NATIONAL ASPHALT PAVEMENT ASSOCIATION

Asphalt Pavement Industry Survey on

Recycled Materials and Warm-Mix Asphalt Usage 2019

Information Series 138

10th Annual Survey

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16. Abstract

A shared goal of the Federal Highway Administration (FHWA) and the National Asphalt Pavement Association (NAPA) is to support and promote sustainable practices, such as the use of recycled materials and warm-mix asphalt (WMA). The use of recycled materials, primarily reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS), in asphalt pavements conserves raw materials and reduces overall asphalt mixture costs, as well as reduces the stream of material going into landfills.

WMA technologies have been introduced to reduce production and compaction temperatures for asphalt mixtures, which reduces the energy needed and emissions associated with mixture production. Additional benefits include improved low-temperature compaction of asphalt mixtures leading to improved pavement performance, as well as a longer paving season. WMA was chosen for accelerated deployment in federal-aid highway, state department of transportation, and local road projects as part of FHWA's 2010 Every Day Counts initiative.

The objective of this survey, first conducted for the 2009 and 2010 construction seasons, is to quantify recycled materials used and WMA produced annually by the asphalt pavement industry to document the deployment of these technologies to understand where they are being used and where they are underutilized. Results show significant growth in the use of RAP, RAS, and WMA technologies since 2009, although the rate of year-over-year growth has generally slowed since 2013.

The asphalt industry remains the country's most diligent recycler with more than 99 percent of reclaimed asphalt pavement being put back to use. The average percentage of RAP used in asphalt mixtures has increased from 15.6 percent in 2009 to 21.1 percent in 2019. In 2019, the estimated RAP tonnage used in asphalt mixtures was 89.2 million tons. This represents 4.5 million tons (24 million barrels) of asphalt binder conserved, along with the replacement of more than 84 million tons of virgin aggregate. The use of RAS in asphalt pavement mixtures has increased from 701,000 tons in 2009 to an estimated 921,000 tons in 2019 with the use of RAS decreasing (12.5 percent) from 2018 to 2019.

The combined savings of asphalt binder and aggregate from using RAP and RAS in asphalt mixtures is estimated at more than $3.3 billion and some 59 million cubic yards of landfill space.

More than 1.3 million tons of other recycled materials were reported as being incorporated into nearly 8.3 million tons of asphalt pavement mixtures during the 2019 construction season, including recycled tire rubber, blast furnace slag, steel slag, and cellulose fibers.

The estimated total production of asphalt with WMA technologies during the 2019 construction season was 164.5 million tons of which about 48 percent was produced at reduced temperatures. This was a 4 percent increase from the estimated 157.7 million tons of WMA in 2018, with increased utilization reported for the DOT and Commercial and Residential sectors tonnage for the year. Utilization of WMA technologies in 2019 was 879 percent more than the estimated 16.8 million tons in the 2009 construction season.

Asphalt produced with WMA technology made up 38.9 percent of the total estimated asphalt mixture market in 2019. Production plant foaming, representing 51 percent of the market, is the most commonly used warm-mix technology; chemical additive technologies accounted for a little more than 48 percent of the market. Relatively minor differences were seen in which WMA technologies were used when production temperatures were or were not reduced.

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
CCP	Coal Combustion Product
CCPR	Cold Central Plant Recycling
CIR	Cold In-Place Recycling
CRM	Crumb Rubber Modifier
DOT	Department of Transportation
FDR	Full-Depth Reclamation
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GTR	Ground Tire Rubber
HIR	Hot In-Place Recycling
HMA	Hot-Mix Asphalt
MWAS	Manufacturing Waste Asphalt Shingles
NAPA	National Asphalt Pavement Association
NCAT	National Center for Asphalt Technology
NCAUPG	North Central Asphalt User/Producer Group
NEAUPG	North East Asphalt User/Producer Group
NSA	National Slag Association
OGFC	Open-Graded Friction Course
PCAS	Post-Consumer Asphalt Shingles
PCCAS	Pacific Coast Conference on Asphalt Specifications
RAP	Reclaimed Asphalt Pavement
RAS	Reclaimed Asphalt Shingles
RBR	Recycled Binder Ratio
RMA	Rubber Manufacturers Association
RMAUPG	Rocky Mountain Asphalt User/Producer Group
RTR	Recycled Tire Rubber
SAPA	State Asphalt Pavement Association
SEAUPG	Southeastern Asphalt User/Producer Group
UPG	User/Producer Group
WMA	Warm-Mix Asphalt

On the Cover

For a mill-and-overlay project on US 51 in Janesville, Wis., Rock Road Companies used a high quantity of recycled materials while maintaining a high-quality final product. The mixture contained between 30 and 40 percent recycled asphalt, resulting in a liquid AC and virgin stone savings of approximately 30 to 40 percent. In addition, the test sections involving ground tire rubber (GTR) are the first of their kind in Wisconsin. Data gathered from these sections as well as continued field surveys will help forge the new specification for the future use of GTR in Wisconsin asphalt mixtures.

Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2019

Executive Summary

The results of the asphalt pavement industry survey for the 2019 construction season show that asphalt mixture producers have a strong record of employing sustainable practices and continue to increase their use of recycled materials and warm-mix asphalt (WMA). The use of recycled materials, particularly reclaimed asphalt pavement (RAP) and reclaimed asphalt shingles (RAS), conserves raw materials and reduces overall asphalt mixture costs, allowing road owners to achieve more roadway maintenance and construction activities within limited budgets. WMA technologies can improve compaction at reduced temperatures, ensuring pavement performance and long life; conserve energy; reduce emissions from production and paving operations; and improve conditions for workers.

The objective of this survey, first conducted for the 2009 and 2010 construction seasons, was to quantify the use of recycled materials, primarily RAP and RAS, as well as the use of WMA technologies by the asphalt pavement industry. For the 2019 construction season, the National Asphalt Pavement Association (NAPA) conducted a voluntary survey of asphalt mixture producers across the United States on tons produced, along with a survey of state asphalt pavement associations (SAPAs) regarding total tons of asphalt pavement mixture produced in their state.

Asphalt mixture producers from 48 states, one U.S. territories, and the District of Columbia completed the 2019 construction season survey. A total of 212 companies and a total of 1,101 production plants were represented in the survey.

A degree of fluctuation in year-to-year comparisons of data is influenced by which companies responded to the 2019 construction season survey versus prior year survey respondents. Respondents to the 2019 construction season survey decreased by 60 companies compared to 2018. Of the companies responding to the 2019 survey, 20 did not respond to the 2018 construction season survey.

The following are highlights of the survey of usage during the 2019 construction season:

Reclaimed Asphalt Pavement

- Asphalt mixture producers remain the country's most diligent recyclers, with more than 94 percent of asphalt mixture reclaimed from old asphalt pavements being put back to use in new pavements and the remaining 6 percent being used in other civil engineering applications, such as unbound aggregate bases.
- The total estimated tons of RAP used in asphalt mixtures was 89.2 million tons in 2019. This is a nearly 8.5 percent increase from the 2018 construction season and represents a nearly 59.3 percent increase from the total estimated tons of RAP used in 2009. Since 2009, total asphalt mixture tonnage has increased only 17.7 percent.
- The percentage of producers reporting use of RAP was at 97.7 percent of respondents, up 0.3 percent from 2018. Three producers reported landfilling a minor amount (52,550 tons, or 0.013 percent) of RAP during 2019.
- RAP usage during the 2019 construction season is estimated to have reduced the need for 4.5 million tons (24 million barrels) of asphalt binder and more than 84 million tons of aggregate with a total estimated value of more than $3.2 billion.
- The total estimated amount of RAP stockpiled nationwide at the end of the 2019 construction season was about 138 million tons.

- Reclaiming 97 million tons of RAP for future use saved about 58.9 million cubic yards of landfill space, and more than $5.3 billion in gate fees for disposal in landfills.
- The use of RAP in new asphalt mixtures reduced greenhouse gas emissions in 2019 by 2.4 million metric tons of CO_{2e}, which is equivalent to the annual emissions of 520,000 passenger vehicles

Reclaimed Asphalt Shingles

- The total estimated tons of RAS used in asphalt mixtures decreased 12.5 percent to an estimated 921,000 tons in 2019. This reversed the increase in the use of RAS reported during the 2018 construction season, with utilization at about 53 percent below the 2014 peak level of reported usage.
- The total estimated amount of RAS stockpiled nationwide at the end of the 2019 construction season was about 1.14 million tons, a 16.5 percent decrease from 2018.
- RAS usage during the 2019 construction season is estimated to have reduced the need for 184,200 tons (more than 1 million barrels) of asphalt binder and about 460,000 tons of aggregate with a total estimated value of more than $103 million.
- Reclaiming 611,000 tons of unprocessed RAS for future use saved about 370,000 cubic yards of landfill space, and more than $33 million in gate fees for disposal in landfills.

Other Findings

- The use of softer binders and recycling agents with mixtures incorporating RAP and RAS was reported nationwide. There was little correlation between the level of RAP and RAS used and the use of softer binders and/or recycling agents.
- Other recycled materials commonly reported as being used in asphalt mixtures during the 2019 construction season were recycled tire rubber, blast furnace slag, steel slag, cellulose fibers, and fly ash.
- Nearly 1.3 million tons of other recycled materials was reported as being used in nearly 8.3 million tons of asphalt mixtures by 52 companies in 24 states during the 2019 construction season.

Warm-Mix Asphalt Technologies

- The estimated total tonnage of asphalt pavement mixtures produced with WMA technologies for the 2019 construction season was 164.5 million tons. This was a 4 percent increase from the estimated 157.7 million tons of WMA in 2018, driven largely by increased WMA tonnage in the commercial and residential sector.
- Mixtures produced with WMA technologies made up 38.9 percent of the total estimated asphalt mixture market in 2019. About 47.9 percent (78.8 million tons) of these mixtures were produced with a temperature reduction of at least 10°F.
- Production plant foaming, representing 51 percent of the market in 2019, remains the most commonly used warm-mix technology, despite decreasing about 12.2 percent since the 2018 construction season.
- Chemical additive technologies accounted for a little more than 48 percent of the market in 2019, an increase of 14 percent from their use in the 2018 construction season.
- A continued increase in the use of chemical additive WMA technologies and a decrease in plant-based foaming technologies has been seen in the survey since 2011.
- About 62 percent of survey respondents produce asphalt with WMA technologies; 130 producers in 44 states reported using WMA technologies.
- The use of WMA technologies to produce asphalt mixture at reduced temperatures reduced greenhouse gas emissions in 2019 by 0.05 – 0.21 million metric tons of CO_{2e}, which is equivalent to the annual emissions of 11,000 to 46,000 passenger vehicles.

Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2019

Background

A shared goal of the Federal Highway Administration (FHWA) and the National Asphalt Pavement Association (NAPA) is to support and promote sustainable practices, such as incorporation of recycled materials in pavement mixtures and the use of warm-mix asphalt (WMA) technologies. Reclaimed asphalt pavement (RAP) is recycled at a greater rate than any other material in the United States and helps lower overall material costs, allowing road owners to achieve more roadway maintenance and construction activities within limited budgets. Another recycled material used in asphalt mixtures is reclaimed asphalt shingles (RAS) from both manufacturing waste (MWAS) and post-consumer asphalt shingles (PCAS). The use of RAP and RAS in asphalt pavements can reduce the amount of new asphalt binder and aggregates required in mixtures, which can help stabilize the price of asphalt mixtures and save natural resources. Other recycled materials commonly incorporated into asphalt pavements include recycled tire rubber (RTR), steel and blast furnace slags, and cellulose fibers. By putting waste materials and byproducts to a practical use, the asphalt pavement industry helps reduce the amount of material going to landfills while improving the sustainability of asphalt mixtures.

