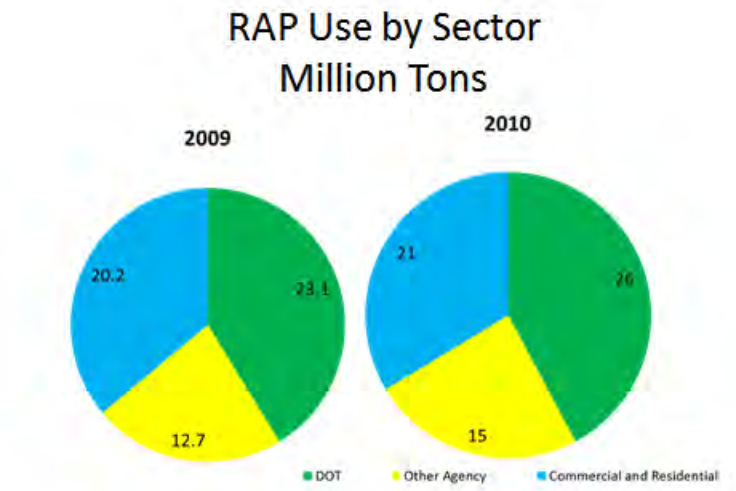

Figure 10: RAP Use by Sector

Figures 11 and 12 show the average percent of RAP used in the different states based on reported RAP and total tons. It should be noted that the accuracy of data for individual states will vary depending on the number of responses received from each state and the total number of tons represented by the responses.

