

Information Series 138

Annual Asphalt Pavement Industry Survey on

Recycled Materials
and Warm-Mix Asphalt Usage:
2009–2013



4th Annual Survey



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16. Abstract <p>One of the shared goals of the Federal Highway Administration (FHWA) and the National Asphalt Pavement Association (NAPA) is to support and promote sustainable practices such as pavement recycling and warm-mix asphalt (WMA). The use of recycled materials, primarily reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS), in asphalt pavements reduces the amount of new materials required to produce asphalt mixes and material going to landfills. This is vital to the mission of environmental stewardship and extending the service life of the nation's infrastructure while lowering overall costs.</p> <p>WMA technologies have been introduced to reduce the mixing and compacting temperatures for asphalt mixtures as a means of reducing emissions. Additional benefits include improved compaction of asphalt mixtures leading to improved pavement performance. As part of FHWA's Every Day Counts initiative, WMA was chosen for accelerated deployment in federal-aid highway, state department of transportation (DOT), and local road projects.</p> <p>It is important for the industry to track the deployment of these technologies, which reduce costs, energy, waste, emissions, and the amount of new materials required for road construction. FHWA has established two survey mechanisms for tracking the use of recycled materials and WMA in asphalt pavements. The first survey tracks state DOT usage, and the other tracks industry usage. These surveys have established a baseline for RAP, RAS, and WMA usage and have tracked the growth of the use of these sustainable practices in the highway industry since 2009.</p> <p>The objective of this survey is to quantify the use of recycled materials, and WMA produced by the asphalt pavement industry. Survey results show significant growth in the use of RAP, RAS, and WMA technologies from 2009 through 2013. The asphalt industry remains the country's number-one recycler by recycling asphalt pavements at a rate of over 99 percent and for the first time all (100 percent) contractors/branches report using RAP in 2013. The average percentage of RAP used in asphalt mixtures has increased from 16.2 percent in 2009 to 20.0 percent in 2013. In 2013 the estimated RAP tonnage used in asphalt mixes was 67.8 million tons. Assuming 5 percent liquid asphalt in RAP, this represents over 3.4 million tons (19 million barrels) of asphalt binder conserved during 2013. The estimated savings at \$600 per ton for asphalt binder is \$2.04 billion.</p> <p>Use of both manufacturers' scrap and post-consumer asphalt shingles used in asphalt mixes increased 135 percent since 2009 to more than 1.6 million tons 2013. Assuming a conservative asphalt content of 20 percent for the RAS, this represents about 320,000 tons (1.7 million barrels) of asphalt binder conserved. The estimated savings at \$600 per ton for asphalt binder is \$192 million.</p> <p>For 2012 and 2013, contractors were asked about their use of other recycled materials in asphalt mixtures. The number of states where contractors reported using steel and blast furnace slag in asphalt mixtures dropped slightly from 13 states in 2012 to 11 states in 2013s. The number of states where contractors reported ground tire rubber (GTR) being used in asphalt mixtures grew from nine states in 2012 to 15 states and Puerto Rico in 2013. The reported use of cellulose fiber grew from one state in 2012 to six states in 2013. Other recycled materials used to a lesser degree include fly ash, foundry slag, and glass. Due to the low response rate on other recycled materials, no attempt was made to estimate the total quantities of other recycled materials used.</p> <p>In 2013, WMA was more than 30 percent of the total asphalt mixture market. WMA use increased by nearly 22 percent from 2012 to 2013, and about 533 percent since 2009. Plant foaming is used most often in producing WMA, with 87 percent of the market. WMA additives accounted for about 13 percent of the market.</p>			
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Annual Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2009–2013

Executive Summary

The 2013 survey results show that the asphalt pavement industry continues to improve its outstanding record of sustainable practices by further increasing the use of recycled materials and warm-mix asphalt (WMA). The use of recycled materials such as reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS) conserve raw materials and reduce overall asphalt mixture costs while, WMA technologies improve conditions for achieving performance and long life, conserve energy, reduce emissions from production and paving operations, and improve conditions for workers.

The objective of this survey was to quantify the use of recycled materials, primarily RAP and RAS, and WMA produced by the asphalt pavement industry. The National Asphalt Pavement Association (NAPA) conducted a voluntary survey of asphalt mixture producers in the United States and state asphalt pavement associations (SAPAs). The survey was broken into five sections: general information, RAP, RAS, WMA, and other recycled materials. For the first time asphalt mix producers from all 50 states, District of Columbia, and Puerto Rico completed the 2013 survey. A total of 249 companies/branches with 1,281 plants are represented in the 2013 survey.

The following are highlights of the 2013 survey:

- The asphalt industry remains the country's number-one recycler by recycling asphalt pavements at a rate of over 99 percent. 100 percent of the contractors/branches reported using RAP in 2013, which is up two percent from 2012. The amount of RAP used in asphalt mixtures was 67.8 million tons in 2013, a 21 percent increase over the tons used in 2009 (56 million tons). This is a 1 percent decrease over the tons used in 2012 (68.3 million tons). However, total asphalt tonnage was down from 2012 to 2013, so in term of percent of total tonnage there was a 2 percent increase in the use of RAP from 2012 to 2013. Assuming 5 percent liquid asphalt in RAP, this represents over 3.4 million tons (19 million barrels) of asphalt binder conserved. The amount of RAP landfilled decreased from previous years to less than 0.2 percent.
- Use of both manufacturers' scrap and post-consumer shingles decreased from nearly 1.9 million tons in 2012 to more than 1.6 million tons in 2013, an 11.6 percent decrease. Assuming a conservative asphalt content of 20 percent for the RAS that may be used to replace virgin binder, this represents 320,000 tons (1.7 million barrels) of asphalt binder conserved. As in the 2012 survey, the amount of scrap shingles collected was less than the amount used for all purposes. This is due to fewer unprocessed scrap shingles being collected by asphalt mix producers in 2012 and 2013 than prior years, and producers buying RAS from shingle processors.
- Information on other recycled materials was obtained for the second time in this year's survey. The most commonly used materials in asphalt mixtures were blast furnace slag, steel slag, ground tire rubber, and cellulose fibers. Less commonly used recycled materials included fly ash and foundry sand.
- Total tonnage of WMA is estimated at 106.4 million tons in 2013. This is nearly a 23 percent increase over 2012 WMA tonnage (86.7 million tons). As of 2013, WMA is now over 30 percent of the total asphalt mixture market. Plant foaming is used most often in producing WMA, with more than 87 percent of the market; additives accounted for about 13 percent of the market.

Background

One of the shared goals of the Federal Highway Administration (FHWA) and the National Asphalt Pavement Association (NAPA) is to support and promote sustainable practices, such as incorporating recycled materials in pavements and the use of warm-mix asphalt (WMA). Reclaimed asphalt pavement (RAP) is recycled at a higher rate than any other material in the United States and is vital to the mission of extending the service life of the nation's infrastructure while lowering overall costs. Another recycled material increasingly used in asphalt mixtures is reclaimed asphalt shingles (RAS) from both manufacturers' waste and post-consumer shingles. The use of RAP and RAS in asphalt pavements reduces the amount of material going to landfills and can reduce the amount of new asphalt binder required in mixes, which helps to stabilize the price of asphalt mixtures and saves natural resources. Other recycled materials incorporated into asphalt pavements include ground tire rubber (GTR), steel slag, blast furnace slag, and cellulose fibers, among others. These materials put waste materials to practical use, reducing the amount of material going to landfills and improving the sustainability of asphalt mixtures.

WMA technologies reduce the mixing and compacting temperatures for asphalt mixtures. Environmental benefits include reductions in both fuel consumption and air emissions. Construction benefits include the ability to extend the paving season into the cooler months, haul the material longer distances, improve compaction, and use higher percentages of RAP (Prowell et al., 2012). As part of FHWA's first Every Day Counts initiative, WMA was chosen in 2010 for accelerated deployment in federal-aid highway, state department of transportation (DOT), and local road projects (FHWA, 2013). In 2013, WMA was honored with the Construction Innovation Forum's NOVA Award for its engineering, economic, and environmental benefits (CIF, 2013).

FHWA works closely with the pavement industry through associations and other stakeholders to promote pavement recycling technologies and WMA. As part of this effort, FHWA has established two survey mechanisms for tracking the use of recycled materials and WMA in asphalt pavements. The first survey tracks state DOT usage and the other tracks industry usage. Since 2007, FHWA has partnered with the American Association of State Highway and Transportation Officials (AASHTO) to conduct a biennial survey of state DOTs' use of recycled materials (Copeland, 2011; Copeland et al., 2010; Pappas, 2011). The results of the FHWA/AASHTO survey are typically presented at FHWA Expert Task Group meetings. For the second survey, FHWA partners with NAPA to survey asphalt producers to determine industry use of RAP, RAS, other recycled materials, as well as WMA technologies. These surveys have established a baseline of RAP, RAS, and WMA usage, and have tracked the growth of the use of these sustainable practices in the highway industry.

The FHWA/NAPA industry survey first began in 2010, and was repeated in 2011 and 2012. The survey results showed significant growth in the use of RAP, RAS, and WMA technologies from 2009 to 2012 (Hansen & Newcomb, 2011; Hansen & Copeland, 2013a; Hansen & Copeland, 2013b). In order to continue to track the use of these technologies, FHWA again partnered with NAPA to conduct a similar survey of RAP, RAS, and WMA use for 2013. This report documents the results of the 2013 industry survey, including the survey methodology, results, trends, and changes from 2009 through 2013. For 2012 and 2013, the survey also asked about the use of other recycled materials used in asphalt mixtures. The survey questions and data by state are included in the appendices.

Objective and Scope

The objective of this effort is to quantify the use of recycled materials and WMA produced by the asphalt pavement industry. NAPA conducted a voluntary survey of asphalt mixture producers in the United States and of state asphalt pavement associations (SAPAs). While keeping specific producer data confidential, NAPA staff compiled the amount of asphalt mixtures being produced; the amount of RAP, RAS, and other recycled material used; and the amount of WMA being produced in the United States. The data are broken out on a state-by-state basis in Appendix B. To keep specific producer data confidential, no state specific information is provided if fewer than three producers from a state respond to the survey. Information from states with fewer than three responding companies is still used to calculate national values. The data are analyzed and summarized in this report. In order to accomplish this work, the following tasks were conducted:

1. Develop an online survey similar to the 2009–2012 surveys that enables an analysis of the quantities of RAP and RAS being used in asphalt mixtures, as well as the total amount of WMA produced nationally. For 2012 and 2013 information on other recycled materials used in asphalt mixtures was gathered, too.
2. Conduct a voluntary survey of asphalt mix producers throughout the United States and follow up with verbal requests for information in locations where responses were low.
3. Estimate the total asphalt mixture market in each state or territory by using data from responding SAPAs and the U.S. Department of Transportation Federal Highway apportionment to determine a weighting factor for each state and reconciling the total U.S. asphalt mix tonnage with national estimates.
4. Analyze and summarize the information nationally and by state and prepare a final report.