WMA technologies reduce the mixing and compaction 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 material longer distances, improve compaction at lower temperatures, and use higher percentages of RAP (Prowell et al., 2012; West et al., 2014). As part of FHWA's original group of Every Day Counts initiatives, 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. From 2007 to 2011, the American Association of State Highway and Transportation Officials (AASHTO) conducted a biennial survey of state DOT use of recycled materials (Copeland et al., 2010; Copeland, 2011; Pappas, 2011) and results were presented at FHWA Expert Task Group meetings. FHWA partners with NAPA to document industry use of RAP, RAS, other recycled materials, as well as WMA technologies used by asphalt mixture producers. These efforts have established a baseline for RAP, RAS, and WMA usage, and have tracked the growth in use of these sustainable practices by the road construction industry since 2009.

FHWA first partnered with NAPA to capture annual RAP, RAS, and WMA use for the 2009 construction season (Hansen & Newcomb, 2011; Hansen & Copeland, 2013a; 2013b; 2014; 2015; 2017; Hansen et al., 2017; Williams et al., 2018; 2019). Compared to the findings of the first survey (Hansen & Newcomb, 2011), asphalt mixture producers have shown significant growth in the use of these technologies, although the year-over-year rate of growth has slowed since the 2013 construction season. Since 2012, the survey has also asked about other recycled materials used in asphalt mixtures. Prior-year versions of this report are available at *https://goaspha.lt/IS138results*.

This report documents the results of the industry survey for the 2019 construction season, including the results, trends, and changes from 2009 through 2019. The survey methodology and survey instrument are included in Appendix A, and state-level data are included in Appendix B.

Objective and Scope

The objective of this effort is to quantify the use of recycled materials and WMA technologies by the asphalt pavement industry. From January to July 2020, NAPA fielded a voluntary survey of asphalt mixture producers in the

United States on tons produced, along with a survey of state asphalt pavement associations (SAPAs) regarding total tons of asphalt pavement mixture produced in their state during the 2019 construction season. While keeping specific producer data confidential, NAPA staff compiled the amount of asphalt mixtures produced; the amount of RAP, RAS, and other recycled material used; and the amount of WMA produced in the United States. A separate survey was conducted in parallel to measure the use of in-place asphalt pavement recycling techniques, such as full-depth reclamation (FDR), cold in-place recycling (CIR), hot in-place recycling (HIR), and cold central plant recycling (CCPR).

Survey Methodology

The survey methodology used to collect and analyze the data in this report is detailed in Appendix A. Note that when reporting data at the state level, to keep specific producer information confidential, no state-specific results are provided in the tables or appendixes if fewer than three producers from that state responded to the survey. Information from states with fewer than three responding companies is included in the estimated national values, however.

Producer Survey Results

Asphalt mixture producers from 48 states, one U.S. territories, and the District of Columbia completed the survey for the 2019 construction season. A total of 212 companies and a total of 1,101 production plants are represented in the 2019 survey. The reported total asphalt mixture tons for 2019 was 161.7 million tons, and the average tons produced per plant has continued to rise steadily since 2013.

A degree of fluctuation in year-to-year comparisons of data is influenced by which companies responded to the 2019 construction season survey versus prior-year survey respondents. For the 2019 construction season survey, there was a 22.1 percent decrease in the total number of companies responding and a 17.1 percent decrease in the number of plants; 9 percent of companies and more than 6 percent of the plants responding in 2019 did not participate in the 2018 survey. About 10 percent of responding companies, representing about 4.5 percent of the total reported tonnage, were not NAPA members.

Table 1 summarizes the number of asphalt mixture production companies and the number of production plants reporting for each state. Branches, subsidiaries, and operating units are counted as unique companies in Table 1 and throughout this report.

Table 1: Number of Companies Completing 2019 Construction Season Survey in Each State/Territory

State	Cos.	Prod. Plants	State	Cos.	Prod. Plants	State	Cos.	Prod. Plants
Alabama	6	29	Kentucky	5	29	Ohio	9	90
Alaska	*	*	Louisiana	4	4	Oklahoma	7	18
American Samoa	*	*	Maine	*	*	Oregon	3	11
Arizona	3	21	Maryland	6	9	Pennsylvania	5	24
Arkansas	8	28	Massachusetts	3	9	Puerto Rico	NCR	NCR
California	3	43	Michigan	5	35	Rhode Island	*	*
Colorado	5	21	Minnesota	3	24	South Carolina	5	17
Connecticut	3	15	Mississippi	4	21	South Dakota	NCR	NCR
Delaware	NCR	NCR	Missouri	8	26	Tennessee	5	49
District of Columbia	*	*	Montana	*	*	Texas	4	34
Florida	9	52	Nebraska	*	*	U.S. Virgin Islands	NCR	NCR
Georgia	*	*	Nevada	*	*	Utah	8	18
Guam	NCR	NCR	New Hampshire	*	*	Vermont	*	*
Hawaii	4	12	New Jersey	4	30	Virginia	7	38
Idaho	5	18	New Mexico	2	4	Washington	8	38
Illinois	7	15	New York	14	65	West Virginia	3	15
Indiana	5	19	North Carolina	6	53	Wisconsin	3	62
Iowa	3	6	North Dakota	*	*	Wyoming	*	*
Kansas	*	*	No. Mariana Islands	NCR	NCR	**Total**†	212	1101

NCR = No Companies Responding
* = Fewer than 3 Companies Reporting
† = Total includes companies/production plants from states with fewer than 3 companies reporting

Table 2 summarizes the total number of companies and production plants responding in previous years, as well as the average tons of asphalt pavement mixture produced by each plant.

Table 2: Summary of Jurisdictions (States or Territories), Companies, and Production Plants Responding, 2009–2019

Year	No. Jurisdictions Reporting	No. of Companies Reporting	No. of Production Plants Represented in Survey	Average Tons Produced per Plant
2009	48	196	1,027	121,000
2010	48	196	1,027	117,000
2011	49	203	1,091	121,000
2012	49	213	1,141	122,000
2013	52	249	1,281	115,000
2014	50	228	1,185	127,000
2015	49	214	1,119	137,000
2016	50	229	1,146	136,000
2017	52	237	1,146	141,000
2018	52	272	1,328	143,000
2019	50	212	1,101	147,000

Table 3 includes state-by-state 2019 construction season total estimated asphalt mixture tonnage, as estimated by the SAPA or from Equation A1 (see Survey Methodology in Appendix A); tonnage reported by survey respondents; and the percentage of reported tons included in estimated tons. The closer a state's percentage is to 100 percent indicates the completeness of reported tonnage compared to estimated tonnage. At the national level, survey responses make up 38 percent of the estimated total tons for the 2019 construction season.

Table 3: Summary of 2019 Estimated and Reported Asphalt Mixture Tons in Each State

State	Tons, Millions		Reported % of Estimated	State	Tons, Millions		Reported % of Estimated
	Estimated	Reported			Estimated	Reported	
Alabama	6.5	3.2	49%	Montana	4.2	*	*
Alaska	5.1	*	*	Nebraska	2.8	*	*
American Samoa	0.03	*	*	Nevada	3.4	*	*
Arizona	8.4	3.9	46%	New Hampshire	1.3	*	*
Arkansas	6.0	2.3	38%	New Jersey	11.8	6.8	58%
California	25.9	7.9	31%	New Mexico	3.7	*	*
Colorado	8.7	4.4	51%	New York	17.5	6.7	38%
Connecticut	5.0	2.3	46%	North Carolina	15.0	7.7	51%
Delaware	1.3	NCR	NCR	North Dakota	2.3	*	*
District of Columbia	1.3	*	*	No. Mariana Isl.	0.03	NCR	NCR
Florida	16.0	9.7	61%	Ohio	19.4	11.2	58%
Georgia	17.4	*	*	Oklahoma	5.5	2.0	36%
Guam	0.12	NCR	NCR	Oregon	5.3	1.9	36%
Hawaii	0.9	0.7	78%	Pennsylvania	20.5	2.6	13%
Idaho	2.7	1.5	56%	Puerto Rico	1.4	NCR	NCR
Illinois	13.6	1.5	11%	Rhode Island	1.9	*	*
Indiana	13.0	4.6	35%	South Carolina	8.9	3.3	37%
Iowa	3.7	0.9	24%	South Dakota	2.6	NCR	NCR
Kansas	2.8	*	*	Tennessee	10.1	8.2	81%
Kentucky	6.0	2.5	42%	Texas	40.0	5.9	15%
Louisiana	6.8	1.2	18%	U.S. Virgin Isl.	0.09	NCR	NCR
Maine	1.1	*	*	Utah	4.2	2.9	69%
Maryland	7.0	1.7	24%	Vermont	1.7	*	*
Massachusetts	6.5	2.1	32%	Virginia	12.0	5.8	48%
Michigan	15.1	7.9	52%	Washington	6.3	4.4	70%
Minnesota	11.0	5.6	51%	West Virginia	4.2	2.3	55%
Mississippi	2.9	2.2	76%	Wisconsin	12.0	8.7	73%
Missouri	6.8	2.7	40%	Wyoming	2.3	*	*
				Total	421.9	161.7†	38%

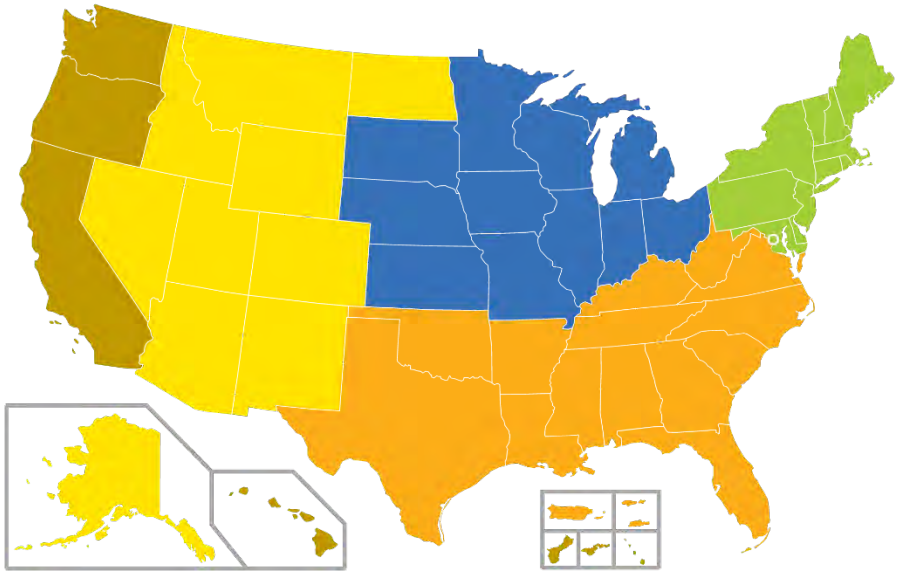
No Companies Responding
Fewer than 3 Companies Reporting
Total Reported Tons includes values from state with fewer than 3 Companies Reporting
SAPA Estimated Tons
Numbers do not add up exactly due to rounding

Figure 1 shows the number of production plants, as well as the average tons produced per production plant, separated by User/Producer Group (UPG) region. The number of production plants responding from each UPG region decreased from 2018 to 2019 with the largest decrease in the Southeastern Asphalt User/Producer Group (SEAUPG) and the North Central Asphalt User/Producer Group (NCAUPG) regions and the smallest in the combined Rocky Mountains Asphalt User/Producer Group (RMAUPG) and Pacific Coast Conference on Asphalt Specification (PCCAS) regions. The North East Asphalt User/Producer Group (NEAUPG) and combined Rocky Mountains Asphalt User/Producer Group (RMAUPG) and Pacific Coast Conference on Asphalt Specification (PCCAS) regions saw a decrease in tonnage produced per plant, Southeastern Asphalt User/Producer Group (SEAUPG) region saw an increase in tonnage produced per plant, while the North Central Asphalt User/Producer Group (NCAUPG) region was flat or saw a modest decrease during the 2019 construction season.