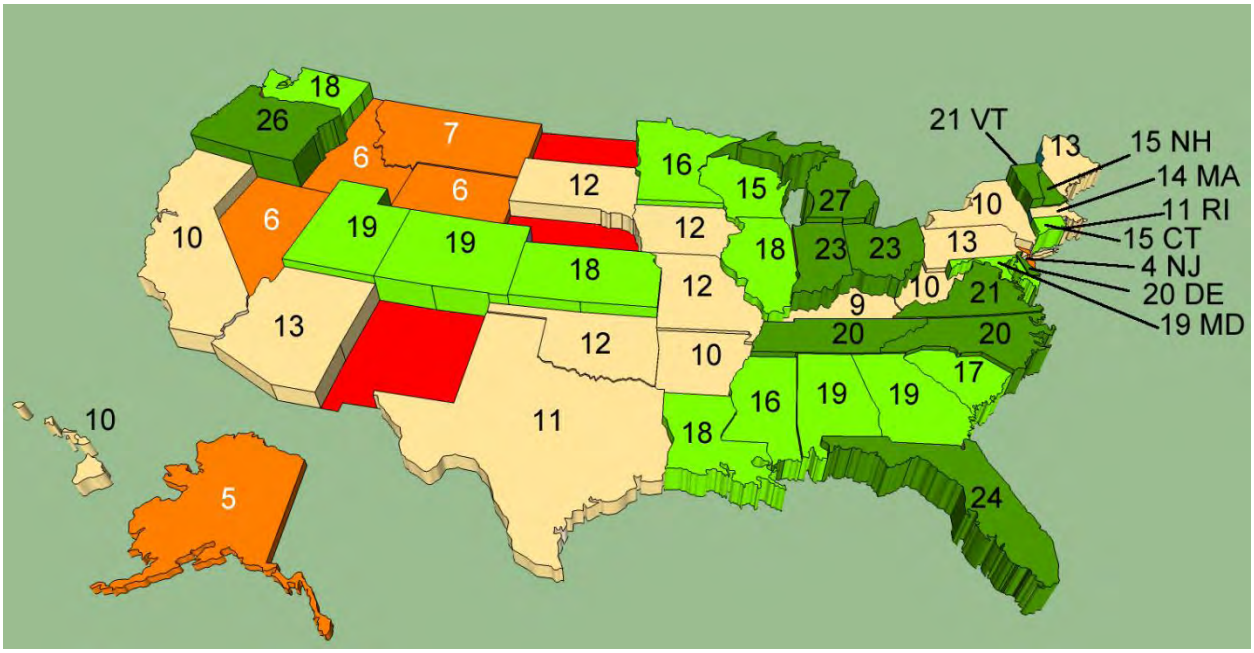

Figure 11: Estimated average percent of RAP by state for 2009

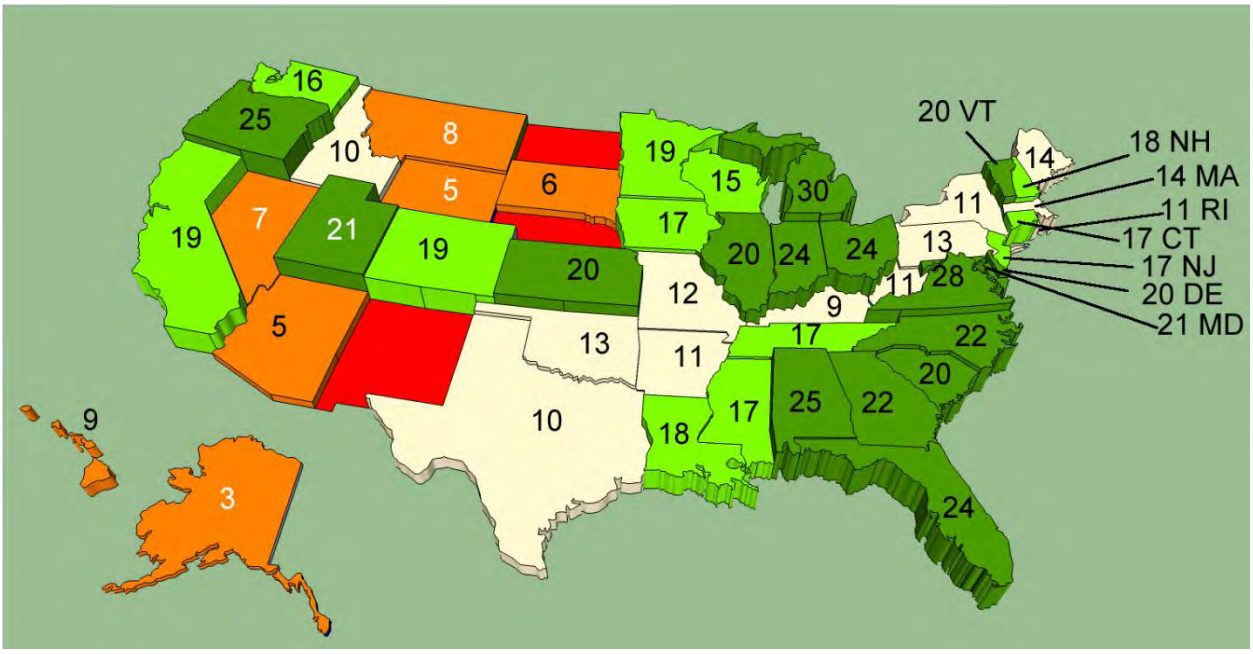

Figure 12: Estimated average percent of RAP by state for 2010

RAP use began in the 1970s. Today, most contractors are using RAP in mixes, with 96 percent of the contractors/branches reporting using RAP and over 86 percent of these contractors reporting excess RAP. From 2009 to 2010, the amount of RAP used in HMA/WMA increased from 56.0 to 62.1 million tons for a 10 percent increase. The average percent RAP used in mixes has increased about from about 16 to 18 percent between 2009 and 2010.

Reclaimed Asphalt Shingles

Table 5 summarizes the RAS data from the survey. Based on the total estimated tons received and the amount used for all purposes, including landfilling, there was an excess of 126,000 and 616,000 tons in 2009 and 2010, respectively.