Survey Methodology

The survey was conducted using a web survey service, SurveyMonkey®. Sections 1 through 4 of the survey for 2013 were identical to the surveys used for 2009 through 2011 (Hansen & Newcomb, 2011; Hansen & Copeland, 2013a; Hansen & Copeland, 2013b). Section 5 was added for 2012 and 2013 to collect information on the use of other recycled material in asphalt mixtures. A copy of the 2013 survey is included as Appendix A.

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. SAPAs participated by placing notices on their websites and in their newsletters. Announcements were made at NAPA meetings, as well as at several state asphalt conferences. A press release was sent to construction industry trade media, and republished in print and to their websites. Notices of the survey and links were shared through social media channels, including Twitter, Facebook, and LinkedIn. Asphalt mixture producers then went to the website and completed the survey form. After the initial data was gathered and analyzed, anomalies in individual producer records were identified and reconciled.

The survey was broken into five sections. These sections were general information, RAP, RAS, WMA, and other recycled materials. Table 1 summarizes the questions asked in each section.

Table 1: Survey Questions Summary

Section 1: General Information	Sections 2 and 3: RAP & RAS	Section 4: WMA	Section 5: Other Recycled Materials
Number of Plants	Tons Accepted	Average % Produced for DOT Tons	Other Recycled Materials Used
DOT Tons	Tons Used in HMA/WMA	Average % Produced for Other Agency Tons	Tons of HMA/WMA Produced Using Each Recycled Material
Other Agency Tons	Tons Used in Aggregate	Average % Produced for Commercial & Residential Tons	Tons of Other Recycled Product Used
Commercial & Residential Tons	Tons Used in Cold Mix	Chemical Additive %	
	Tons Used in Other	Additive Foaming %	
	Tons Landfilled	Plant Foaming %	
	Average % for DOT Mixes	Organic Additive %	
	Average % for Other Agency Mixes		
	Average % for Commercial & Residential Mixes		

Most surveys were completed online with one multistate contractor collecting data from its different operations and submitting them in spreadsheet form. 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 anomaly.

To determine the total amount of RAP and RAS used and WMA produced in each state and in the nation, the total amount of asphalt mix produced in each state needed to be determined. Total tonnage of asphalt mix produced represents commercial (i.e., private) and government (i.e., DOTs and local agencies) tonnages. Estimated tonnages were provided by SAPAs in 38 states/territories, which totaled about 283 million tons. This included one SAPA that supplied DOT-estimated tonnages. For this state, the total tonnage was estimated by dividing the DOT tonnage by the percent of DOT tons provided by asphalt mix producers in that state who completed the survey. To estimate the total tons in states where a SAPA estimate of total tonnage was not available, the total asphalt mixture tonnage was estimated through a relationship developed for those states where SAPA estimated tons were available and their federal highway apportionment. This is the same methodology used to estimate tonnage in the 2009–2011 surveys; for more details see Hansen & Newcomb (2011). This resulted in the following power curve relationship:

$$\text{Total Estimated Tons} = 0.2359 \times (\text{State Federal Apportionment})^{0.843}$$

This formula used to estimate the tonnage for states with no SAPA estimate based on the state’s federal apportionment.

Survey Results

Asphalt mix producers from all 50 states, District of Columbia, and Puerto Rico completed the survey. In 2009–2010, 2011 and 2012, 48, 49, and 49 jurisdictions completed the survey respectively. A total of 249 companies/branches with 1,281 plants are represented in the 2013 survey. In the 2009–2010, 2011, and 2012 surveys, 1,027, 1,091, and 1,141 plants were represented respectively. Table 2 summarizes the number of companies/branches and the number of plants reporting for each state.

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

State	2009 & 2010		2011		2012		2013		State	2009 & 2010		2011		2012		2013	
	Cos.	Plants	Cos.	Plants	Cos.	Plants	Cos.	Plants		Cos.	Plants	Cos.	Plants	Cos.	Plants	Cos.	Plants
AL	3	17	5	38	4	31	5	32	MT	*	*	4	8	4	8	3	7
AK	3	20	*	*	*	*	*	*	NE	—	—	*	*	*	*	3	10
AZ	*	*	4	6	4	7	3	7	NV	*	*	*	*	3	14	3	5
AR	3	9	*	*	5	17	3	12	NH	*	*	*	*	3	14	4	16
CA	6	49	4	48	4	36	7	75	NJ	*	*	3	21	*	*	4	17
CO	8	26	7	24	5	16	6	17	NM	—	—	*	*	—	—	*	*
CT	*	*	3	23	*	*	*	*	NY	13	68	11	64	11	68	14	74
DE	*	*	—	—	3	6	*	*	NC	6	52	5	29	6	35	6	37
DC	—	—	—	—	—	—	*	*	ND	—	—	3	8	—	—	*	*
FL	6	61	4	22	5	34	7	44	OH	5	50	5	87	6	102	6	100
GA	*	*	6	66	6	67	5	51	OK	4	20	3	18	3	14	6	15
HI	*	*	*	*	*	*	*	*	OR	6	10	6	16	6	15	3	3
ID	5	17	3	8	3	8	4	10	PA	17	63	7	34	15	66	14	58
IL	16	44	7	24	5	10	9	19	PR	*	*	*	*	*	*	*	*
IN	3	19	4	29	5	28	7	42	RI	*	*	*	*	*	*	*	*
IA	7	16	6	14	10	28	10	29	SC	4	16	3	6	4	15	3	6
KS	6	25	4	21	3	20	5	24	SD	*	*	3	9	3	8	*	*
KY	3	24	4	19	5	38	7	49	TN	*	*	7	72	5	32	6	48
LA	*	*	*	*	*	*	3	10	TX	7	38	9	41	10	51	8	42
ME	*	*	*	*	*	*	3	18	UT	5	30	6	17	6	16	8	24
MD	4	10	4	10	7	23	9	24	VT	*	*	*	*	*	*	*	*
MA	*	*	*	*	3	14	4	19	VA	5	38	7	26	8	46	8	38
MI	4	40	6	39	4	28	5	24	WA	6	39	4	30	4	29	4	44
MN	*	*	6	26	4	20	10	37	WV	*	*	3	15	3	14	3	14
MS	*	*	4	26	3	16	5	20	WI	*	*	3	13	3	16	3	58
MO	6	35	7	38	5	35	3	25	WY	*	*	3	7	3	7	*	*

* Fewer than three companies responding

The average tons produced per plant was 121,000 in 2009; 117,000 in 2010; 121,000 in 2011; 122,000 in 2012; and 115,000 in 2013.

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

State	Tons (Millions)									
	2009		2010		2011		2012		2013	
	Estimated	Reported	Estimated	Reported	Estimated	Reported	Estimated	Reported	Estimated	Reported
Alabama	7.50	1.75	8.00	1.09	8.00	4.24	8.00	3.37	8.00	3.87
Alaska	3.67	0.82	4.41	1.15	5.98	*	5.46	*	4.94	*
Arizona	7.50	*	7.14	*	8.00	0.91	7.55	1.04	6.79	1.01
Arkansas	3.05	0.71	4.15	0.78	5.56	*	4.20	1.41	4.20	0.95
California	19.97	8.44	13.79	7.68	23.00	9.38	22.50	4.06	24.30	11.06
Colorado	7.72	3.00	10.52	2.62	6.50	2.50	6.50	1.48	7.00	2.01
Connecticut	4.96	*	5.01	*	4.34	2.95	4.00	*	4.95	*
Delaware	0.79	*	0.65	*	2.08	—	2.20	0.71	1.30	*
District of Columbia	1.62	—	1.81	—	1.71	—	1.85	—	1.88	*
Florida	14.70	6.91	13.00	5.81	13.57	3.01	12.38	3.82	12.00	6.1
Georgia	13.00	*	11.70	*	9.50	7.29	8.00	7.78	6.75	5.19
Hawaii	1.73	*	1.91	*	1.81	*	1.20	*	1.98	*
Idaho	3.00	1.13	3.09	1.14	3.45	0.56	3.49	0.79	3.08	0.77
Illinois	19.25	7.81	17.60	7.17	13.94	2.12	13.50	1.16	12.50	2.35
Indiana	9.60	3.28	7.90	3.06	9.50	4.07	10.00	4.44	9.00	4.08
Iowa	4.74	3.54	3.45	1.99	3.30	1.31	4.26	2.80	4.18	3.4
Kansas	4.17	2.08	7.12	1.85	4.00	1.67	4.50	1.55	4.50	1.69
Kentucky	7.00	1.72	7.00	1.74	7.00	1.86	9.00	2.90	7.00	4.56
Louisiana	6.00	*	6.00	*	6.00	*	5.50	*	6.00	1.97
Maine	1.80	*	2.03	*	1.91	*	2.36	*	2.01	1.92
Maryland	7.20	1.07	6.50	1.06	6.50	1.73	6.50	4.01	5.80	3.82
Massachusetts	6.00	*	6.00	*	6.00	*	6.00	1.64	6.10	2.04
Michigan	11.50	7.49	10.80	7.03	10.00	6.54	10.00	5.16	10.30	5.36
Minnesota	12.50	*	13.10	*	13.00	4.94	13.00	4.73	13.50	7.02
Mississippi	4.62	*	4.79	*	6.00	2.67	4.00	1.98	4.00	2.29
Missouri	7.13	3.02	4.70	3.19	8.00	4.06	6.24	3.23	6.20	2.35
Montana	3.78	*	3.99	*	4.89	0.59	4.80	0.51	4.17	0.51
Nebraska	2.96	—	3.09	—	3.37	*	3.43	*	3.10	0.95
Nevada	3.11	*	3.57	*	4.24	*	4.18	1.58	3.76	0.44
New Hampshire	1.86	*	1.94	*	1.92	*	2.05	1.09	1.94	1.5
New Jersey	9.33	*	9.09	*	8.73	3.24	8.09	*	8.83	3.37
New Mexico	3.78	—	3.84	—	4.48	*	4.44	—	3.80	*
New York	16.00	5.65	16.00	5.54	16.50	5.88	14.50	6.00	16.00	5.93
North Carolina	9.37	4.95	12.11	5.66	11.00	2.90	13.00	3.93	12.00	2.85
North Dakota	2.55	—	2.70	—	3.89	1.05	3.03	—	5.00	*
Ohio	14.50	5.69	15.10	6.23	14.30	10.81	16.30	12.68	14.60	10.49
Oklahoma	5.74	2.47	5.99	2.16	5.20	1.91	6.50	1.09	5.52	1.7
Oregon	5.22	1.27	4.81	1.16	4.91	1.95	5.14	1.71	4.75	0.37
Pennsylvania	17.40	10.97	18.30	11.66	16.83	4.17	15.86	9.03	14.90	6.66
Puerto Rico	2.49	*	1.44	*	1.19	*	2.06	*	1.60	*
Rhode Island	2.07	*	2.34	*	1.73	*	1.87	*	2.45	*
South Carolina	6.23	1.77	6.14	1.98	6.00	0.85	5.15	1.62	5.40	0.67
South Dakota	2.73	*	2.96	*	2.17	0.93	3.51	0.56	2.10	*
Tennessee	7.95	*	7.87	*	9.04	7.05	8.00	2.79	7.67	3.83
Texas	14.77	4.23	16.54	5.73	13.67	6.36	15.85	8.79	17.00	7.12
Utah	3.14	3.71	3.35	3.23	4.00	2.77	3.99	3.19	3.40	2.62
Vermont	1.74	*	2.12	*	1.96	*	2.13	*	2.30	*
Virginia	9.10	4.64	10.90	4.51	13.10	4.06	12.00	6.78	10.00	4.93
Washington	5.70	4.65	5.70	4.46	4.20	3.26	4.20	2.99	4.30	2.78
West Virginia	2.90	*	3.00	*	3.75	2.10	3.50	1.65	3.00	1.52
Wisconsin	10.52	*	11.96	*	13.00	1.53	11.20	4.22	12.00	7.59
Wyoming	2.77	*	2.83	*	3.25	0.32	3.32	0.30	2.80	*
Total	358.43	123.98	359.85	119.87	365.97	130.54	360.29	139.03	350.68	147.61

* Fewer than three contractors responding

Note: Blue shaded cells indicate states and years where SAPA-provided data was used to compute total estimated value. Where no data was available on total tons, a relationship between tonnage and federal apportionment was used to estimate the total tons for states.