NEAUPG		
Year	*Plants*	*Tons/Plant*
2009	232	123,000
2010	232	122,000
2011	195	115,000
2012	252	119,000
2013	258	111,000
2014	193	122,000
2015	207	137,000
2016	218	136,000
2017	239	142,000
2018	247	144,000
2019	186	138,000

NCAUPG		
Year	*Plants*	*Tons/Plant*
2009	239	106,000
2010	239	106,000
2011	311	114,000
2012	298	116,000
2013	377	123,000
2014	374	136,000
2015	324	152,000
2016	313	136,000
2017	337	153,000
2018	373	153,000
2019	295	152,000

SEAUPG		
Year	*Plants*	*Tons/Plant*
2009	348	106,000
2010	348	106,000
2011	406	114,000
2012	430	116,000
2013	434	113,000
2014	416	125,000
2015	402	129,000
2016	401	140,000
2017	386	134,000
2018	502	135,000
2019	415	146,000



RMAUPG/PCCAS		
Year	*Plants*	*Tons/Plant*
2009	208	118,000
2010	208	112,000
2011	179	124,000
2012	161	113,000
2013	212	110,000
2014	202	122,000
2015	186	123,000
2016	214	128,000
2017	184	134,000
2018	206	157,000
2019	205	146,000

Figure 1: Number of Production Plants Responding to Survey by User/Producer Group Region and Estimated Tonnage Per Plant, 2009–2019

Data Summary and National Estimates

Table 4: Summary of RAP, RAS, WMA Data

NATIONAL SUMMARY	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	189.6	161.7	389.3	421.9
DOT	78.1	63.2	160.4	164.8
Other Agency	50.9	42.2	104.6	110.2
Commercial & Residential	60.6	56.3	124.3	146.8
No. of Companies Reporting	272	212		
RAP	Tons, Millions		Tons, Millions	
Accepted	46.8	40.2	101.1	97.0
Used in HMA/WMA Mixtures	41.1	36.5	82.2	89.2
Used as Aggregate	2.9	1.7	6.4	3.8
Used in Cold-Mix Asphalt	0.1	0.1	0.3	0.3
Used in Other	0.9	0.6	2.0	1.4
Landfilled	0.0	0.1	0.0	0.1
Total Tons of RAP Stockpiled at Year-End	54.9	58.8	110.3	138.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	20.2%	20.1%		
Average % for Other Agency Mixtures[1]	20.0%	19.3%		
Average % for Commercial & Residential Mixtures[1]	23.3%	23.4%		
National Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			21.1%	21.1%
No. of Companies Reporting Using RAP	265	207		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed PCAS Shingles Accepted	254	106	534	277
Unprocessed MWAS Shingles Accepted	171	128	356	334
Processed Shingles Accepted	205	162	430	423
Used in HMA/WMA Mixtures	503	353	1,053	921
Used as Aggregate	24	7	50	18
Used in Cold-Mix Asphalt	0	0	0	0
Used in Other	0	0	0	0
Landfilled	0	0	0	0
Total Tons of RAS Stockpiled at Year-End	666	438	1,368	1,143
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.286%	0.226%		
Average % for Other Agency Mixtures[1]	0.249%	0.195%		
Average % for Commercial & Residential Mixtures[1]	0.265%	0.228%		
National Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.271%	0.218%
No. of Companies Reporting Using RAS	67	46		
WMA Technologies	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			79.5	78.8
Total Tons Produced With WMA Technology at HMA Temperatures			78.2	85.7
DOT	43.9%	43.5%	69.3	71.7
Other Agency	29.5%	40.6%	46.5	44.8
Commercial & Residential	26.6%	32.7%	42.0	48.0
No. of Companies Reporting Using WMA Technologies	185	130		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

Table 4 summarizes the RAP, RAS, and WMA data from the 2019 construction season survey alongside data from the 2018 construction season survey (Williams et al., 2019) for comparison. The information requested in the survey is summarized in Appendix A. In the column labeled “Reported Values” are national summaries of the values from asphalt mixture producers completing the survey. The column labeled “Estimated Values” for the category labeled “Tons of HMA/WMA Produced” was determined as outlined in the Survey Methodology section of Appendix A.

For the amount of RAP accepted, asphalt mixture producers were asked “How many tons of removed asphalt pavement and asphalt millings were accepted/delivered to your facilities in the state in 2019?” For the amount of RAS accepted, producers were asked “How many tons of shingles were accepted/delivered to your facilities in the state in 2019?” Producers were asked to report tons of unprocessed PCAS and unprocessed MWAS accepted/delivered, as well as tons of processed RAS acquired from shingle processors. These data are reported in Table 4 as the tonnage of material accepted. Producers were also asked for the tonnage of RAP and RAS used in the production of asphalt pavement mixtures, cold-mix asphalt, as aggregate, or for other purposes, such as in a chip seal. The tons of reclaimed material sent to landfills were also requested, along with the tons of material stockpiled at year-end.

For each state, the tons of RAS and RAP reported as accepted and used were multiplied by the ratio of total estimated production to total reported production, and these values were summed to arrive at the national estimated tons for these materials, which is reported in the “Estimated Values” column of Table 4.

To understand the average percentage of recycled material used in mixtures, producers were asked to report the percent of RAP or RAS averaged across all asphalt mixtures produced for each sector (DOT, Other Agency, Commercial & Residential). If precise data were not available, respondents were asked to provide their best estimate. These responses are reported in the “Average % Used in Mixtures” section of Table 4 for RAP and RAS. A “National Average All Mixtures Based on Tons Used in HMA/WMA” was calculated and reported in Table 4 for both RAP and RAS based on reported tonnage of each material used in HMA/WMA mixtures divided by the total reported tons produced. Producers were not asked about allowable RAP or RAS limits or binder replacement requirements, which can influence demand for mixtures that incorporate these materials.

Producers were asked to give their best estimate of the percentage of tons of asphalt paving mixture produced for each sector using WMA technologies with a temperature reduction of 10°F to 100°F. A separate question was asked about the percentage of tons of asphalt paving mixture produced for each sector with WMA technologies but without reducing production temperatures. These percentages were multiplied by the total mixture production for each sector to determine the total estimated tons of asphalt mixture produced using WMA technologies for each sector.

Total Asphalt Mixture Production

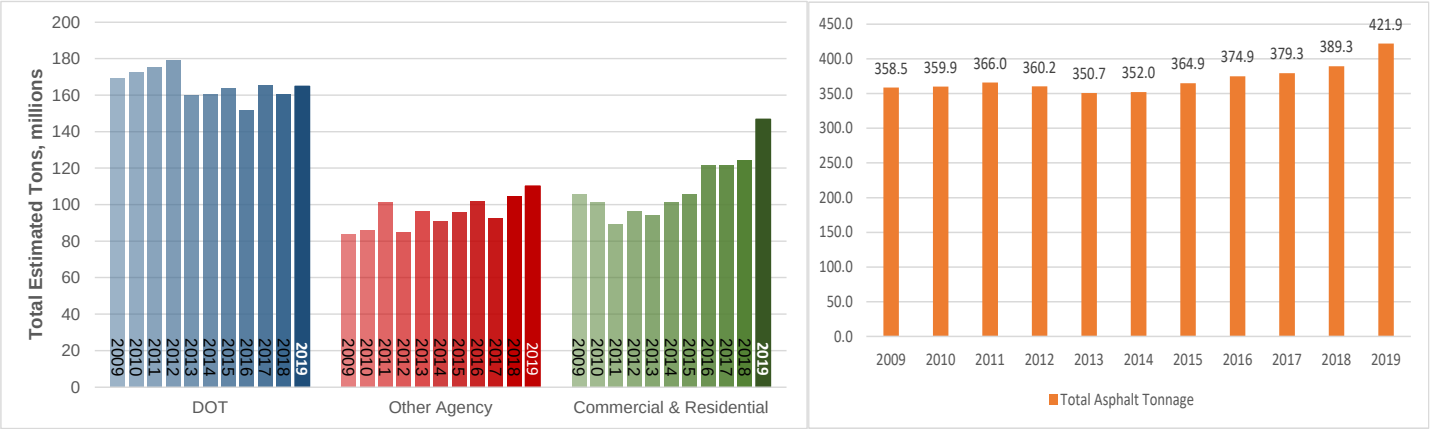


Figure 2: Estimated Total Asphalt Mixture Production by Sector (left) and in Total (right), 2009–2019

Table 4 includes the national summary of asphalt mixture production data from the 2018 and 2019 construction season surveys. The information requested in the survey is detailed in Appendix A and summarized in Table A1, Section 2. State-level data are reported in Appendix B.

From 2018 to 2019, the estimated total amount of asphalt mixture produced in the United States increased from 389.3 million tons to 421.9 million tons, an increase of 7.7 percent.

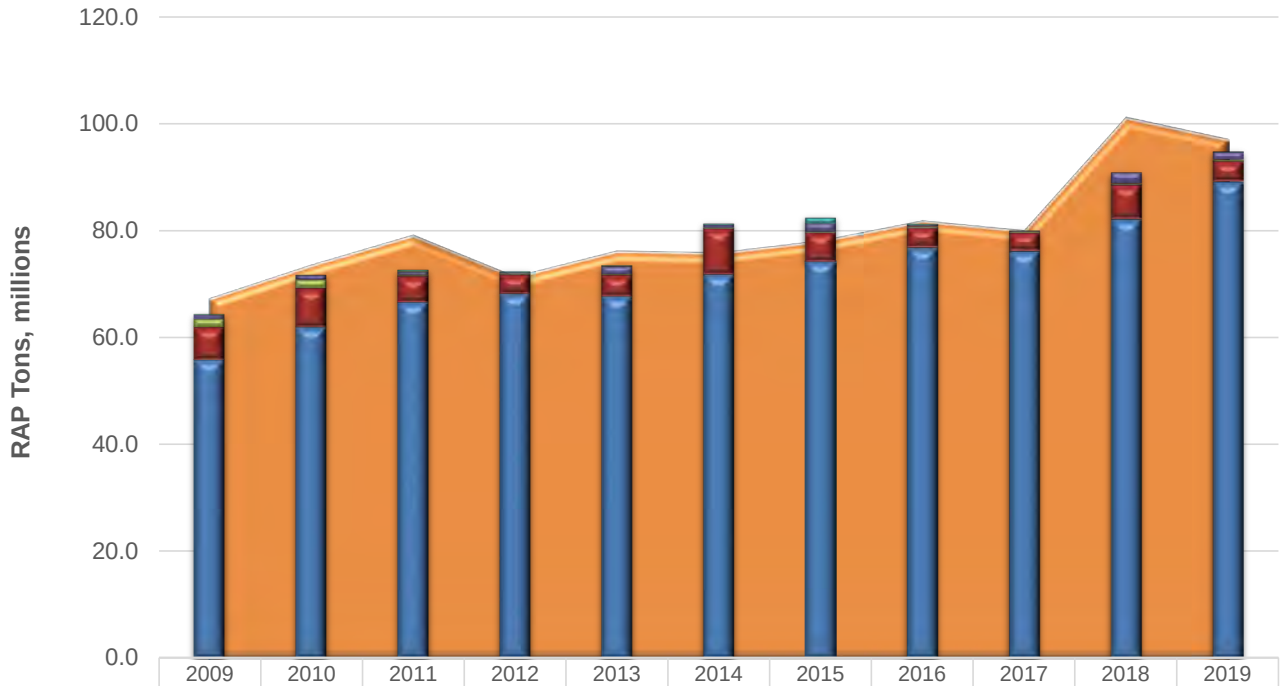
Asphalt pavement mixture producers' customers can be divided into two broad sectors: the private sector (Commercial & Residential) and the public sector (DOT or Other Agency). The "Other Agency" sector includes asphalt pavement mixtures produced for public works agencies; toll authorities; and city, county, and tribal transportation agencies, as well as the U.S. military and federal agencies, such as the Federal Aviation Administration, National Park Service, and U.S. Forest Service.