Table 5: Summary of RAS Data

	Reported Tons Thousand		Total Estimated Tons Thousand	
	2009	2010	2009	2010
Companies/branches Reporting Using RAS	44	61		
Tons Accepted	332	558	957	1,851
Tons Used in HMA/WMA	245	392	701	1,099
Tons Used in Aggregate	5	2	6	3
Tons Used in Cold Mix	-	-	-	-
Tons Used in Other	39	34	123	124
Tons Landfilled	-	0.5	-	6
Avg. % for DOT Mixes	0.33%	0.78%		
Avg. % for Other Agency Mixes	0.37%	0.47%		
Avg. % for Commercial & Residential Mixes	0.63%	0.81%		
National Average All Mixes Based on RAS Tons Used in HMA/WMA	0.27%	0.33%		

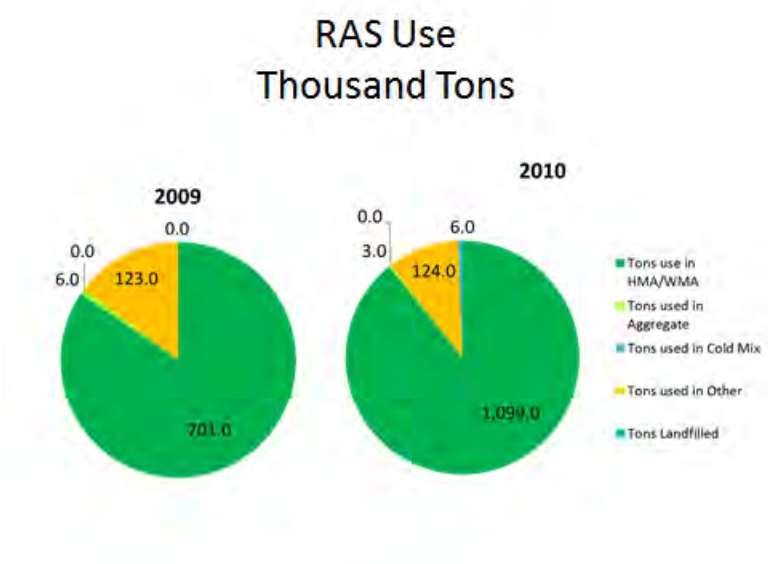

Figure 13: Summary of RAS use.

Figure 13 shows the total estimated amount of RAS used. Figure 14 summarizes how RAS was used in the different sectors of the paving market. These values were calculated using the average percentages of RAS reported for the different sectors and adjusted to account for the difference in reported RAP tons and the tons calculated from the percentage by sector.

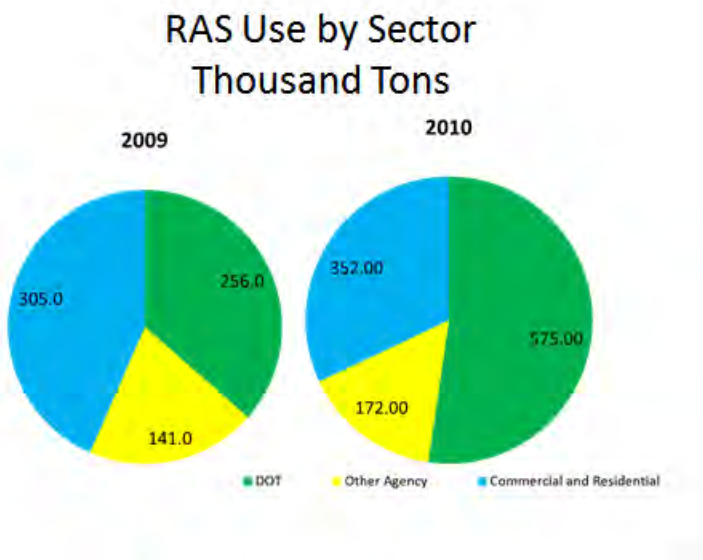

Figure 14: Summary of RAS use by sector.

Figure 15 shows states where plant-mix producers reported using RAS in 2009 and/or 2010.