Table 3 includes the estimated tonnage for each state as given by the SAPA or estimated from the federal apportionment and includes the reported tonnage for each state from the survey results. Figure 1 illustrates the Table 3 data and provides another perspective on the survey responses, depicting the ratio of the tons reported in each state to the total estimated tons for each year, 2009–2013. The closer a state’s number is to 100 indicates that the reported tonnage from the survey matches the estimated tonnage provided by the SAPA or tonnage estimated from the federal apportionment. The data reported in the survey represent about 42 percent of the estimated total U.S. tonnage for 2013.

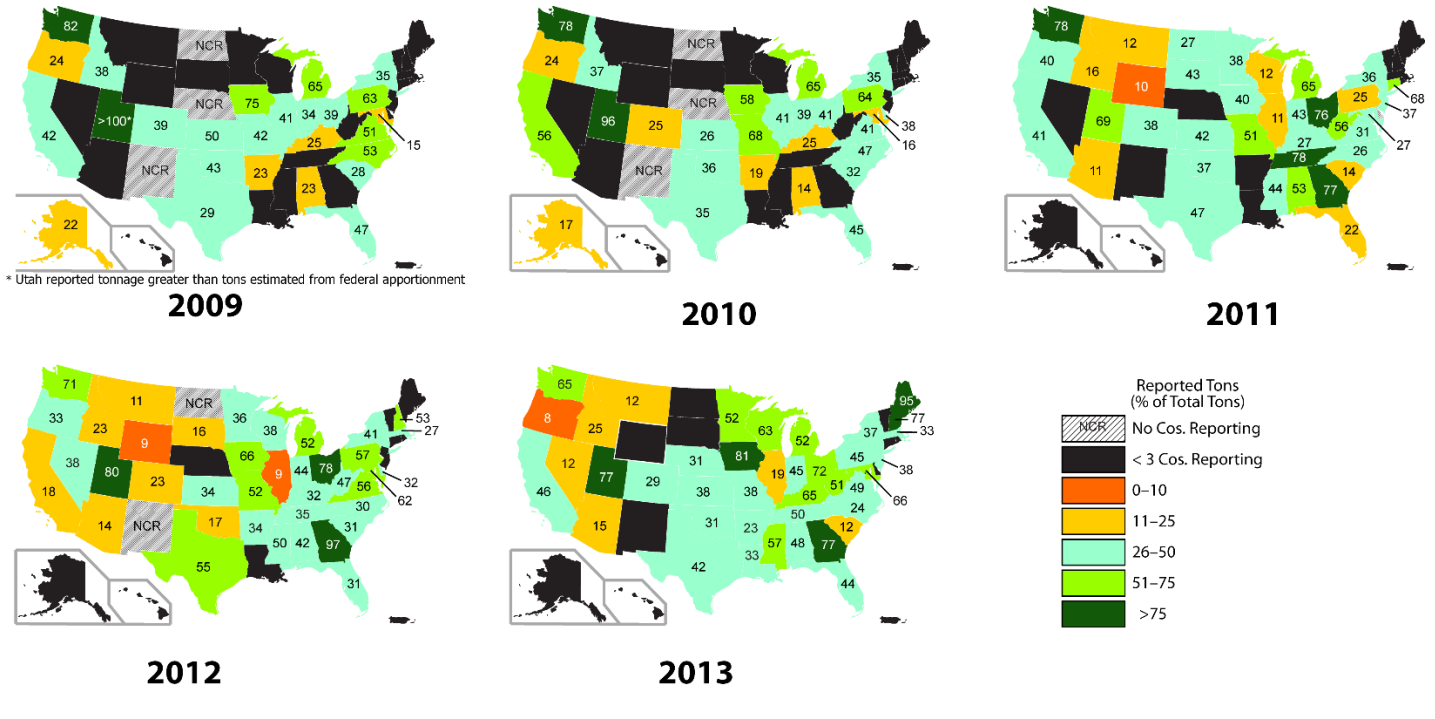


Figure 1: Reported Tons as a Percent of Estimated Tons

Figure 2 shows the number of plants as well as the average tons produced per plant separated by different user/producer group regions. The tons/plant for the North Central Asphalt User/Producer Group (NCAUPG) increased significantly from 2012 to 2013 to an all-time high since the beginning of the survey. The tons/plant for Rocky Mountain Asphalt User/Producer Group (RMAUPG) and Pacific Coast Conference on Asphalt Specification (PCCAS), and Southeast Asphalt User/Producer Group (SEAUPG) both dropped slightly from 2012 to 2013. The tons/plant for the Northeast Asphalt User/Producer Group (NEAUPG) decreased significantly from 2012 to 2013. Both the RMAUPG/PCCAS and NEAUPG tons/plant declined to their lowest value since the beginning of the survey in 2009. The number of plants represented in the 2013 survey increased to all-time highs for all regions.

Number of Plants Responding to Survey by User/Producer Group

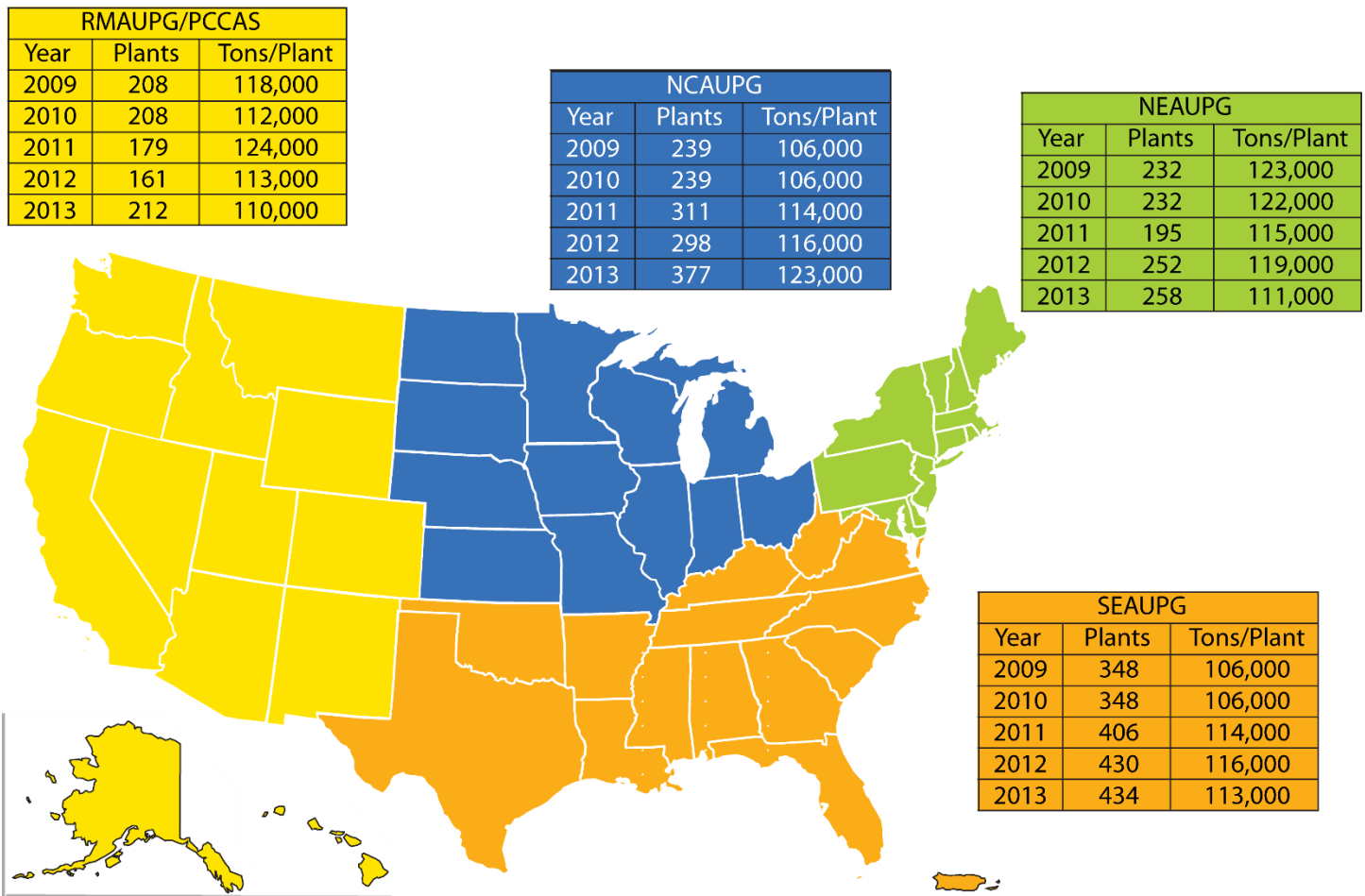


Figure 2: Number of Plants Responding to Survey by User/Producer Group Regions and Estimated Tonnage, 2009–2013

Reclaimed Asphalt Pavement

Table 4 summarizes the RAP, RAS, and WMA data from the surveys. The information asked for in the survey is shown in Appendix A and summarized in Table 1. Producers were not asked about allowable RAP or binder replacement requirements, which can have an effect on demand for mixes that incorporate these materials. Figure 3 is a visual representation of the estimated total tons of RAP used in asphalt mixes, aggregate, cold mix, other uses, and landfilled. The overwhelming majority of RAP is used in hot-mix asphalt (HMA) or warm-mix asphalt (WMA), which is the most optimal use of RAP. It is estimated that less than 0.1 percent was sent to landfills in 2009 and 2010; less than 0.4 percent in 2011; less than 0.3 percent in 2012; and less than 0.2 percent in 2013.