As seen in Figure 2, increases and decreases in total tonnage production estimates by sector have varied from year to year. Compared to the 2018 construction season, 2019 asphalt mixture tonnage produced for the DOT sector increased 2.7 percent, mixture production for the Other Agency sector increased by 5 percent, and the Commercial and Residential sector grew significantly (15.3 percent) from 2018 to 2019.

Reclaimed Asphalt Pavement

Table 4 includes the national summary of RAP data from the 2018 and 2019 construction season surveys. The information requested in the survey is detailed in Appendix A and summarized in Table A1, Section 2. State-level data is reported in Appendix B. Figure 3 is a visual representation of the estimated total tons of RAP used in asphalt mixtures, aggregate, cold-mix asphalt, and other uses, as well as the amount landfilled, from the 2009 to 2019 construction season surveys. The overwhelming majority of RAP is used in hot-mix asphalt (HMA) or warm-mix asphalt (WMA) mixtures, which is the most optimal use of RAP.

From the 2018 to 2019 construction season, the amount of RAP used in HMA/WMA increased from 82.2 million to 89.2 million tons. The average percent RAP used in asphalt mixtures remained the same at 21.1 percent in 2018 and 2019. For 2019, about 98 percent of companies responding to the survey reported using RAP. This was a slight increase from the 97 percent of companies reporting using RAP in 2018, and a slight decrease from the 100 percent of companies reporting using RAP in 2013 and 2014, and the 99 percent of companies reporting RAP use in the 2015 survey.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Accepted	67.2	73.5	79.1	71.3	76.1	75.8	78.0	81.8	79.9	101.1	97.0
Landfilled	0.1	0.0	0.3	0.2	0.1	0.2	1.0	0.1	0.0	0.0	0.1
Used in Other	0.7	0.8	0.7	0.2	1.5	0.6	1.6	0.4	0.2	2.0	1.4
Used in Cold Mix	1.5	1.6	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Used in Aggregate	6.2	7.3	4.9	3.6	4.0	8.5	5.5	3.7	3.4	6.4	3.8
Used in HMA/WMA	56.0	62.1	66.7	68.3	67.8	71.9	74.2	76.9	76.2	82.2	89.2

Figure 3: Comparison of Tons of RAP Accepted and Tons of RAP Used or Landfilled (Million Tons), 2009–2019

Placement of RAP in construction and demolition landfills is rare. Since the beginning of the survey in 2009, the average amount of RAP landfilled is less than 115,000 tons per year. In 2019, just 52,550 tons, about 0.013 percent, of RAP was landfilled. The amount of RAP accepted during the 2019 construction season saved about 58.9 million cubic yards of landfill space.

RAP Use by Sector

Figure 4 shows the total estimated tons of RAP used in each sector. These values were calculated using the average percentages of RAP reported by producers for each sector and adjusted to account for differences between reported RAP tonnage and tons calculated from the percentage by sector.

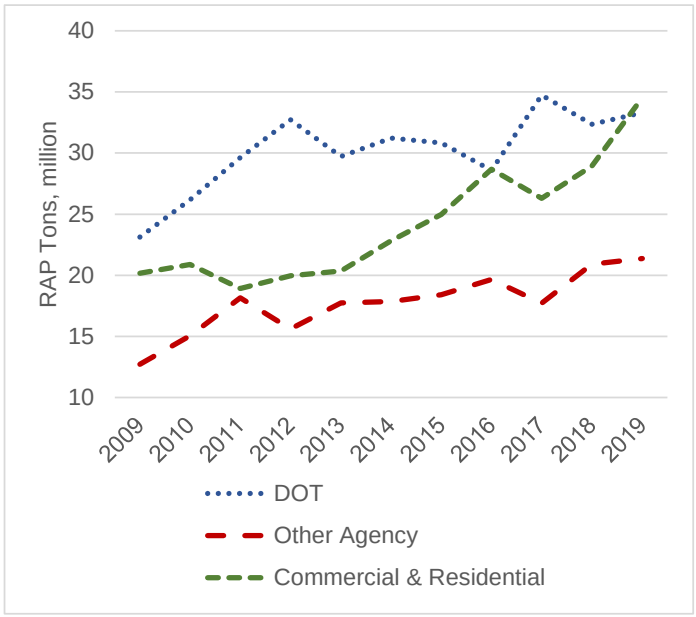


Figure 4: RAP Use by Sector (Million Tons)

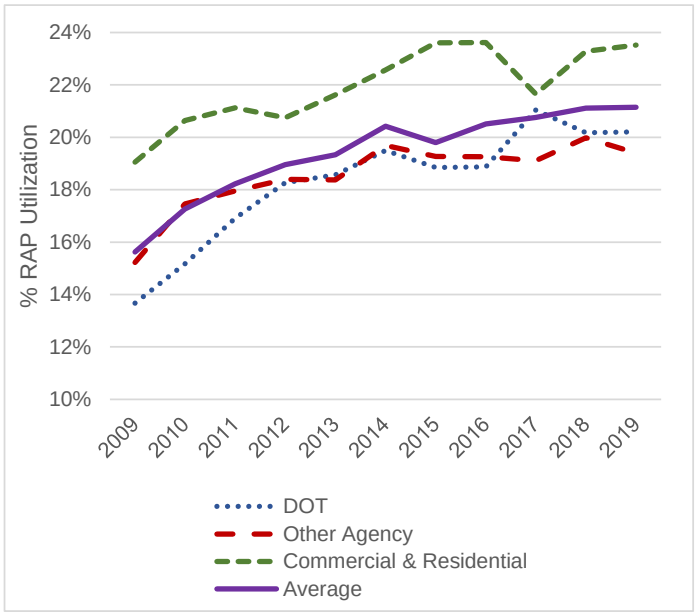


Figure 5: Average Percent RAP Used by Sector

Figure 5 shows the average percentage of RAP used by each sector and overall across all asphalt pavement mixtures. In 2019, the average percent RAP used by all sectors remained at the high of 21.1 percent set in 2018. Previously, the average percent RAP had seen steady growth from 2009 to 2014 before plateauing around 20 percent through 2017. The percent of RAP used in each sector during 2019 remained steady with the utilization percentages from 2018.

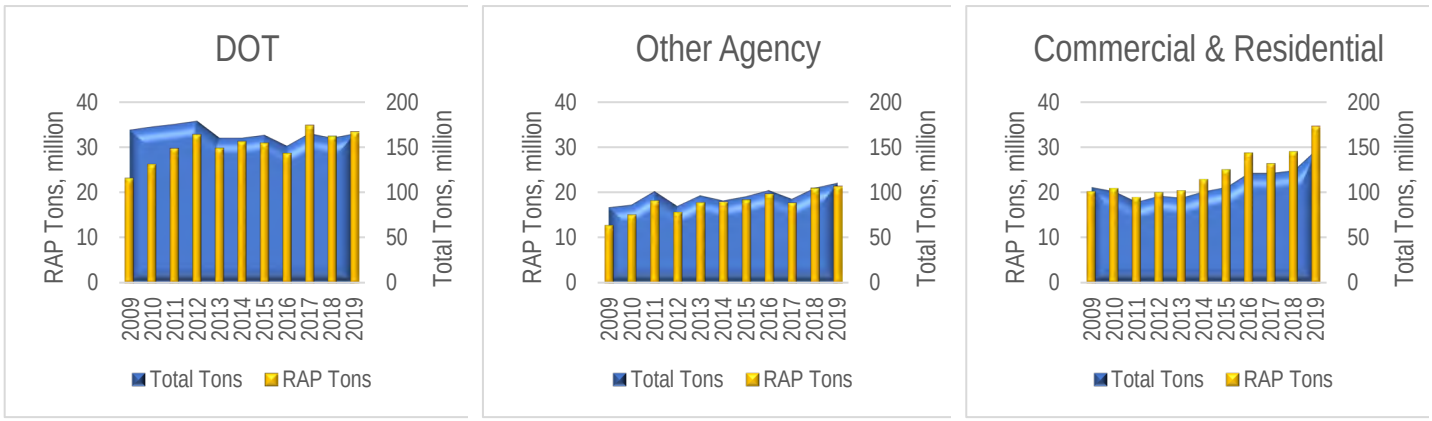


Figure 6: RAP Tons and Total Mixture Tons Comparison (Million Tons)

Since the 2012 construction season, the tonnage of RAP used by each sector has generally moved up or down with the total tonnage used by the sector, which is shown in Figure 6. For the 2019 construction season, the tons of RAP used increased in all sectors. The increased RAP tonnage used was a result of increased mix tonnages in each sector, and the sectors remained relatively flat in their percent utilization, which resulted in the national average percentage of RAP used remaining the same as in the 2018 season (21.1 percent).

RAP Use in Each State

Table 5 and Figure 7 show the average percentage of RAP used in HMA/WMA mixtures in each state by construction season based on reported RAP tons used in HMA/WMA mixtures and total reported tonnage. It should be noted that the accuracy of data for individual states varies depending on the number of responses received from producers in each state and the total number of tons accounted for in the responses.

Figure 7 revisualizes the Table 5 data, showing the number of states with producers reporting average RAP percentages used at the various ranges by construction season from 2009 to 2019. The number of states with producers reporting average RAP percentages 20 percent or greater has increased significantly, rising from 10 states in 2009 to 27 states in 2014; 29 states in 2016, decreasing to 24 states in 2017, 30 states in 2018, and now peaking at 31 states in 2019. The number of states with producers reporting RAP percentages less than 15 percent has decreased from 23 states in 2009 to just two states in 2014 and then remained relatively steady at 10 or 11 states in 2015 through 2017, before dropping to six states in 2018 and five states in 2019.