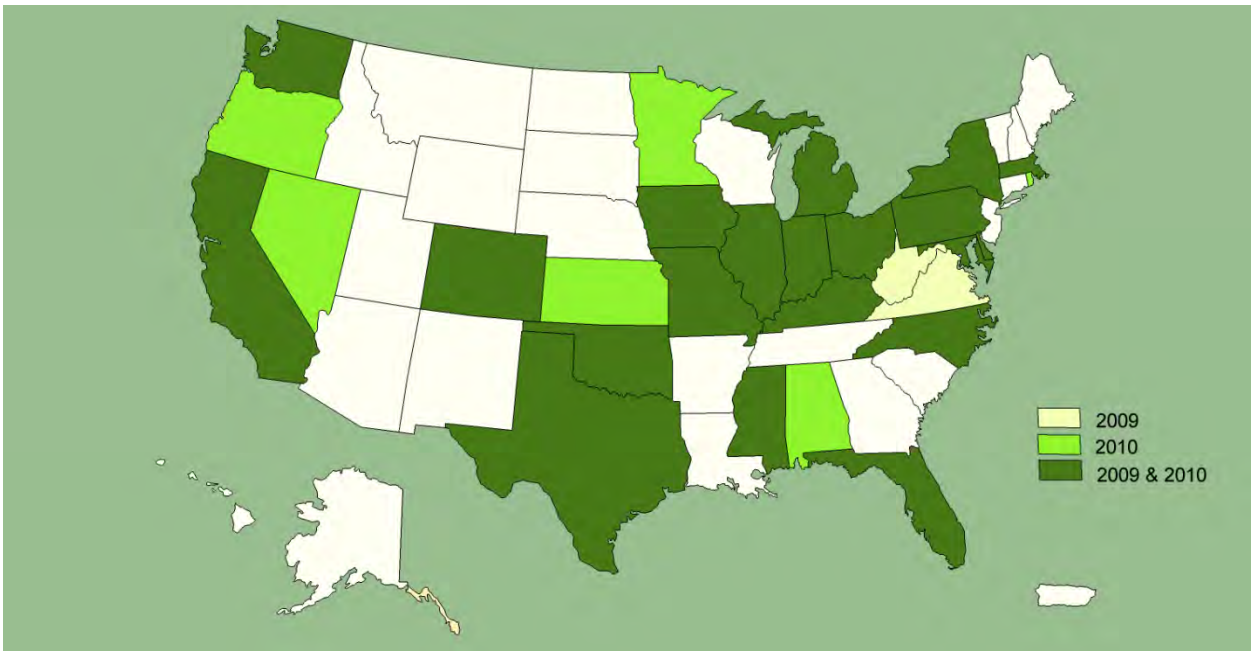

Figure 15: States with companies/branches reporting using RAS

RAS use increased from 702,000 to 1.10 million tons from 2009 to 2010, a 57 percent increase. The number of companies/branches using RAS increased from 44 to 61, a 39 percent increase. The number of states where plant mix producers reported using RAS increased from 23 to 26 from 2009 to 2010.

Warm-Mix Asphalt

Table 6 summarizes WMA data from the survey. The survey asked producers their estimated percentages of tons produced for the different sectors and the percent of which technologies were used. It is not necessary to calculate estimated values since the percent will not change.

WMA saw a tremendous increase between 2009 and 2010. The number of companies/branches using WMA increased from 85 to 121. The percent of DOT, other agency, and commercial/residential mixes using WMA increased from 6.3 to 15.0, 4.4 to 11.7, and 4.5 to 11.6, respectively.

Table 6: Summary of WMA data.

	Reported % of Sector		Estimated Total Tons, million	
	2009	2010	2009	2010
Companies/Branches Reporting Using WMA	85	121		
DOT	6.3%	15.0%	10.7	25.8
Other Agency	4.4%	11.7%	3.7	10.1
Commercial & Residential	4.5%	11.6%	4.8	11.7
Chemical Additive %	15%	6%		
Additive Foaming %	2%	1%		
Plant Foaming %	83%	92%		
Organic Additive %	0.3	1%		

Figures 16 through 19 show the estimated total tons of WMA produced in each state. It should be noted that the accuracy of data for individual states varies depending on the number of responses received from each state and the total number of tons represented by the responses. Nationally, the total tons of WMA increased from 19.2 million tons to 47.6 million tons, a 148 percent increase. Plant foaming is used most often in producing WMA. Additives accounted for about 17 and 8 percent of the total WMA production in 2009 and 2010, respectively.