Table 4: Summary of RAP, RAS, WMA Data

	Reported Values					Total Estimated Value				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
Tons of HMA/WMA Produced	Tons (Millions)					Tons (Millions)				
Total	124.0	119.8	131.7	139	147.6	358.4	359.8	366.0	360.3	350.7
DOT	56.9	55.6	63.1	69.1	67.4	169.2	172.5	175.3	179.1	160.1
Other Agency	28.1	27.8	36.4	32.8	40.6	83.5	86.2	101.2	84.9	96.5
Commercial and Residential	35.6	32.6	32.2	37.1	39.6	105.8	101.2	89.5	96.2	94.1
Companies/Branches Reporting	196		203	213	249					
RAP	Tons (Millions)					Tons (Millions)				
Accepted	23.2	24.0	29.8	29.1	34.9	67.2	73.5	79.1	71.3	76.1
Used in HMA/WMA	20.1	21.6	25.1	27.2	29.5	56.0	62.1	66.7	68.3	67.8
Used in Aggregate	1.4	1.6	1.2	1.2	1.7	6.2	7.3	4.9	3.6	4.0
Used in Cold Mix	0.4	0.4	0.1	0.1	0.1	1.5	1.6	0.2	0.2	0.2
Used in Other	0.1	0.1	0.2	0.1	0.3	0.7	0.8	0.7	0.2	1.5
Landfilled	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.3	0.2	0.1
	Average % Used in Mixes									
Average % for DOT Mixes ¹	12.5%	13.2%	15.8%	18.1%	19.5%					
Average % for Other Agency Mixes ¹	14.0%	15.2%	16.7%	18.2%	19.3%					
Average % for Commercial & Residential ¹	17.5%	18.0%	19.7%	20.5%	22.7%					
National Average All Mixes Based on % Reported for Different Sectors ¹	15.6%	17.2%	18.2%	18.9%	19.3%					
National Average All Mixes Based on RAP Tons Used in HMA/WMA ²	16.2%	18.0%	19.1%	19.6%	20.0%					
Companies/Branches Reporting Using RAP	189		198	208	249					
RAS	Tons (Thousands)					Tons (Thousands)				
Accepted	332	559	769	693	685	957	1,851	2,500	1,724	1,599
Used in HMA/WMA	246	393	430	783	718	702	1,100	1,192	1,863	1,647
Used in Aggregate	5	3	14	20	28	6	3	74	73	82
Used in Cold Mix	—	—	—	—	—	—	—	—	—	—
Used in Other	39	35	—	4	2	123	125	—	12	5
Landfilled	—	0.5	0.1	—	—	—	7	0.2	—	—
	Average % Used in Mixes									
Average % for DOT Mixes ¹	0.33%	0.78%	0.66%	0.83%	0.85%					
Average % for Other Agency Mixes ¹	0.37%	0.47%	0.93%	0.90%	1.08%					
Average % for Commercial & Residential ¹	0.63%	0.81%	1.04%	1.25%	1.24%					
National Average All Mixes Based on RAS Tons Used in HMA/WMA ²	0.20%	0.33%	0.33%	0.56%	0.49%					
Companies/Branches Reporting Using RAP	44	61	81	87	97					
WMA	% Total Production					Tons (Millions)				
DOT	6.3%	15.0%	23.5%	30.8%	37.3%	8.6	20	34.6	46.4	55.7
Other Agency	4.4%	11.7%	18.2%	24.5%	32.4%	3.6	9.8	16.3	18.9	27.9
Commercial and Residential	4.5%	11.6%	19.9%	22.8%	25.9%	4.6	11.3	17.8	21.4	22.8
Total						16.8	41.1	68.7	86.7	106.4
	% of Market									
Chemical Additive %	15%	6%	4.1%	9.4%	12.1%					
Additive Foaming %	2%	1%	0.2%	2.0%	0.3%					
Plant Foaming %	83%	92%	95.4%	88.3%	87.0%					
Organic Additive %	0.3%	1%	0.3%	0.2%	0.7%					
Companies/Branches Reporting Using WMA	85	121	150	161	193					

¹ Average percent based on contractor's reported percentage for each sector.

² Average percent based on total reported tons of RAP used in HMA/WMA divided by reported total tons HMA/WMA produced.

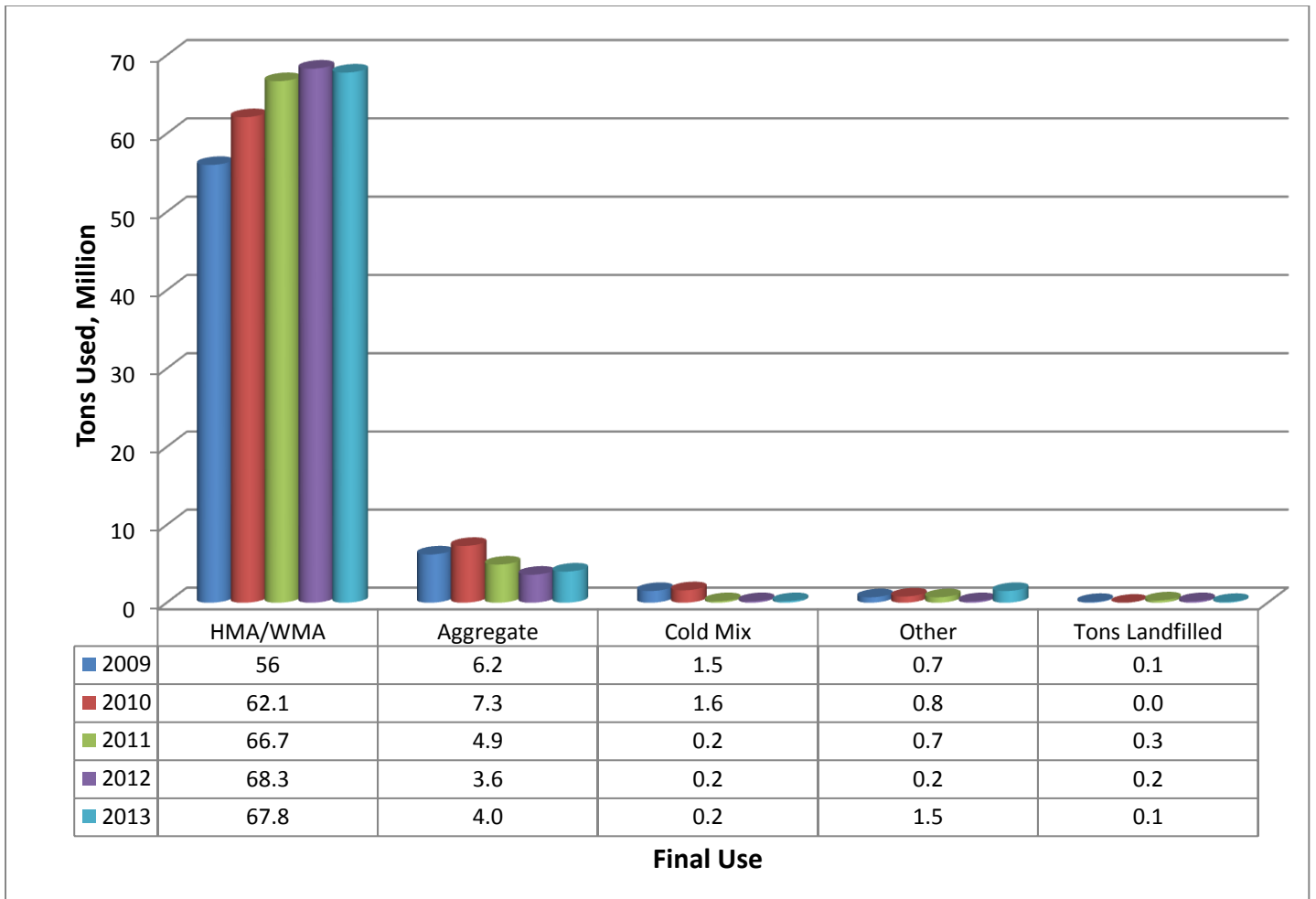


Figure 3: RAP Tons by Final Use (Million Tons)

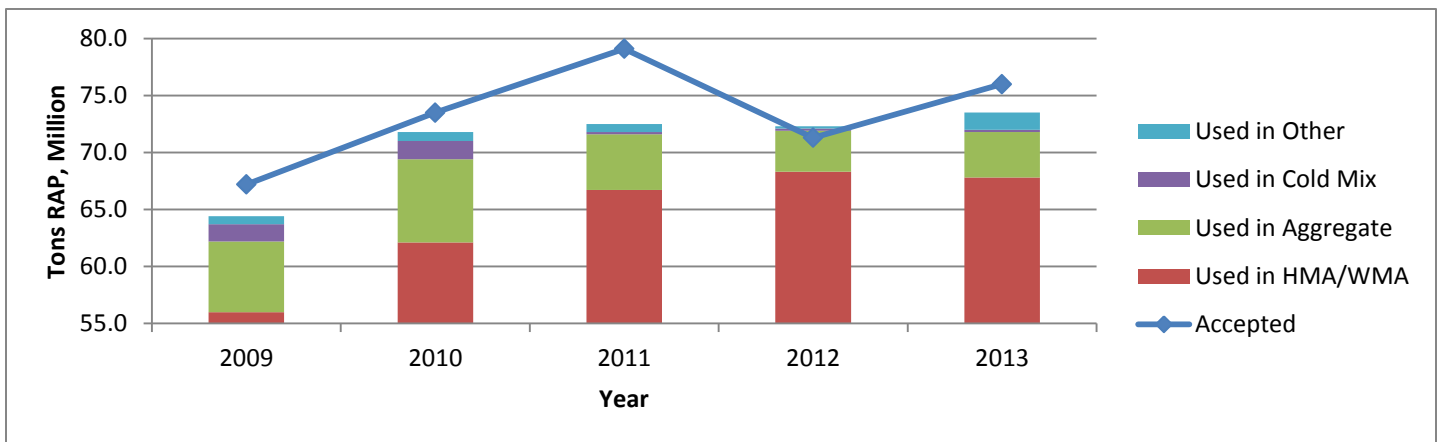


Figure 4: Comparison of Tons of RAP Accepted and Tons of RAP Used (Million Tons)

Figure 5 shows the total estimated amount of RAP used in the different industry sectors. These values were calculated using the average percentages of RAP reported for the different sectors and adjusted to account for the difference between reported RAP tons and tons calculated from the percentage by sector. Figure 6 shows the average percentage of RAP used by each sector. The average percent RAP used by all sectors has seen a steady increase from 2009 to 2013. The fluctuations in the RAP tonnages used by each sector are primarily due to changes in the total tonnage used by each sector, as is illustrated in Figure 7. It is interesting that while total tonnage for the DOT sector decreased, the percentage of RAP used DOT mixes increased, indicating that states and contractors are making greater use of RAP in their mixes.