Table 5: Average Estimated Percentage of RAP Used in Each State, 2015–2019

State	Average RAP Percent					State	Average RAP Percent				
	2015	2016	2017	2018	2019		2015	2016	2017	2018	2019
Alabama	25%	24%	24%	26%	25%	Montana	*	*	*	*	*
Alaska	*	*	*	*	*	Nebraska	*	*	19%	26%	*
American Samoa	NCR	NCR	*	*	*	Nevada	*	22%	12%	*	*
Arizona	*	9%	10%	12%	9%	New Hampshire	19%	21%	22%	18%	*
Arkansas	14%	10%	11%	12%	13%	New Jersey	*	19%	19%	18%	20%
California	16%	15%	18%	16%	16%	New Mexico	NCR	22%	21%	19%	*
Colorado	20%	24%	24%	20%	20%	New York	16%	16%	16%	17%	17%
Connecticut	*	21%	18%	15%	21%	North Carolina	26%	23%	18%	26%	24%
Delaware	*	*	*	*	NCR	North Dakota	*	*	12%	*	*
Dist. of Columbia	NCR	NCR	*	*	*	No. Mariana Isl.	NCR	NCR	NCR	NCR	NCR
Florida	33%	32%	35%	27%	31%	Ohio	28%	27%	28%	28%	32%
Georgia	*	27%	23%	25%	*	Oklahoma	20%	17%	15%	17%	19%
Guam	NCR	NCR	NCR	NCR	NCR	Oregon	27%	22%	18%	27%	26%
Hawaii	*	*	20%	23%	19%	Pennsylvania	15%	15%	15%	16%	13%
Idaho	25%	21%	27%	27%	24%	Puerto Rico	*	NCR	NCR	NCR	NCR
Illinois	25%	23%	25%	28%	23%	Rhode Island	*	*	*	*	*
Indiana	28%	22%	22%	24%	21%	South Carolina	19%	23%	21%	22%	22%
Iowa	13%	14%	11%	18%	19%	South Dakota	NCR	*	*	NCR	NCR
Kansas	17%	20%	19%	21%	*	Tennessee	23%	21%	23%	18%	24%
Kentucky	15%	13%	24%	16%	16%	Texas	13%	13%	15%	17%	16%
Louisiana	*	19%	21%	22%	22%	U.S. Virgin Islands	NCR	NCR	NCR	*	NCR
Maine	*	16%	20%	*	*	Utah	25%	25%	22%	27%	28%
Maryland	23%	26%	23%	26%	30%	Vermont	*	*	*	*	*
Massachusetts	18%	18%	16%	16%	16%	Virginia	29%	28%	32%	28%	28%
Michigan	32%	32%	28%	28%	29%	Washington	25%	25%	20%	24%	23%
Minnesota	22%	21%	20%	25%	24%	West Virginia	14%	14%	18%	20%	18%
Mississippi	17%	19%	18%	20%	23%	Wisconsin	16%	22%	16%	17%	21%
Missouri	23%	23%	23%	21%	27%	Wyoming	*	10%	12%	*	*

No Company Responding	< 3 Companies Reporting	0–9%	10–14%	15–19%	20–29%	≥ 30%

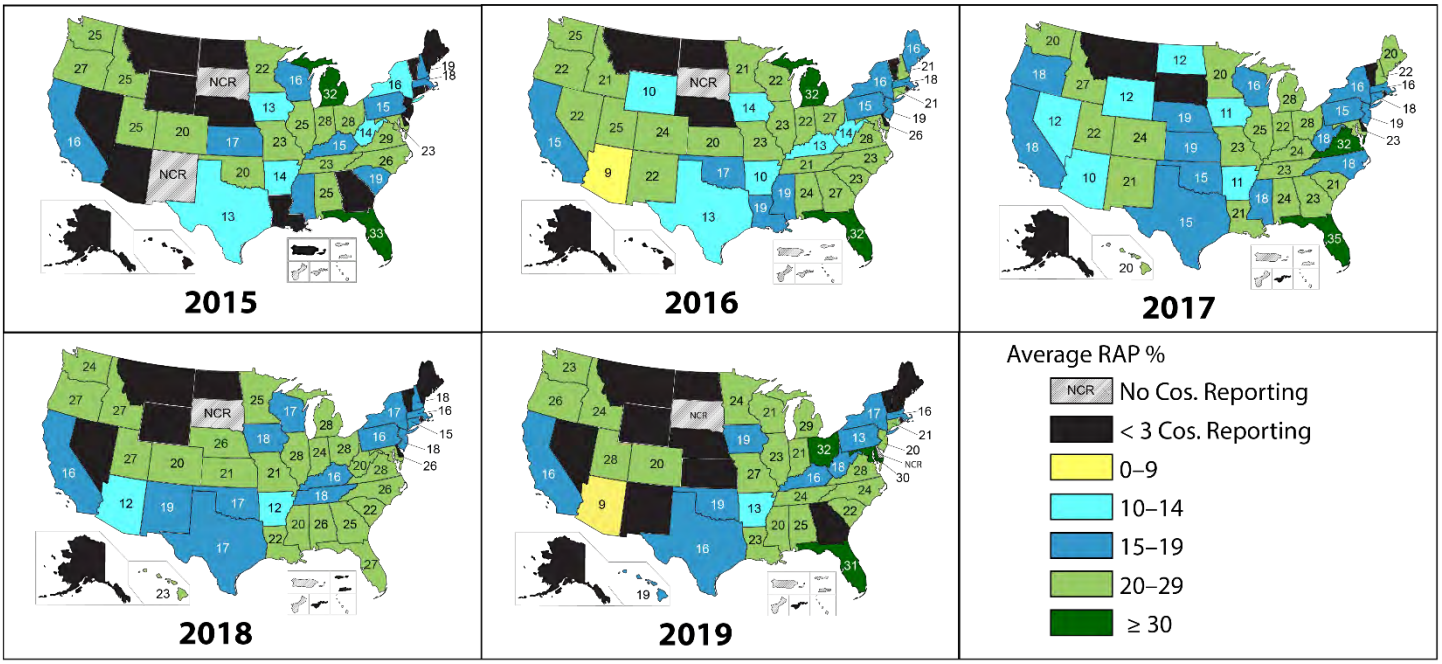


Figure 7: Estimated Average Percentage of RAP Used in Each State, 2015–2019

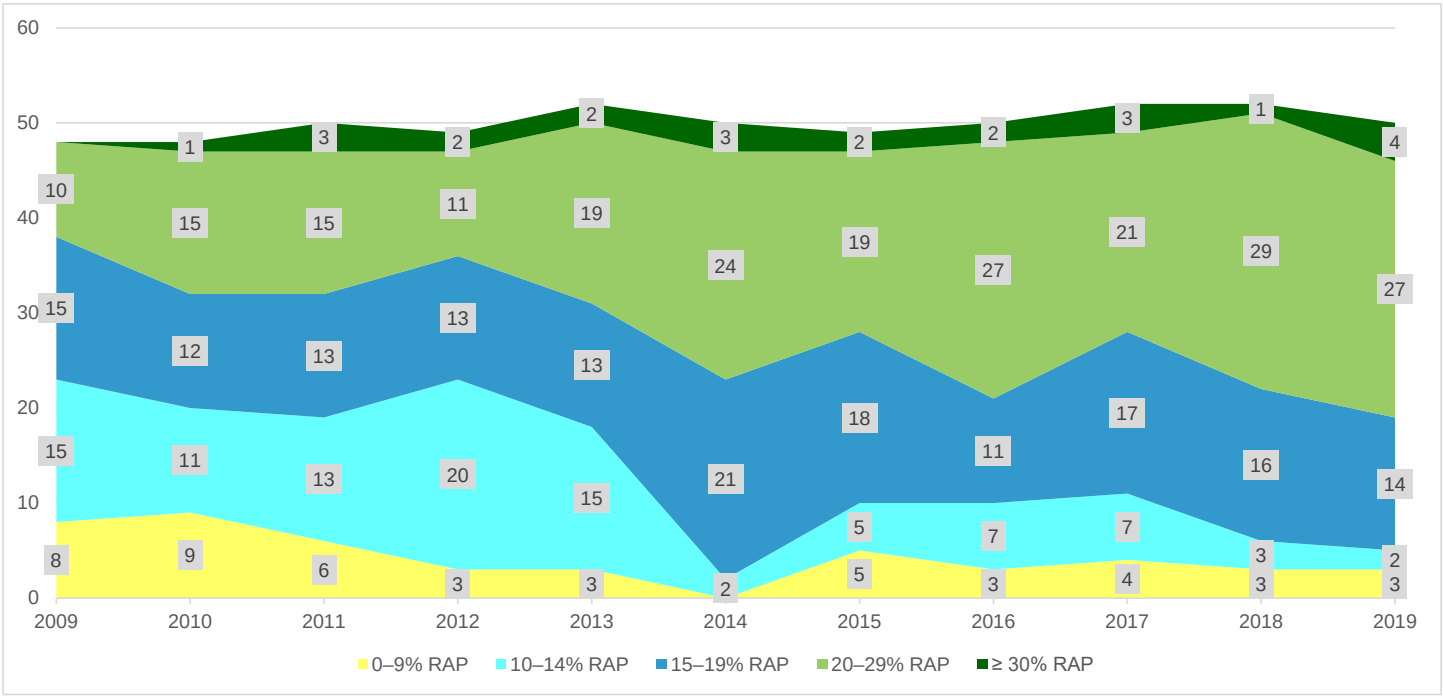


Figure 8: Number of States at Different Average Percentage of RAP Used in HMA/WMA Mixtures, 2009–2019

RAP Stockpiles

During the 2019 construction season, an estimated 97.0 million tons of RAP was accepted by asphalt mixture producers, and 94.8 million tons of RAP was used across all purposes during the year. In 2019, as in 2018 and 2016, more RAP was received than was utilized, indicating an increase in producer inventory. By comparison, in 2012, 2014, and 2015, more RAP was used than was received, indicating producers were drawing upon stockpiled RAP. In 2017, RAP acceptance and use were about equal. In 2019, the estimated amount of RAP stockpiled nationwide increased to 138.04 million tons, a 20 percent increase from the 110.31 million tons of RAP stockpiled at the end of the 2018 construction season. This increase in stockpiled inventory is greater than the difference in the amount of RAP used and accepted. For 2019, 93.9 percent of producers reported having stockpiled RAP, down from 94.5 percent of producers in 2018. The reported RAP stockpiled represents about 1.5 years of inventory at 2019 utilization levels. Table 6 shows the reported and estimated amount of RAP stockpiled in each state at the end of the 2019 construction season. To calculate the estimated values, reported tons of RAP stockpiled were divided by the ratio of total reported tons of mixture produced to estimate tons of mixture produced. The total tonnage row in Table 6 includes stockpiled tonnages from states with fewer than three producers reporting.