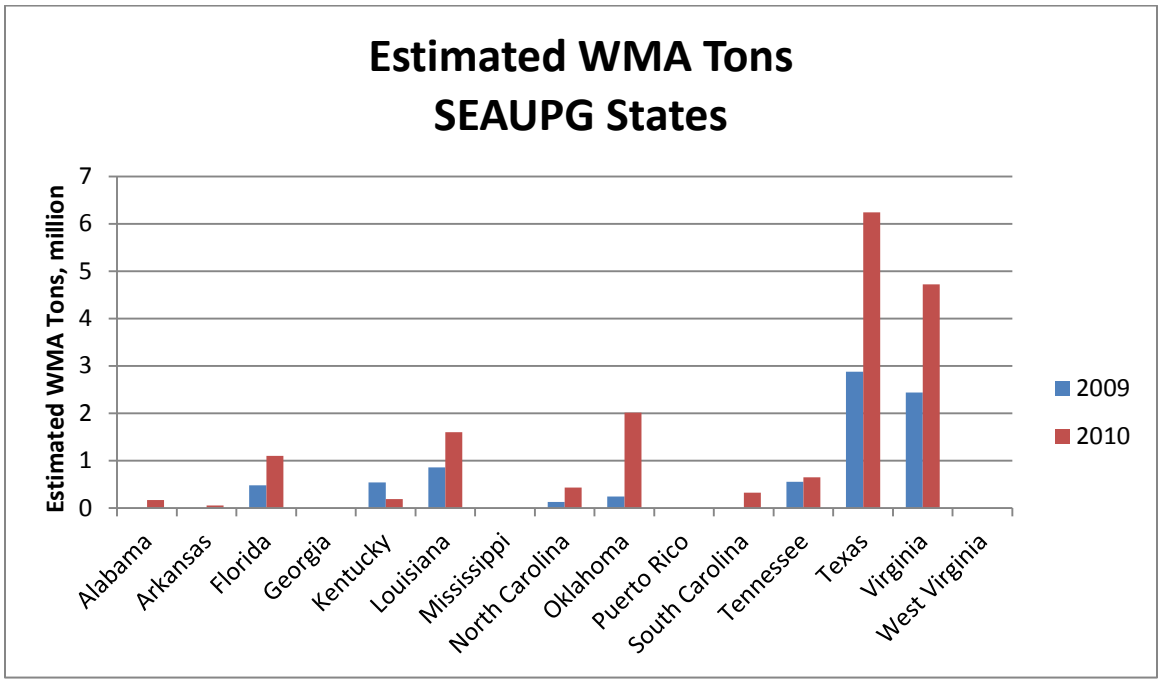

Figure 16: Estimated total WMA tons for Southeast Asphalt User Producer Group states/territories