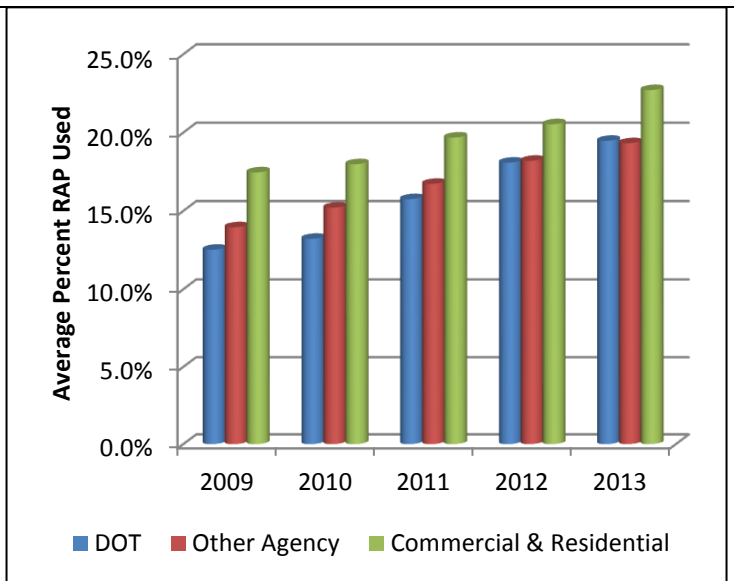
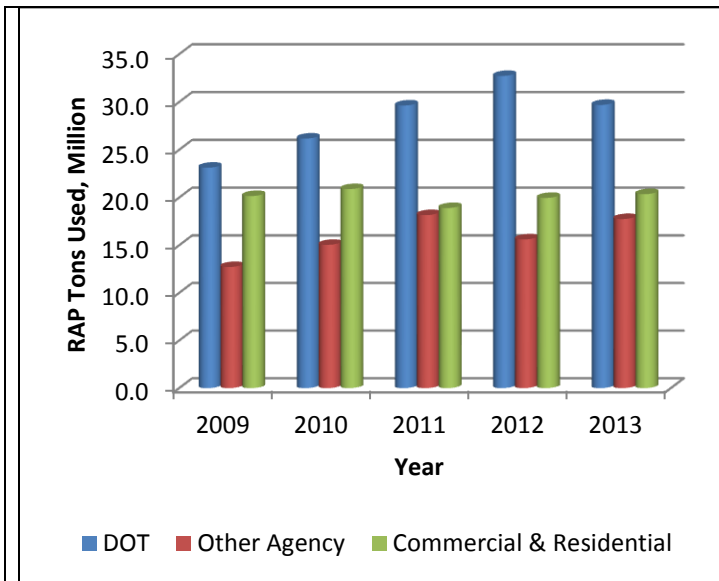


Figure 5: RAP Use by Sector (Million Tons)

Figure 6: Average Percent RAP Used by Sector

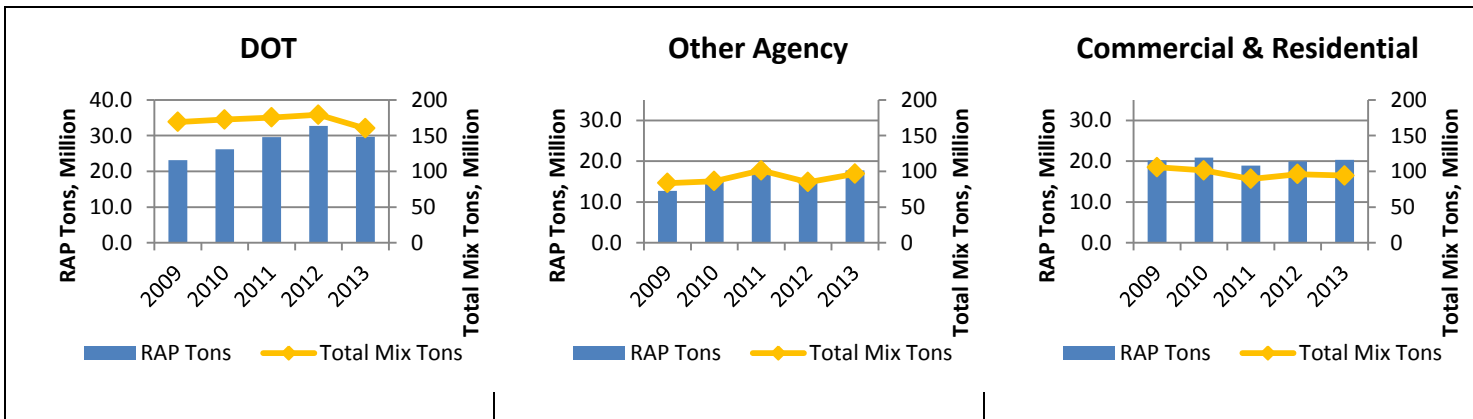
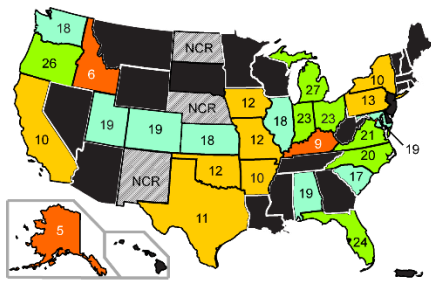


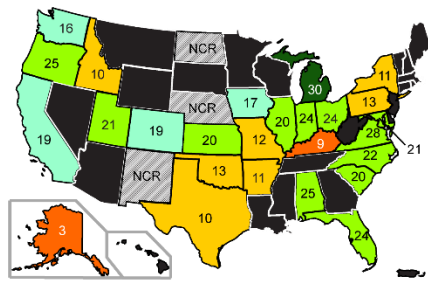
Figure 7: RAP Tons and Total Mix Tons Comparison

Figures 8 and Table 5 show the average percent of RAP used in the different states based on reported RAP and total tonnage. 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. Comparing Figures 12–15, the number of states averaging more than 20 percent RAP in HMA/WMA (colored lime and dark green in the charts) increased steadily from seven states in 2009 to 22 states in 2013. The use of increased amounts of RAP has quickly spread in the Midwest and West. For example, Idaho average percent RAP increased steadily from 6 percent in 2009 to 30 percent in 2013.

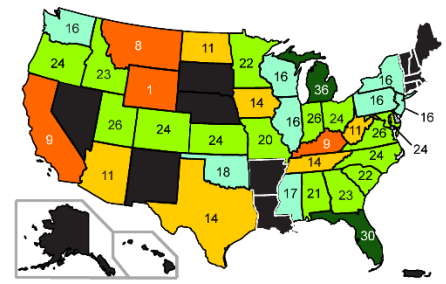
For 2013, all (100 percent) of the contractors/branches responding to the survey reported using RAP, and more than 87 percent of these contractors reported excess RAP in 2013. In 2011 and 2012, 98 percent of respondents reported using RAP. From 2012 to 2013, the amount of RAP used in HMA/WMA decreased from 68.3 million to 67.8 million tons, a 0.73 percent decrease despite a larger (2.66 percent) decrease in total tonnage for the industry. The average percent RAP used in mixes increased modestly from 19.6 percent in 2012 to 20 percent in 2013.



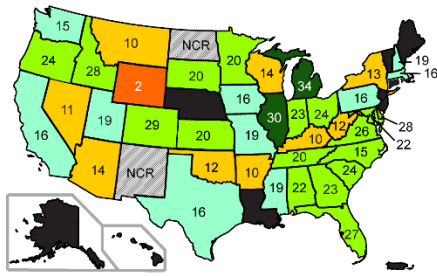
2009



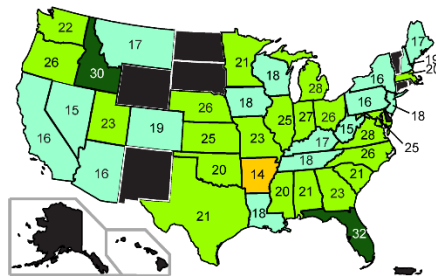
2010



2011



2012



2013

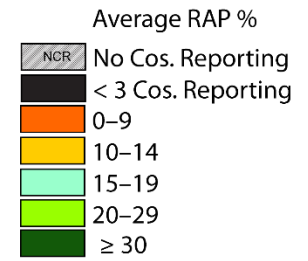


Figure 8: Estimated Average Percent of RAP by State

Table 5: Average Estimated RAP Percent

State	Average RAP Percent					State	Average RAP Percent				
	2009	2010	2011	2012	2013		2009	2010	2011	2012	2013
Alabama	19%	25%	21%	22%	24%	Montana			8%	10%	11%
Alaska	5%	3%				Nebraska	NCR	NCR			29%
Arizona			11%	14%	13%	Nevada				11%	14%
Arkansas	10%	11%		10%	12%	New Hampshire				19%	19%
California	10%	19%	9%	16%	11%	New Jersey			16%		19%
Colorado	19%	19%	24%	29%	27%	New Mexico	NCR	NCR		NCR	
Connecticut						New York	10%	11%	16%	13%	13%
Delaware			NCR	28%		North Carolina	20%	22%	24%	15%	25%
Dist. of Columbia	NCR	NCR	NCR	NCR		North Dakota	NCR	NCR	11%	NCR	
Florida	24%	24%	30%	27%	31%	Ohio	23%	24%	23%	24%	28%
Georgia			23%	23%	23%	Oklahoma	12%	13%	18%	12%	13%
Hawaii						Oregon	26%	25%	24%	24%	25%
Idaho	6%	10%	23%	28%	28%	Pennsylvania	13%	13%	16%	16%	15%
Illinois	18%	20%	16%	30%	22%	Puerto Rico					
Indiana	23%	24%	26%	23%	27%	Rhode Island					
Iowa	12%	17%	14%	15%	18%	South Carolina	17%	20%	22%	24%	23%
Kansas	18%	20%	20%	20%	23%	South Dakota			18%	20%	
Kentucky	9%	9%	9%	10%	15%	Tennessee			14%	20%	17%
Louisiana					18%	Texas	11%	10%	13%	16%	14%
Maine					18%	Utah	19%	21%	25%	19%	24%
Maryland	19%	21%	24%	22%	23%	Vermont					
Massachusetts				16%	18%	Virginia	21%	28%	26%	26%	27%
Michigan	27%	30%	36%	34%	32%	Washington	18%	16%	16%	15%	19%
Minnesota			22%	20%	21%	West Virginia			11%	12%	12%
Mississippi			18%	19%	18%	Wisconsin			16%	14%	15%
Missouri	12%	12%	19%	19%	20%	Wyoming			1%	2%	
NCR	= No companies reporting										
	= < 3 companies reporting										
	= 0–9%										
	= 10–14%										
	= 15–19%										
	= 20–29%										
	≥ 30%										

Reclaimed Asphalt Shingles

Table 4 includes the summary of RAS data from the surveys. The information asked for in the survey is shown in Appendix A and summarized in Table 1. Producers were not asked about allowable RAS or binder replacement requirements. For the 2009–2011 surveys, more unprocessed shingles were received than were used for all purposes including landfilling. In 2012 this changed with more than 200,000 tons of RAS being used for all purposes than was received. In 2013 this trend continued with 130,000 tons of RAS being used for all purposes than was received. Contractors using more RAS than they receive indicates that they either had RAS stockpiled or were purchasing it from shingle processors. From 2012 to 2013, the amount of RAS accepted by producers decreased by 7.25 percent. No RAS was reported as being landfilled in 2012 or 2013; in 2011, the amount landfilled was about 0.008 percent. In 2012 less than 0.7 percent of RAS accepted was used for other purposes; in 2013 that decreased to about 0.3 percent of RAS accepted.

Figure 9 shows the total estimated amount of RAS used for different purposes. From 2012 to 2013 there was a moderate decrease, 11.6 percent, in the tons of RAS used in asphalt mixtures. This decrease is due to a decrease in the average percent

of RAS being used in mixes, as well as a decrease in the total tons of asphalt mix produced. This decrease for RAS use in asphalt mixtures follows a large increase, 56 percent, from 2011 to 2012. From the first survey in 2009 to 2013, RAP use has increased nearly 135 percent.