Table 6: Reported Tons of RAP Stockpiled

State	Reported Tons Stockpiled (Million)		Estimated Tons Stockpiled (Million)		State	Reported Tons Stockpiled (Million)		Estimated Tons Stockpiled (Million)	
	2018	2019	2018	2019		2018	2019	2018	2019
Alabama	1.80	0.80	2.41	1.62	Montana	*	*	*	*
Alaska	*	*	*	*	Nebraska	0.32	*	1.60	*
American Samoa	*	*	*	*	Nevada	*	*	*	*
Arizona	0.58	0.46	1.18	0.99	New Hampshire	0.15	*	0.15	*
Arkansas	0.30	0.18	0.52	0.48	New Jersey	4.24	6.32	10.81	11.04
California	1.52	0.69	3.90	2.29	New Mexico	0.14	*	0.78	*
Colorado	0.37	0.66	1.46	1.32	New York	2.02	1.20	5.92	3.14
Connecticut	1.00	0.20	2.22	0.44	North Carolina	1.14	1.63	3.17	3.16
Delaware	*	NCR	*	NCR	North Dakota	*	*	*	*
District of Columbia	*	*	*	*	No. Mariana Isl.	NCR	NCR	NCR	NCR
Florida	0.29	2.24	0.45	3.69	Ohio	8.15	6.37	11.20	11.07
Georgia	3.80	*	9.47	*	Oklahoma	0.36	0.39	0.77	1.10
Guam	NCR	NCR	NCR	NCR	Oregon	0.35	0.82	0.83	2.25
Hawaii	0.10	0.15	0.17	0.19	Pennsylvania	0.93	0.40	2.95	3.18
Idaho	0.73	0.98	1.41	1.80	Puerto Rico	NCR	NCR	NCR	NCR
Illinois	1.00	0.70	3.91	6.33	Rhode Island	*	*	*	*
Indiana	2.37	1.16	3.57	3.30	South Carolina	1.09	0.71	1.99	1.91
Iowa	0.12	0.34	0.25	1.38	South Dakota	NCR	NCR	NCR	NCR
Kansas	0.83	*	0.86	*	Tennessee	1.39	4.02	2.17	4.94
Kentucky	0.97	0.33	1.20	0.80	Texas	1.68	0.77	4.01	5.27
Louisiana	0.16	0.19	1.32	1.08	U.S. Virgin Islands	*	NCR	*	NCR
Maine	*	*	*	*	Utah	1.43	1.17	1.55	1.66
Maryland	1.02	0.16	1.58	0.68	Vermont	*	*	*	*
Massachusetts	1.28	0.54	1.66	1.65	Virginia	1.81	1.73	3.90	3.60
Michigan	3.17	14.75	5.15	28.12	Washington	1.02	1.26	1.09	1.79
Minnesota	2.13	1.50	3.28	2.93	West Virginia	0.56	0.33	0.78	0.66
Mississippi	0.49	0.43	0.69	0.57	Wisconsin	1.87	2.00	2.54	2.77
Missouri	1.55	1.66	2.65	4.13	Wyoming	*	*	*	*
					Total[†]	54.86	58.80	110.31	138.04

NCR No Companies Responding for the State to the Survey
* Fewer than 3 Companies Reporting
[†] Includes Values from States with Fewer than 3 Companies Reporting

RAP Fractionation

Table 7 shows the average percentage of RAP fractionated into two or more sizes in each state, as reported by survey participants. **These results are representative *only* of the survey participants and do not completely reflect practices in a given state.** This also helps explain the state-level variability from year to year. Producers and SAPAs were not questioned about state specifications regarding fractionation and recycled material content.

Previous reports have shown that fractionation of RAP does not correlate to RAP utilization percentages. This holds true for the 2019 data, with an example being Texas, which reports 50 percent of RAP being fractionated and averaging 16 percent RAP in mixtures, while Maryland reported only 0 percent of RAP being fractionated but averaged 30 percent RAP in mixtures.

Table 7: Reported Percentage of RAP Fractionated, in Each State, 2018–2019

State	% Fractionated		State	% Fractionated		State	% Fractionated	
	2018	2019		2018	2019		2018	2019
Alabama	16%	19%	Kentucky	42%	48%	Ohio	7%	13%
Alaska	*	*	Louisiana	95%	92%	Oklahoma	52%	32%
American Samoa	*	*	Maine	*	*	Oregon	11%	1%
Arizona	10%	0%	Maryland	14%	0%	Pennsylvania	13%	0%
Arkansas	21%	15%	Massachusetts	14%	0%	Puerto Rico	NCR	NCR
California	28%	3%	Michigan	17%	21%	Rhode Island	*	*
Colorado	33%	43%	Minnesota	11%	15%	South Carolina	61%	46%
Connecticut	17%	20%	Mississippi	19%	0%	South Dakota	NCR	NCR
Delaware	*	NCR	Missouri	16%	22%	Tennessee	22%	15%
Dist. of Columbia	*	*	Montana	*	*	Texas	63%	50%
Florida	23%	15%	Nebraska	17%	*	U.S. Virgin Isl.	*	NCR
Georgia	3%	*	Nevada	*	*	Utah	29%	13%
Guam	NCR	NCR	New Hampshire	0%	*	Vermont	*	*
Hawaii	67%	50%	New Jersey	0%	10%	Virginia	26%	27%
Idaho	28%	0%	New Mexico	40%	*	Washington	12%	23%
Illinois	39%	25%	New York	20%	7%	West Virginia	0%	0%
Indiana	69%	57%	North Carolina	21%	7%	Wisconsin	5%	3%
Iowa	1%	0%	North Dakota	*	*	Wyoming	*	*
Kansas	29%	*	No. Mariana Isl.	NCR	NCR			
					Average, Where Used[†]		24%	21%

NCR No Companies Responding for the State to the Survey

* Fewer than 3 Companies Reporting

[†] Includes Values from States with Fewer than 3 Companies Reporting

RAP Recycling Agent Use

Table 8 shows the percentage of reported tons of RAP-containing mixtures produced using softer binder or recycling agents in each state. **These results are representative *only* of the survey participants and do not completely reflect practices in a given state.** While there is no strong relationship between the amount of RAP mixtures using softer binder or recycling agents and percentage of RAP used by the state, it should be noted that of the 29 states using 20 percent or more RAP, 23 of them report using softer binders and or recycling agents in a percentage of their RAP mixtures and six of these states reported no use of softer binders or recycling agents in RAP mixtures.

Table 8: Percentage of RAP Mixes Using Softer Binder and/or Recycling Agents in Each State, 2019

State	Softer Binder	Recyc. Agent	State	Softer Binder	Recyc. Agent	State	Softer Binder	Recyc. Agent
Alabama	0%	0%	Kentucky	17%	20%	Ohio	31%	7%
Alaska	*	*	Louisiana	10%	0%	Oklahoma	10%	0%
American Samoa	*	*	Maine	*	*	Oregon	7%	35%
Arizona	2%	0%	Maryland	33%	0%	Pennsylvania	0%	0%
Arkansas	8%	0%	Massachusetts	35%	0%	Puerto Rico	NCR	NCR
California	5%	32%	Michigan	36%	0%	Rhode Island	*	*
Colorado	21%	0%	Minnesota	16%	0%	South Carolina	0%	0%
Connecticut	0%	16%	Mississippi	0%	2%	South Dakota	NCR	NCR
Delaware	NCR	NCR	Missouri	27%	4%	Tennessee	0%	0%
Dist. of Columbia	*	*	Montana	*	*	Texas	14%	20%
Florida	64%	0%	Nebraska	*	*	U.S. Virgin Isl.	NCR	NCR
Georgia	*	*	Nevada	*	*	Utah	52%	7%
Guam	NCR	NCR	New Hampshire	*	*	Vermont	*	*
Hawaii	0%	0%	New Jersey	8%	8%	Virginia	19%	7%
Idaho	62%	20%	New Mexico	*	*	Washington	27%	1%
Illinois	22%	0%	New York	3%	7%	West Virginia	0%	0%
Indiana	21%	0%	North Carolina	44%	0%	Wisconsin	5%	0%
Iowa	5%	3%	North Dakota	*	*	Wyoming	*	*
Kansas	*	*	No. Mariana Isl.	NCR	NCR			
					Average, When Used[†]		18%	4%

NCR No Companies Responding for the State to the Survey

* Fewer than 3 Companies Reporting

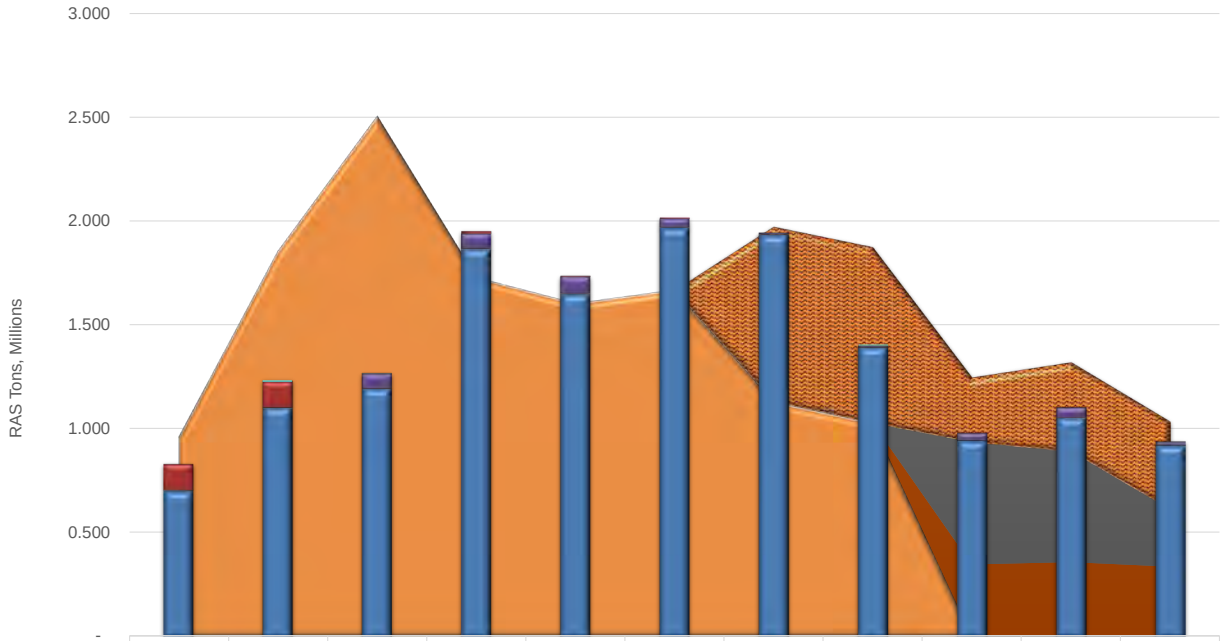
[†] Includes Values from States with Fewer than 3 Companies Reporting

Although the data is highly dependent upon the companies responding to the survey each year, the average percentage of RAP mixtures incorporating softer binders was 18 percent during the 2019 construction season, which is down from 20 percent in the 2018 survey. The percentage of RAP mixtures incorporating recycling agents has fluctuated year to year with 4 percent in 2019, 4 percent in 2018, 4 percent in 2017, 7 percent in 2016, and 3 percent in 2015.

Reclaimed Asphalt Shingles

Table 4 includes the national summary of RAS data from the 2018 and 2019 construction season surveys. The information requested in the survey is detailed in Appendix A and summarized in Table A1, Section 3. State-level data is reported in Appendix B. Producers and SAPAs were not asked about allowable RAS limits or binder replacement requirements for their states. Figure 9 is a visual representation of the estimated total tons of RAS used in asphalt mixtures, aggregate, cold-mix asphalt, and other uses, as well as the amount landfilled, from the 2009 to 2019 construction season surveys.

During the 2019 construction season, the total estimated amount of unprocessed and processed shingles received by producers was 1.03 million tons, which is more than combined amount of RAS used in asphalt mixtures (921,000 tons) and in aggregate (18,000 tons) used that year. This is a 22 percent decrease from the 1.32 million total tons of RAS from all sources accepted during the 2018 construction season. The use of 921,000 tons of RAS in asphalt pavement mixtures during 2019 is a 12.5 percent decrease from the 1,053,000 tons used in 2018.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Processed Shingles Accepted	-	-	-	-	-	-	0.842	0.846	0.311	0.430	0.423
PCAS	-	-	-	-	-	-	-	-	0.591	0.534	0.277
MWAS	-	-	-	-	-	-	-	-	0.344	0.356	0.334
Unprocessed Shingles Accepted	0.957	1.851	2.500	1.724	1.599	1.664	1.129	1.027	-	-	-
Landfilled	-	0.007	0.000	-	-	-	-	0.005	-	-	-
Used in Other	0.123	0.125	-	0.012	0.005	0.006	-	-	-	-	-
Used in Cold Mix	-	-	-	-	-	-	-	-	-	-	-
Used in Aggregate	0.006	0.003	0.074	0.073	0.082	0.043	0.009	0.009	0.036	0.050	0.018
Used in HMA/WMA	0.702	1.100	1.192	1.863	1.647	1.964	1.931	1.390	0.944	1.053	0.921

Figure 9: Comparison of Tons of RAS Accepted and Tons of RAS Used or Landfilled (Million Tons), 2009–2019. Processed RAS Acceptance First Tracked in 2015

As shown in Figure 9, from the 2012 to 2014 construction seasons, producers reported using RAS in greater quantities than they accepted. When this trend was first noticed, producers were contacted to confirm the reported values. All producers contacted indicated they either had RAS stockpiled or were purchasing RAS from shingle processors. To capture the volume of processed shingles accepted by producers, the 2015 survey began asking producers “How many tons of processed shingles were accepted/delivered to your facilities in the state?” Beginning with the 2017 construction season survey producers were asked to report the tons of unprocessed PCAS, unprocessed MWAS, and processed RAS accepted separately.