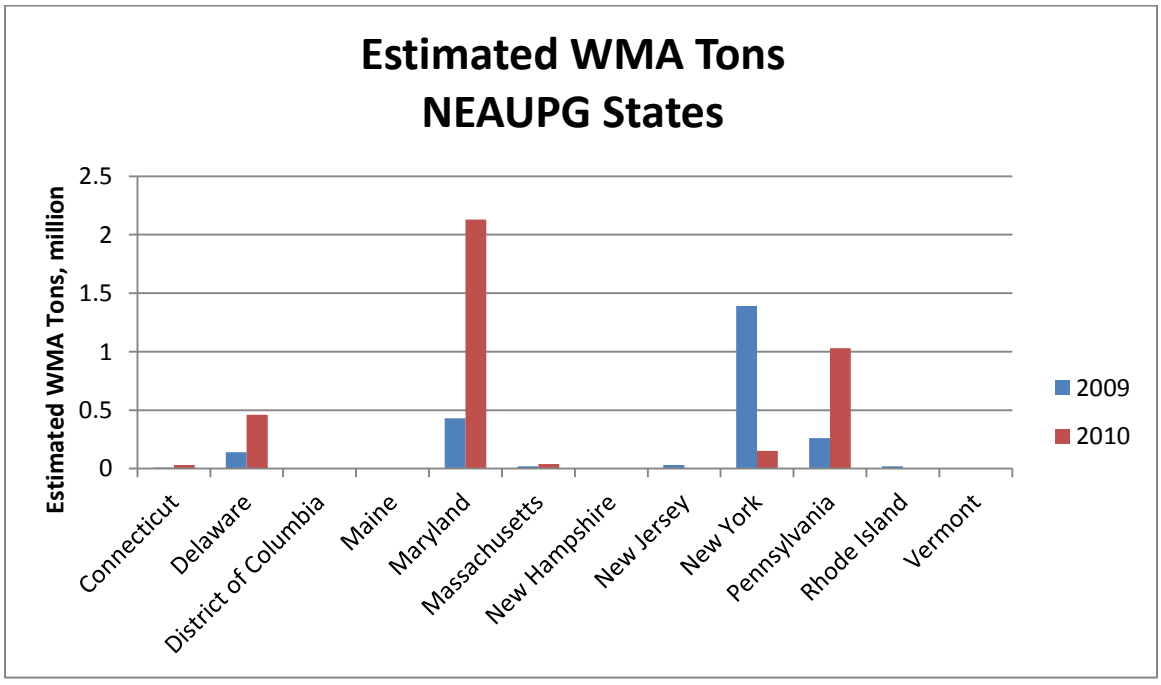

Figure 17: Estimated total WMA tons for Northeast User Producer Group states

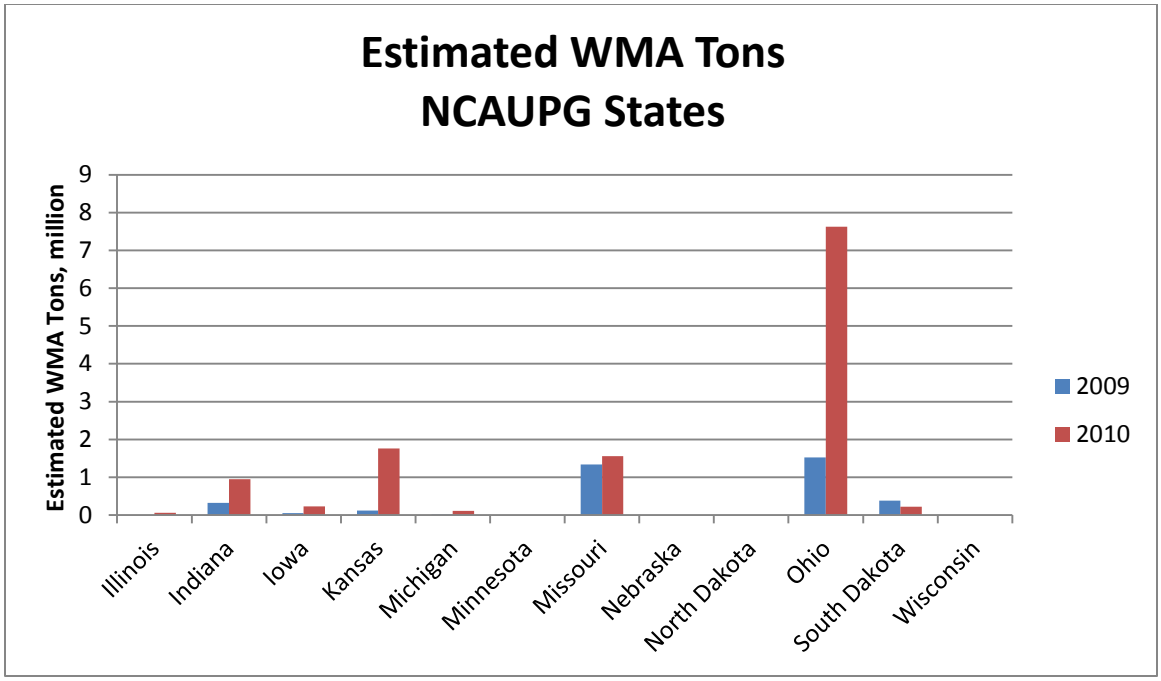

Figure 18: Estimated total WMA tons for North Central Asphalt User Producer Group states