Similar to RAP, RAS is primarily used in HMA/WMA. Figure 10 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 were adjusted to account for the difference in reported RAS tons and the tons calculated from the percentage by sector. There was a significant decrease in the tons of RAS used by DOTs and commercial and residential while there was a significant increase in the amount of RAS used by non-DOT public agencies. The decrease in the tons of RAS used by DOTs and the commercial and residential sector is due to the decrease in the total tons of asphalt mix used by these sectors. Figure 11 shows the average RAS percent used in asphalt mixes for the three different sectors. The use of RAS in the commercial and residential sector had seen a steady and significant gain from 2009 to 2012. From 2012 to 2013, however, commercial and residential sector use remained flat. The DOT sector had a significant gain from 2009 to 2010, but has seen only modest gains since. The percentage of RAS for the public agency other than DOT sector saw significant gains from 2009 to 2011, but has only seen a modest gains since 2011. The number of companies/branches using RAS increased from 87 to 97 from 2012 to 2013, a nearly 11.5 percent increase.

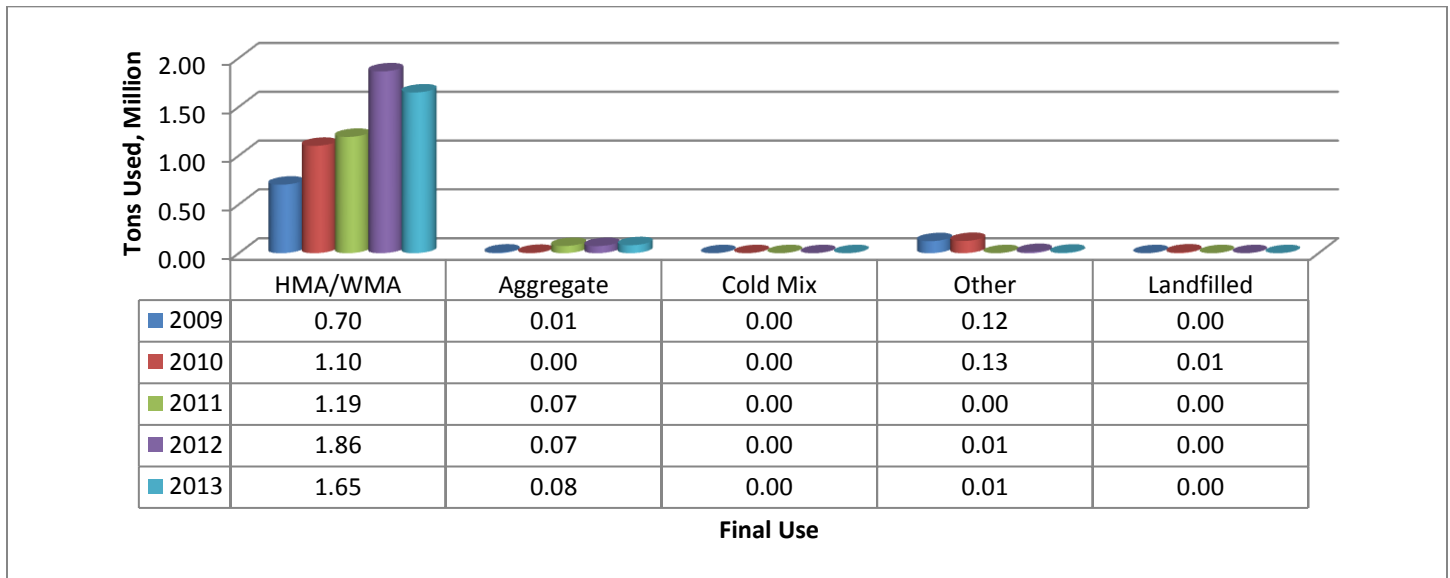


Figure 9: Summary of RAS Use (Million Tons)

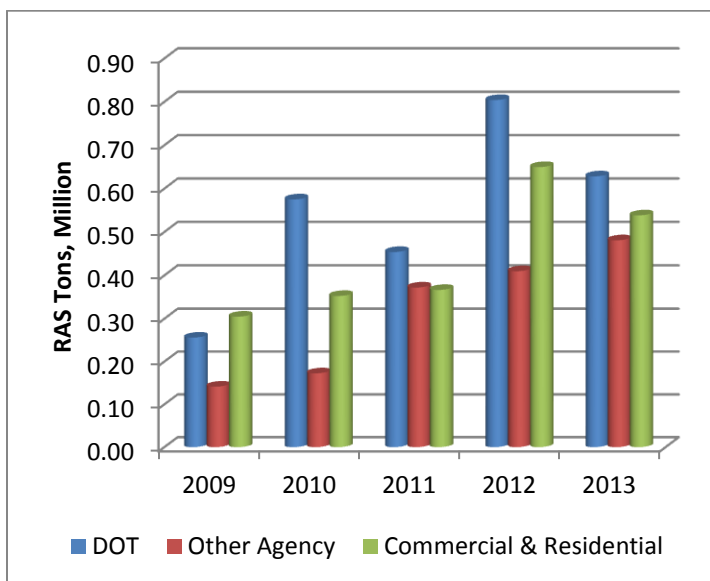


Figure 10: Estimated RAS Use by Sector (Million Tons)

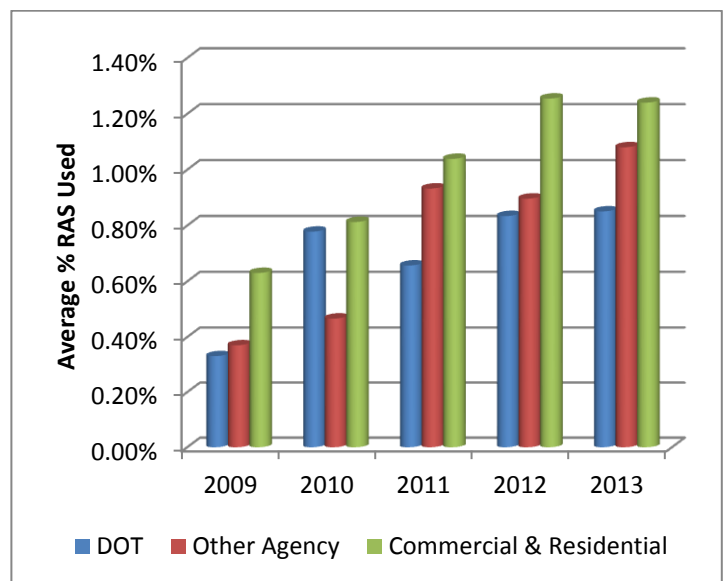


Figure 11: Average Percent RAS Used by Sector

Figure 12 shows states where plant-mix producers reported using RAS in 2009 through 2013. Red indicates states where RAS use was not reported for these years. The number of states where plant-mix producers reported using RAS increased each year from 22 in 2009 to 38 in 2013. Three states — Connecticut, Louisiana, and Wyoming — reported their first use of RAS in 2013. Two states — Colorado and West Virginia — reported using RAS in previous years, but did not report its use in 2013. Table 6 shows the states where producers reported using RAS for 2009–2013.