As seen in Table 4, there was a significant (48 percent) decrease in the acceptance of PCAS in 2019 compared to 2018, leading to a 22 percent decrease in the total amount of RAS accepted during the 2019 construction season. The total estimated amount of unprocessed shingles accepted by producers declined 31 percent from 890,000 tons in 2018 to 611,000 tons in 2019. Acceptance of processed shingles decreased 1.6 percent during the same time period, from 430,000 tons in 2018 to 423,000 tons in 2019.

No RAS accepted by producers was reported as landfilled during the 2019 construction season. By accepting 611,00 tons of unprocessed RAS from both PCAS and MWAS sources, asphalt mixture producers saved about 370,000 cubic yards of landfill space.

According to the Asphalt Roofing Manufacturers Association (ARMA, 2015), about 13.2 million tons of waste shingles are generated annually — about 12 million tons of PCAS and 1.2 million tons of MWAS. Therefore, asphalt mixture producers in 2019 diverted about 7 percent of the total available supply of waste shingles from landfills.

The number of companies using RAS increased from 67 in 2018 to 46 during the 2019 construction season. The percentage of producers reporting use of RAS decreased from 25 percent of respondents in 2018 to 22 percent in 2019.

RAS Use by Sector

Figure 10 shows the total estimated amount of RAS used in each of the three sectors of the paving market. These values were calculated using the average percentages of RAS reported by producers for the sectors and adjusted to account for differences between reported RAS tonnage and tons calculated from the percentage by sector. There was a slight decrease in the tons of RAS used by DOTs and Other Agencies from the 2018 to 2019 construction season. All sectors saw decreases in percentage and tonnage of RAS use from 2018 to 2019.

Figure 11 shows the average percentage of RAS used by each sector and overall across all asphalt pavement mixtures. These values were calculated using the average percentages of RAS reported for the different sectors and adjusted to account for differences between reported RAS tonnage and tons calculated from the percentage by sector. Although previous years' surveys saw relatively steady growth across all sectors from 2009 to 2014 with some year-to-year variation, there was a leveling of total RAS use from 2012 to 2015 until a notable decline began

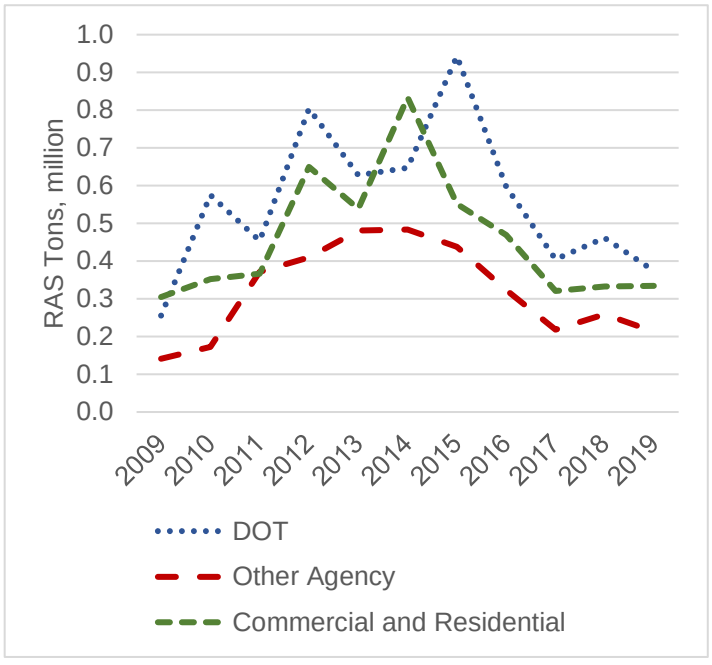


Figure 10: Estimated RAS Use by Sector (Million Tons)

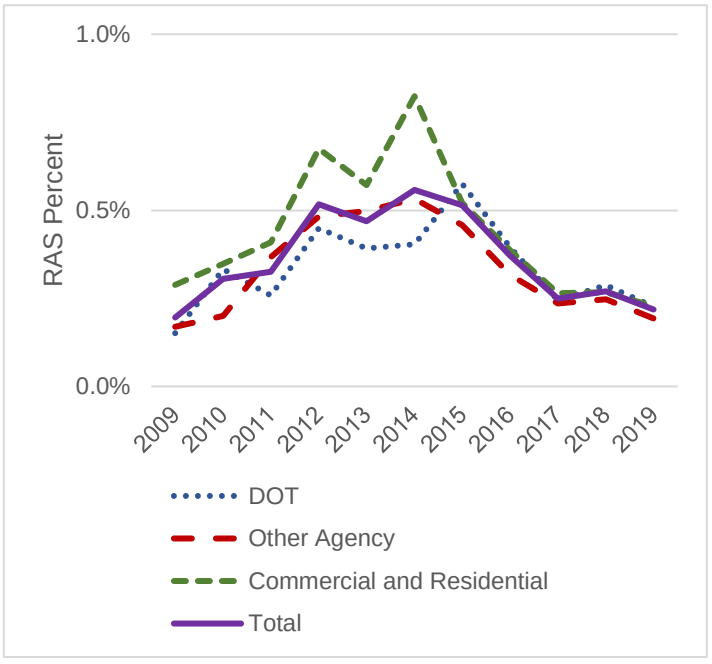


Figure 11: Average Percent RAS Used by Sector

in 2016 and continued into the 2019 season. The average percentage RAS peaked at 0.56 percent in 2012 and started declining from 0.54 percent in 2014 to 0.22 percent in the 2019 construction season.

In 2019, producers and SAPAs were asked which sectors allow RAS to be included in asphalt mixtures. Responses came from 49 states, and this information is summarized in Table 9. In cases where conflicting answers were provided, a middle ground was assumed with SAPA responses being given greater weight regarding the public sectors' RAS use and contractors' responses being given greater weight for the private sector. Most respondents reported that RAS is allowed in at least some mixtures and sectors. According to responses from producers and SAPAs, 25 DOTs reportedly allow RAS in some asphalt pavement mixtures, and six other DOTs allow it in all mixtures. These findings generally align the findings of a 2016 FHWA survey (Aschenbrener, 2017) examining DOT acceptance of the use of RAS. Aschenbrener (2017) also found that five state DOTs — District of Columbia, New Jersey, New York, Pennsylvania, and Massachusetts —allow only the use of MWAS in asphalt pavement mixtures. RAS use is allowed in some Other Agency sector mixtures in 35 states, with no additional states allowing RAS in all mixtures for that sector. Similarly, RAS is allowed in at least some Commercial & Residential sector mixtures in 37 states. There were no reports of states allowing RAS in all mixtures for all sectors, while ten states — Alaska, Arizona, Hawaii, Louisiana, Nevada, New Mexico, North Dakota, Rhode Island, West Virginia, and Wyoming — reportedly do not allow the use of RAS in mixtures for any sector.

Table 9: Sectors Allowing RAS, 2019

State	RAS Allowed In?			State	RAS Allowed In?		
	DOT Mixtures	Other Agency Mixtures	Commercial & Residential Mixtures		DOT Mixtures	Other Agency Mixtures	Commercial & Residential Mixtures
Alabama	Some	Some	Some	Montana	Some	None	None
Alaska	None	None	None	Nebraska	Some	Some	Some
American Samoa	DNA	DNA	DNA	Nevada	None	None	None
Arizona	None	None	None	New Hampshire	Some	Some	Some
Arkansas	Some	Some	Some	New Jersey	Some	None	None
California	None	Some	Some	New Mexico	None	None	None
Colorado	Some	Some	Some	New York	All	Some	Some
Connecticut	Some	Some	Some	North Carolina	All	Some	Some
Delaware	DNA	DNA	DNA	North Dakota	None	None	None
District of Columbia	DNA	DNA	DNA	No. Mariana Isl.	NCR	NCR	NCR
Florida	None	Some	Some	Ohio	Some	Some	Some
Georgia	None	Some	Some	Oklahoma	Some	Some	Some
Guam	NCR	NCR	NCR	Oregon	Some	Some	Some
Hawaii	None	None	None	Pennsylvania	Some	Some	Some
Idaho	None	Some	Some	Puerto Rico	NCR	NCR	NCR
Illinois	All	Some	Some	Rhode Island	None	None	None
Indiana	All	Some	Some	South Carolina	Some	Some	Some
Iowa	Some	Some	Some	South Dakota	None	Some	Some
Kansas	Some	Some	Some	Tennessee	Some	Some	Some
Kentucky	Some	Some	Some	Texas	Some	Some	Some
Louisiana	None	None	None	U.S. Virgin Islands	DNA	DNA	DNA
Maine	Some	Some	Some	Utah	None	None	Some
Maryland	Some	Some	Some	Vermont	None	Some	Some
Massachusetts	Some	Some	Some	Virginia	Some	Some	Some
Michigan	Some	Some	Some	Washington	Some	Some	Some
Minnesota	All	Some	Some	West Virginia	None	None	None
Mississippi	None	None	Some	Wisconsin	All	Some	Some
Missouri	Some	Some	Some	Wyoming	None	None	None

DNA Did Not Answer
NCR No Companies Responding

Table 10: States With Reported RAS Use, 2010–2019

State	RAS Used?									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Alabama	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Alaska	No	No	No	No	No	No	No	No	No	No
American Samoa	NCR	NCR	NCR	NCR	NCR	NCR	NCR	No	No	No
Arizona	No	No	No	No	No	No	No	No	No	No
Arkansas	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
California	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Colorado	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No
Connecticut	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Delaware	Yes	NCR	Yes	Yes	Yes	Yes	Yes	No	No	NCR
District of Columbia	NCR	NCR	NCR	No	NCR	NCR	NCR	No	No	No
Florida	Yes	No	No	Yes	Yes	Yes	No	No	Yes	No
Georgia	No	Yes	Yes	Yes	No	No	Yes	No	No	No
Guam	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR
Hawaii	No	No	No	No	No	No	No	No	No	No
Idaho	No	No	No	No	No	No	No	No	No	No
Illinois	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indiana	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iowa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kansas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kentucky	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Louisiana	No	No	No	Yes	No	No	Yes	No	No	No
Maine	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maryland	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Massachusetts	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Michigan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minnesota	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mississippi	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Missouri	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Montana	No	No	No	No	No	No	No	No	No	No
Nebraska	NCR	No	Yes	Yes	No	No	Yes	No	No	No
Nevada	Yes	No	No	No	No	No	Yes	Yes	No	No
New Hampshire	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New Jersey	No	No	No	Yes	No	No	No	No	No	Yes
New Mexico	NCR	No	NCR	No	No	NCR	Yes	Yes	No	No
New York	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
North Carolina	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
North Dakota	NCR	No	NCR	No	No	No	No	No	No	No
Northern Mariana Isl.	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR
Ohio	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oklahoma	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oregon	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pennsylvania	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Puerto Rico	No	No	No	No	NCR	No	NCR	NCR	NCR	NCR
Rhode Island	No	No	No	No	No	No	No	No	No	No
South Carolina	No	Yes	No	Yes	Yes	No	Yes	No	No	Yes
South Dakota	No	Yes	Yes	Yes	Yes	NCR	Yes	No	NCR	NCR
Tennessee	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Texas	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
U.S. Virgin Islands	NCR	NCR	NCR	NCR	NCR	NCR	NCR	NCR	No	NCR
Utah	No	No	No	No	No	No	No	No	No	No
Vermont	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Virginia	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Washington	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
West Virginia	Yes	No	No	No	No	No	No	No	No	No
Wisconsin	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wyoming	No	No	No	Yes	No	No	Yes	No	No	No