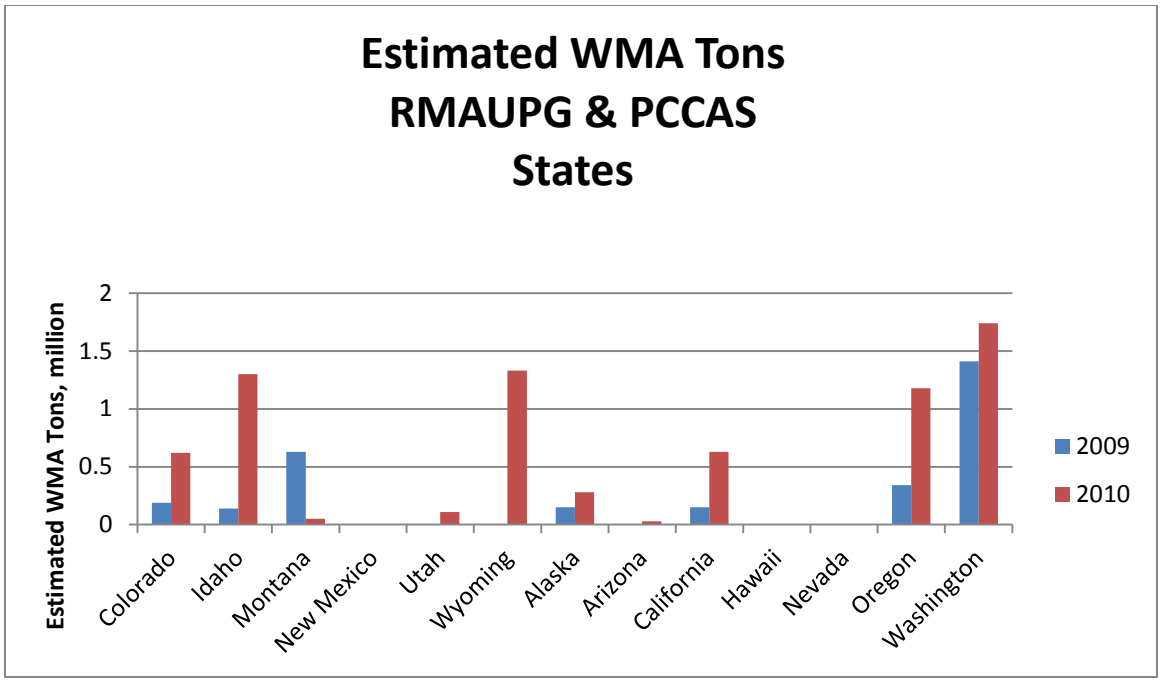

Figure 19: Estimated total WMA tons for Rocky Mountain Asphalt User Producer Group and Pacific Coast Conference on Asphalt Specification states

Summary and Conclusions

The survey clearly shows the asphalt pavement industry continues to improve its environmental stewardship through its increasing use of RAP, RAS, and WMA. These technologies reduce the need for new materials, especially asphalt binders, and energy use.

RAP use began in the 1970s and now most contractors are using RAP in mixes, with 96 percent of the contractors/branches reporting using RAP and over 86 percent of these contractors reporting excess RAP. From 2009 to 2010 the amount of RAP used in HMA/WMA increased from 56.0 to 62.1 million tons, for a 10 percent increase.

Assuming 5 percent liquid asphalt in RAP, this represents over 3 million tons (19 million barrels) of asphalt binder conserved.

RAS use increased from 702,000 to 1.10 million tons from 2009 to 2010, a 57 percent increase. Assuming a conservative asphalt content of 20 percent for the shingles, this represents 234,000 tons (1.5 million barrels) of asphalt binder.

WMA was first used in the U.S. in 2004, with the market growing tremendously since that time. In 2009 the total tonnage of WMA is estimated at 19.2 million tons. This grew to 47.6 million tons in 2010, for a 148 percent increase. Plant foaming is used most often in producing WMA. Additives accounted for about 17 and 8 percent of the total WMA production in 2009 and 2010, respectively.

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