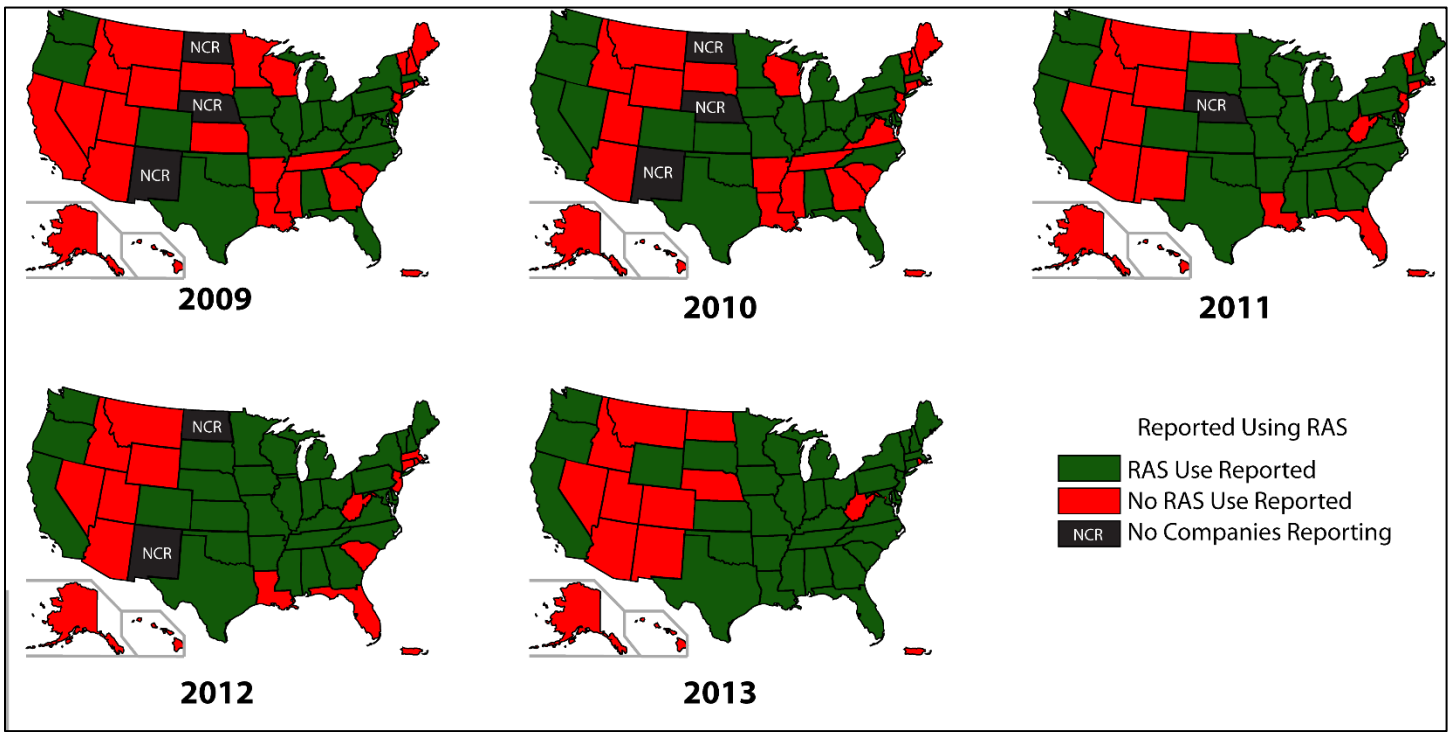


Figure 12: States with Companies/Branches Reporting Using RAS

Table 6: State Reporting RAS Use

State	RAS Used?					State	RAS Used?				
	2009	2010	2011	2012	2013		2009	2010	2011	2012	2013
Alabama	Yes	Yes	Yes	Yes	Yes	Montana	No	No	No	No	No
Alaska	No	No	No	No	No	Nebraska	NCR	NCR	No	Yes	Yes
Arizona	No	No	No	No	No	Nevada	No	Yes	No	No	No
Arkansas	No	No	Yes	Yes	Yes	New Hampshire	No	No	Yes	Yes	Yes
California	No	Yes	Yes	Yes	Yes	New Jersey	No	No	No	No	Yes
Colorado	Yes	Yes	Yes	Yes	No	New Mexico	NCR	NCR	No	NCR	No
Connecticut	No	No	No	No	Yes	New York	Yes	Yes	Yes	Yes	Yes
Delaware	Yes	Yes	NCR	Yes	Yes	North Carolina	Yes	Yes	Yes	Yes	Yes
Dist. of Columbia	NCR	NCR	NCR	NCR	No	North Dakota	NCR	NCR	No	NCR	No
Florida	Yes	Yes	No	No	Yes	Ohio	Yes	Yes	Yes	Yes	Yes
Georgia	No	No	Yes	Yes	Yes	Oklahoma	Yes	Yes	Yes	Yes	Yes
Hawaii	No	No	No	No	No	Oregon	Yes	Yes	Yes	Yes	Yes
Idaho	No	No	No	No	No	Pennsylvania	Yes	Yes	Yes	Yes	Yes
Illinois	Yes	Yes	Yes	Yes	Yes	Puerto Rico	No	No	No	No	No
Indiana	Yes	Yes	Yes	Yes	Yes	Rhode Island	No	No	No	No	No
Iowa	Yes	Yes	Yes	Yes	Yes	South Carolina	No	No	Yes	No	Yes
Kansas	No	Yes	Yes	Yes	Yes	South Dakota	No	No	Yes	Yes	Yes
Kentucky	Yes	Yes	Yes	Yes	Yes	Tennessee	No	No	Yes	Yes	Yes
Louisiana	No	No	No	No	Yes	Texas	Yes	Yes	Yes	Yes	Yes
Maine	No	No	Yes	Yes	Yes	Utah	No	No	No	No	No
Maryland	Yes	Yes	Yes	Yes	Yes	Vermont	No	No	No	Yes	Yes
Massachusetts	Yes	Yes	Yes	No	Yes	Virginia	Yes	No	Yes	Yes	Yes
Michigan	Yes	Yes	Yes	Yes	Yes	Washington	Yes	Yes	Yes	Yes	Yes
Minnesota	No	Yes	Yes	Yes	Yes	West Virginia	Yes	Yes	No	No	No
Mississippi	No	No	Yes	Yes	Yes	Wisconsin	No	No	Yes	Yes	Yes
Missouri	Yes	Yes	Yes	Yes	Yes	Wyoming	No	No	No	No	Yes

NCR = No Companies Reporting
Yes = RAS Use Reported
No = No RAS Use Reported

Warm-Mix Asphalt

Table 4 includes the summary 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.

The percent of companies/branches using WMA saw modest increases from 2011 to 2012 and again from 2012 to 2013, as shown in Figure 13. Figure 14 shows a steady increase in the number of tons of WMA produced from 2011 to 2013. WMA use exceeded 100 million tons in 2013, which is a little more than 30 percent of the total asphalt mix production for 2013. This is probably attributable to increased acceptance of WMA by all industry sectors as illustrated in Figure 14.

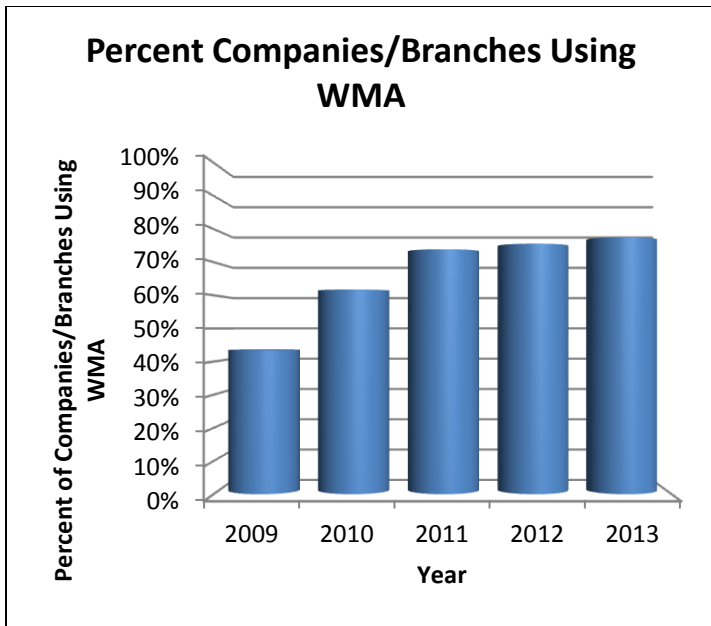


Figure 13: Number of Companies/Branches Using WMA

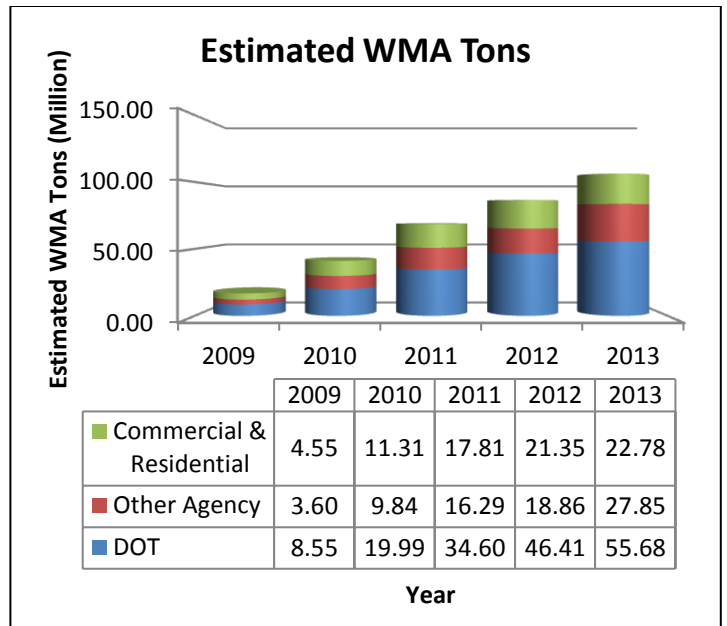


Figure 14: Estimated Tons (in Millions) WMA by Industry Sector

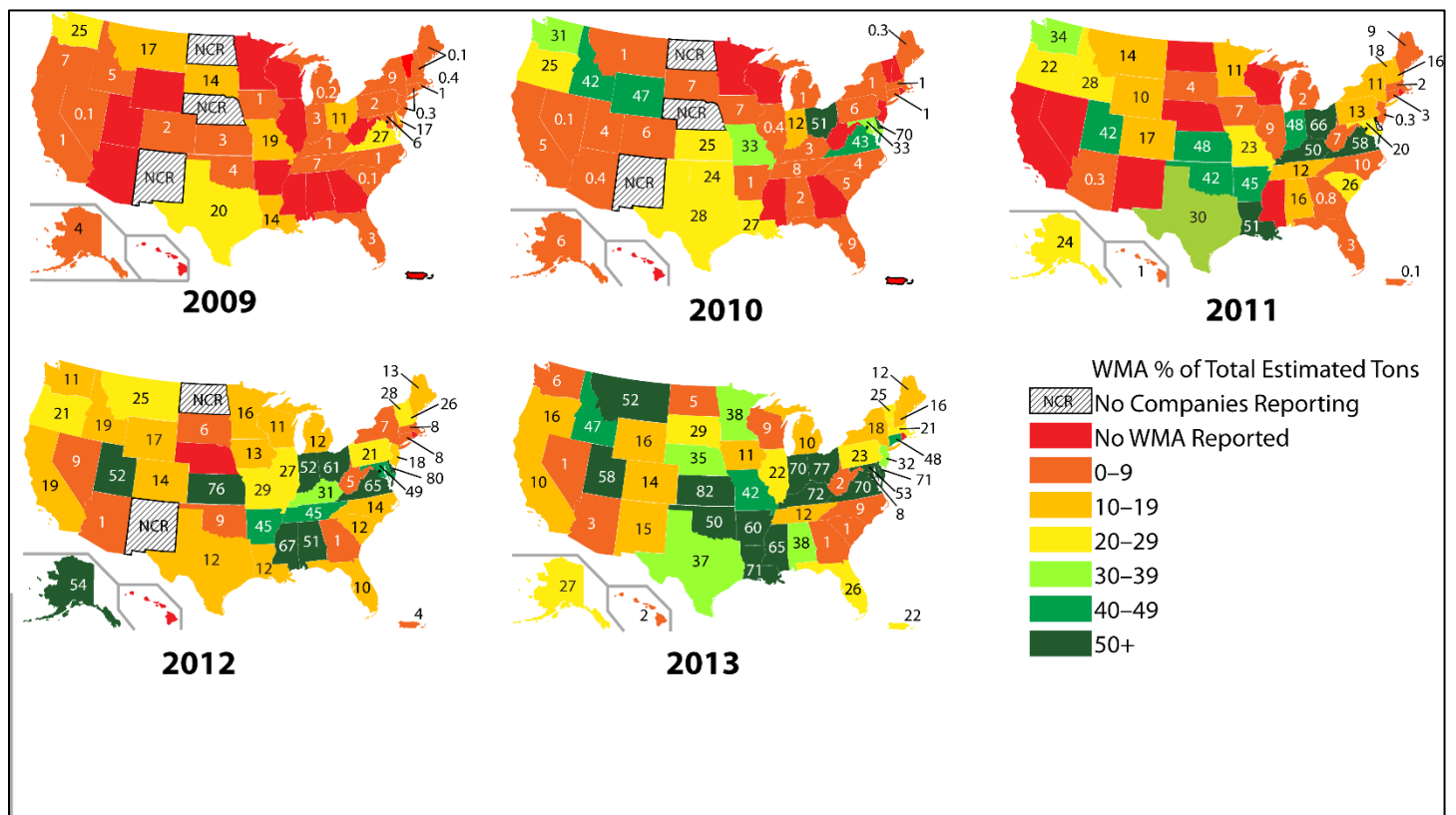


Figure 15: Estimated Percent of Total Production Using WMA

Figure 15 shows the estimated total tons of WMA produced in each state. 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.

From 2012 to 2013, 24 states saw an increase of 5 percent or greater in WMA production, while 10 states had a decrease of 5 percent or greater in WMA production. Six states — Connecticut, Idaho, Kentucky, Louisiana, Montana, and Oklahoma — had an increase of 25 percent or greater in WMA production. Two states — Alaska and Tennessee — had a decrease of 25 percent

or greater in WMA production. The reasons for these fluctuations are uncertain. Only Rhode Island did not report the use of WMA.

Nationally, the total tons of WMA increased from 86.7 million tons in 2012 to 106.4 million tons in 2013, a 23 percent increase despite the decrease in total tonnage. Plant foaming is most commonly used to produce WMA. Use of WMA additives increased from 11.6 percent in 2012 to 13.1 percent in 2012. This is still below the 17 percent market share noted in 2009, but given that WMA production has increased by more than 533 percent since 2009, the volume of additives used, along with plant foaming, has increased significantly.

Other Recycled Materials

For the 2012 and 2013 surveys a series of questions was asked about the use of other recycled materials used in asphalt mixtures. Table 1 summarizes the questions in this section. The full questionnaire is included as Appendix A.

Producers were asked how many tons of mix were produced that incorporated recycled materials, as well as how many tons of specific materials were used in mix production during 2013. Three recycled materials — ground tire rubber (GTR), steel slag, and blast furnace slag — were specifically mentioned in the survey. The respondents were able to specify up to two additional recycled materials used in mixes. Because it was expected that responses to these other recycled materials would be low and that producers may not track the use of these materials, it was agreed to not estimate the total quantities used for these materials. **All values in this section are reported values and do not represent estimates of the total quantity of these materials by state or nationally.** A total of 40 contractors from 23 states reported using other recycled materials in asphalt mixtures.

Table 7 summarizes information on the use of ground tire rubber. Producers from 15 states and Puerto Rico reported the use of GTR in some mixes. It must be noted that Arizona, which is known to use large quantities of GTR in mixes, had a relatively low participation rate in the survey, while Georgia had a very high participation rate. This likely explains why Georgia's reported quantity of GTR is higher than Arizona. The total reported tons of mix using GTR grew from 691,589 tons in 2012 to 1,195,594 tons in 2013, thanks to an increase in the number of contractors reporting use of GTR. Comparing the 2013 data to 2012 data it became apparent that some states had reported unusual levels of GTR tonnage in 2012. While reported tons of mix with GTR were accurate, the estimated tons of GTR used was incorrect for California, Georgia, Ohio, and Texas; the 2012 GTR tonnage data for those states has been removed from this survey.

The "Arizona process" commonly used to create asphalt-rubber binder typically uses more GTR than terminal blends, yielding about 20 percent GTR in the binder. Assuming a gap-graded mix with about 8 percent asphalt-rubber binder by weight of mix, this would result in 1.6 percent GTR by weight of mix. Four states reported using more than 1.6 percent GTR by weight of mix in 2012. For 2013, the percent GTR by weight of mix was calculated to ensure GTR content was near or below the 1.6 percent threshold. In cases where the reported numbers exceeded this threshold, contractors were contacted for additional information, which typically resulted in a lowering of the number of tons of GTR used.

Table 7: Reported Tons Ground Tire Rubber

State	Reported Tons of Mix Using GTR		Reported Tons of GTR Used	
	2012	2013	2012	2013
Arizona	33,590	26,300	532	380
California	101,000	523,213	—	3,748
Florida	86,441	250,779	195	531
Georgia	281,958	65,000	—	260
Illinois	—	4,500	—	20
Indiana	—	13,000	—	30
Louisiana	25,000	104,395	—	550
Maine	—	14,000	—	219
Massachusetts	—	24,897	—	324
Michigan	2,400	12,000	20	71
Missouri	100,000	50,000	300	180
New Hampshire	—	28,000	—	358
New York	—	10	—	—
Ohio	36,200	1,500	—	8
Pennsylvania	—	18,000	—	140
Puerto Rico	—	10,000	—	170
Texas	25,000	50,000	—	—
Total	691,589	1,195,594	1,047	6,989

Table 8 summarizes the reported use of steel slag and blast furnace slag in asphalt mixes. 13 and 11 states reported using these recycled materials in 2012 and 2013, respectively.

Table 8: Reported Tons for Steel and Blast Furnace Slag

State	Reported Tons of Mix Using Steel Slag		Reported Tons of Steel Slag Used		Reported Tons of Mix Using Blast Furnace Slag		Reported Tons of Blast Furnace Slag Use	
	2012	2013	2012	2013	2012	2013	2012	2013
Alabama	625,000	750,000	133,441	165,000	100,000	110,000	10,100	12,500
Arkansas	120,000	25,000	12,000	2,500	—	—	—	—
Illinois	23,000	43,700	8,000	16,300	—	—	—	—
Indiana	70,000	161,115	44,000	61,985	1,487,000	116,500	304,000	57,000
Iowa	20,000	97,500	—	10,200	—	5,000	—	500
Kentucky	5,714	508,000	800	173,265	—	16,000	—	7,500
Michigan	—	750,000	—	95,000	500,000	700,000	50,000	107,000
Minnesota	145,500	200,000	21,800	30,000	—	—	—	—
Ohio	150,000	185,319	42,030	79,085	208,028	416,250	72,400	110,613
Tennessee	30,000	—	6,000	—	—	—	—	—
Virginia	—	—	—	—	54,520	—	16,356	—
Washington	450,000	586,000	80,000	82,954	—	—	—	—
West Virginia	—	—	—	—	588,120	504,704	180,308	155,032
Total	1,639,214	3,306,634	348,071	716,289	2,937,668	1,868,454	633,164	450,145

Table 9 summarizes other recycled materials used in asphalt mixtures. These other recycled materials include fly ash, cellulose fiber, foundry sand, and recycled glass. As in 2012 Mississippi and Texas both reported using fly ash in 2013. In 2012, only Mississippi reported using cellulose fibers; however, in 2013, seven states — Florida, Georgia, Indiana, Louisiana, Maryland, Minnesota, and Texas — reported using cellulose fibers.

Table 9: Other Recycled Materials

State & Description Other Recycled Material	Reported Tons of Mix Produced Using Other Recycled Material		Reported Tons of Other Recycled Material Used	
	2012	2013	2012	2013
Florida				
Cellulose Fiber	—	20,204	—	71
Georgia				
Cellulose Fiber	—	43,000	—	129
Indiana				
Cellulose Fiber	—	6,000	—	60
Louisiana				
Cellulose Fiber	—	31,651	—	63
Maryland				
Cellulose Fiber	—	145,000	—	440
Minnesota				
Cellulose Fiber	—	5,000	—	15
Mississippi				
Fly Ash	50,000	50,000	2,400	2,500
Cellulose Fiber	76,000	—	250	—
Missouri				
Foundry Sand	5,000	15,130	500	1,514
South Dakota				
Bottom Ash	52,000	—	4,280	—
Texas				
Fly Ash	18,000	25,000	1,200	1,700
Cellulose Fiber	—	30,600	—	90
Virginia				
Recycled Glass	173	—	34	—

Summary and Conclusions

The objective of this survey was to quantify the use of recycled materials and WMA produced by the asphalt pavement industry. Asphalt mix producers from all 50 states, District of Columbia, and Puerto Rico completed the 2013 survey. A total of 249 companies/branches with 1,281 plants were represented in the 2013 survey.

The estimated total asphalt mix production saw a slight decrease from 360 million to 351 million tons from 2012 to 2013. The estimated DOT tonnage saw a significant decrease from 179 million to 160 million tons from 2012 to 2013, while other agency tonnage increased from 85 million to 96 million tons from 2012 to 2013. There was a slight decrease in commercial and residential tonnage from 96 million ton 94 million tons.

The use of recycled material continues to increase. The survey shows:

- The percent of producers reporting using RAP increased from 96 percent in 2009 and 2010 to 98 percent in 2011 and 2012 to 100 percent in 2013.
- The estimated percent of RAP used in asphalt mixtures has increased steadily from 2009 to 2013. The average percent RAP used in all mixes has increased from 16.2 percent in 2009 to 20.0 percent in 2013.
- The estimated tons of RAP used in asphalt mixes reached 67.8 million tons in 2013. This represents nearly a 22 percent increase in the amount of tons used from 2009 to 2012. There was a slight (0.73 percent) decrease in the estimate tons of RAP used in 2013, which is related to the decrease in the total asphalt mix produced from 2012 to 2013.

- 87 percent of the contractors/branches reported having excess RAP in 2013. For the first time in the survey's history, the estimated amount of RAP used for all purposes in 2012, including landfilling, exceeded the amount accepted by 1.2 million tons.
- Use of both manufacturers' scrap and post-consumer recycled asphalt shingles decreased from 1.86 million tons used in 2012 to 1.65 million tons used in 2013, an 11.6 percent decrease.
- The amount of RAS accepted by asphalt mix producers continued to decline from its high of 2.5 million tons in 2010 to 1.7 million in 2012 and 1.6 million in 2013. Sixty-four percent of the contractors/branches using RAS reported having excess RAS for 2013. In 2013, 135,000 tons of RAS was used for all purposes than was received.
- Of the RAS used in 2013, about 95 percent was used in asphalt mixes. The remainder was primarily combined with aggregates. No RAS was landfilled.
- The number of states with reported RAS use increased from 32 states in 2012 to 38 states in 2013.
- The number of states/provinces reporting use of ground tire rubber (GTR) in asphalt mixtures increased from nine in 2012 to 16 in 2013.
- The number of states reporting using steel or blast furnace slags decreased slightly from 13 states in 2012 to 11 in 2013.
- Two states, Mississippi and Texas, reported using fly ash in asphalt mixtures in both 2012 and 2013.
- The number of states reporting use of cellulose fibers increased from one state in 2012 to seven states in 2013
- Less commonly reported recycled materials in 2013 included foundry sand, and bottom ash.

The use of WMA continues to increase steadily. The survey shows:

- The estimated total production of WMA for 2013 was more than 106 million tons. This was about a 23 percent increase over 2012 WMA (86.7 million tons) and more than 533 percent increase over 2009.
- WMA was more than 30 percent of the total estimated asphalt mixture market in 2013.
- Plant foaming, representing 87 percent of the market, is the most commonly used warm-mix technology; additives accounted for 13 percent of the market.

The 2013 survey results show that the asphalt pavement industry continues to improve its outstanding record of sustainable practices by further increasing the use of recycled materials and WMA. RAP use continues to increase, albeit at a slower rate. In 2012, more RAP was used than accepted. This was primarily due to a decrease in the amount of RAP collected. The reason for this decrease is uncertain, but it may be partially due to reduced construction, as indicated by the reduction in total production volume. In 2013, the trend returned to 2009–2011 norms where more RAP was received than was used for all purposes returned. However, the differential was less than the peak in 2011. With more RAP being received than is used — and 87 percent of producers indicating they have excess RAP — there are still opportunities to increase the amount of RAP used in asphalt mixes through permissive specifications and through improved RAP processing, production equipment and procedures, and education.

RAS use saw a moderate decrease in 2013 to nearly 1.65 million tons used in asphalt mixes. This represents 15 percent of the estimated 11 million ton waste shingle market (manufacturer and post-consumer waste) (NAHB 1998). This indicates there are still opportunities for increasing the use of RAS in asphalt mixtures, especially in the 12 states and the territories where no RAS use was reported for 2013. As with RAP, permissive specifications, improved processing, production equipment and procedures, and education will help improve the amount and percentages used in asphalt mixes.

The asphalt pavement industry repurposes many products from other industries. The survey shows that steel and blast furnace slag use was reported in 13 states in 2012 and 11 states in 2013, GTR use was reported in nine states in 2012 and 16 states/provinces in 2013, cellulose fiber use was reported in one state in 2012 and seven states in 2013, and fly ash in two states for 2012 and 2013. Other less common materials include glass (2012 only), foundry sand, and bottom ash (2012 only).

WMA reached a milestone in 2013 with more than 106 million tons, which represents more than 30 percent of the total estimated asphalt mix production. All states, with the exception of Rhode Island, reported using WMA in 2013. WMA use is expected to continue to grow as contractors and agencies gain experience and more states implement permissive specifications.

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