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

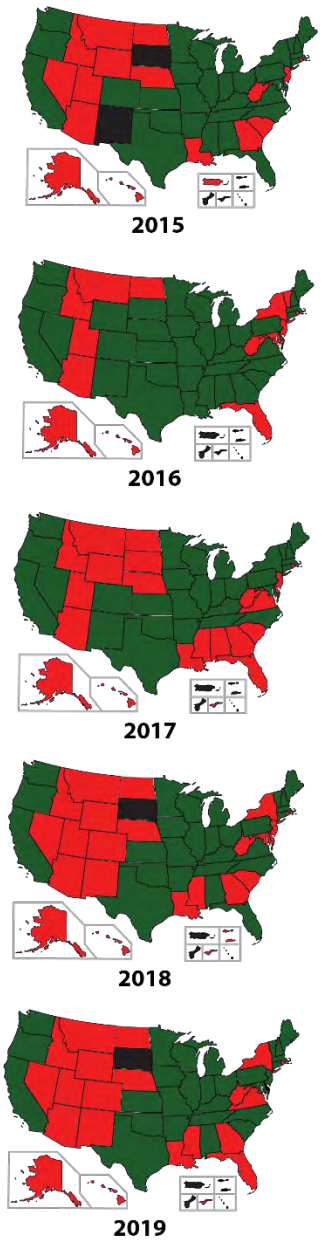


Figure 12: States with Companies Reporting RAS Use by Construction Season, 2015–2019

RAS Use in Each State

Table 10 shows states where asphalt pavement mixture producers reported using RAS in 2010 through 2019, and Figure 12 shows states where producers reported using RAS from 2015 through 2019. Red indicates a state where RAS use was not reported for that construction season. The number of states where producers reported using RAS increased annually from 22 in 2009 to 38 in 2013, but decreased to 34 in 2014, 32 in 2015, 29 in 2017 and 27 in 2018. During the 2019 construction season, asphalt mixture producers in 28 states report RAS use. New Jersey producers for the first time since the 2013 survey reported using RAS, while reporting that RAS is only allowed in some DOT mixtures.

RAS Stockpiles

In 2019, 87 percent of the 46 producers using RAS reported having inventories of stockpiled RAS, compared to 99 percent of the 67 producers using RAS in 2018. Some 1.143 million tons of RAS was reported as stockpiled at year-end 2019, a (16.5 percent) decrease from the 1.368 million tons of RAS in stockpiles at the end of 2018. The reported RAS stockpiled represents about 1.2 years of inventory at 2019 utilization levels.

Table 11: Reported Tons of RAS Stockpiled, 2018–2019

State	Reported Tons Stockpiled (Thousands)		Estimated Tons Stockpiled (Thousands)		State	Reported Tons Stockpiled (Thousands)		Estimated Tons Stockpiled (Thousands)	
	2018	2019	2018	2019		2018	2019	2018	2019
Alabama	40.5	15.0	54.3	30.5	Montana	*	*	*	*
Alaska	*	*	*	*	Nebraska	4.4	*	22.0	*
American Samoa	*	*	*	*	Nevada	*	*	*	*
Arizona	0.0	0.0	0.0	0.0	New Hampshire	0.0	*	0.0	*
Arkansas	33.0	10.8	57.5	28.1	New Jersey	0.0	0.0	0.0	0.0
California	10.0	3.3	25.6	10.9	New Mexico	0.0	*	0.0	*
Colorado	7.2	0.0	28.1	0.0	New York	0.0	0.0	0.0	0.0
Connecticut	0.1	0.2	0.2	0.4	North Carolina	131.3	115.5	364.7	224.4
Delaware	*	NCR	*	NCR	North Dakota	*	*	*	*
District of Columbia	*	*	*	*	No. Mariana Isl.	NCR	NCR	NCR	NCR
Florida	1.0	0.0	1.6	0.0	Ohio	30.2	24.4	41.5	42.4
Georgia	0.0	*	0.0	*	Oklahoma	52.5	5.0	112.2	14.1
Guam	NCR	NCR	NCR	NCR	Oregon	1.9	1.0	4.5	2.8
Hawaii	0.0	0.0	0.0	0.0	Pennsylvania	33.9	5.0	107.6	39.7
Idaho	0.0	0.0	0.0	0.0	Puerto Rico	NCR	NCR	NCR	NCR
Illinois	1.0	0.2	3.9	1.8	Rhode Island	*	*	*	*
Indiana	9.0	16.5	13.6	47.1	South Carolina	2.5	7.0	4.6	18.7
Iowa	14.5	6.2	30.6	25.1	South Dakota	NCR	NCR	NCR	NCR
Kansas	2.0	*	2.1	*	Tennessee	9.6	8.5	15.0	10.4
Kentucky	15.3	40.0	18.9	96.5	Texas	15.0	42.0	77.9	286.5
Louisiana	0.0	0.0	0.0	0.0	U.S. Virgin Isl.	*	NCR	*	NCR
Maine	*	*	*	*	Utah	0.0	0.0	0.0	0.0
Maryland	3.0	7.0	4.6	29.6	Vermont	*	*	*	*
Massachusetts	25.0	22.2	32.5	68.3	Virginia	0.0	0.0	0.0	0.0
Michigan	1.5	1.0	2.4	1.9	Washington	7.2	3.5	7.7	5.0
Minnesota	25.0	12.6	38.5	24.6	West Virginia	0.0	0.0	0.0	0.0
Mississippi	0.0	0.0	0.1	0.0	Wisconsin	129.4	46.2	175.8	63.9
Missouri	42.4	42.5	72.5	105.9	Wyoming	*	*	*	*
					Total[†]	666.4	437.9	1,368.2	1143.0

NCR No Companies Responding
* Fewer than 3 Companies Reporting
[†] Includes Values from States with Fewer than 3 Companies Reporting

Table 11 shows the reported and estimated amount of RAS stockpiled in each state at the end of the 2018 and 2019 construction seasons. To calculate the estimated values, reported tons of RAS stockpiled were divided by the ratio of total reported tons of mix produced to estimated tons of mix produced. The total tonnage row in Table 11 includes stockpiled tonnages from states with fewer than three producers reporting.

RAS Recycling Agent Use

Table 12 shows the percentage of reported tons of RAS-containing mixtures produced using softer binder or recycling agents in each state. **These results are representative *only* of the survey participants and do not completely reflect practices in a given state.** Similar to the RAP, there does not appear to be a relationship between the amount of RAS mixtures using softer binder and/or recycling agents and percentage of RAS used by the state.

Table 12: Percentage of RAS Mixtures Using Softer Binder and/or Recycling Agents in Each State, 2019

State	Softer Binder	Recyc. Agent	State	Softer Binder	Recyc. Agent	State	Softer Binder	Recyc. Agent
Alabama	8%	1%	Kentucky	10%	0%	Ohio	33%	0%
Alaska	*	*	Louisiana	0%	0%	Oklahoma	100%	50%
American Samoa	*	*	Maine	*	*	Oregon	0%	75%
Arizona	0%	0%	Maryland	18%	0%	Pennsylvania	0%	0%
Arkansas	2%	13%	Massachusetts	18%	0%	Puerto Rico	NCR	NCR
California	15%	0%	Michigan	100%	0%	Rhode Island	*	*
Colorado	0%	0%	Minnesota	25%	0%	South Carolina	0%	0%
Connecticut	0%	0%	Mississippi	0%	0%	South Dakota	NCR	NCR
Delaware	NCR	NCR	Missouri	45%	5%	Tennessee	0%	50%
Dist. of Columbia	*	*	Montana	*	*	Texas	13%	0%
Florida	0%	0%	Nebraska	*	*	U.S. Virgin Isl.	NCR	NCR
Georgia	*	*	Nevada	*	*	Utah	0%	0%
Guam	NCR	NCR	New Hampshire	*	*	Vermont	*	*
Hawaii	0%	0%	New Jersey	0%	0%	Virginia	0%	0%
Idaho	0%	0%	New Mexico	*	*	Washington	37%	5%
Illinois	0%	0%	New York	0%	0%	West Virginia	0%	0%
Indiana	10%	0%	North Carolina	75%	0%	Wisconsin	75%	0%
Iowa	0%	0%	North Dakota	*	*	Wyoming	*	*
Kansas	*	*	No. Mariana Isl.	NCR	NCR			
						Average, When Used[†]	20%	8%

NCR No Companies Responding for the State to the Survey

* Fewer than 3 Companies Reporting

[†] Includes Values from States with Fewer than 3 Companies Reporting

Although the data is highly dependent upon the companies responding to the survey each year, in states where RAS is reportedly used, the average percentage of RAS mixtures incorporating softer binders was 26 percent during the 2019 construction season, while the percentage of RAS mixtures incorporating recycling agents was at 9 percent. In 2018, producers reported a higher average percentage (35 percent) of RAS mixtures incorporating softer binders and a higher average percentage (11 percent) of RAS mixtures incorporating recycling agents, than in the 2019 construction season.

The Importance of Engineering Recycled Asphalt Mixtures for Quality

For more than three decades, two guiding principles of asphalt recycling have been: asphalt mixtures containing recycled materials should 1) meet the same requirements as asphalt mixtures with all virgin materials, and 2) perform equal to or better than asphalt mixtures with all virgin materials. This is at the heart of the "Three E's of Recycling," which state that recycled materials should provide Environmental, Economic, and Engineering benefits.

Quality recycled mixtures have been successfully designed and produced for many years. When successfully engineered, designed, produced, and constructed, the proof is in performance. A recent study comparing the performance of recycled versus virgin mixtures based on Long-Term Pavement Performance (LTPP) data from 16 U.S. states and two Canadian provinces shows that overlays containing at least 30 percent RAP performed equal to overlays using virgin mixtures (Carvalho et al., 2010; West et al., 2011). At the NCAT Test Track, test sections containing 50 percent RAP using Superpave mixture design procedures for each layer outperformed companion test sections with all virgin materials in all pavement performance measures.

However, as the amount of recycled materials in asphalt pavement mixtures increase, additional considerations for material handling, engineering, mixture design, quality, and performance testing become more important. In particular, RAP and RAS should be tested and classified to determine the amount, properties, and quality of available asphalt binder. The absorbability of RAP aggregate should also be tested and determined. These values have an impact on pavement performance and are important to assess when developing a high recycled content mixture design. In some cases, it may be necessary to make use of recycling agents or a softer asphalt binder to ensure the final mixture design delivers the desired level of product performance.

For more information about processing and using reclaimed asphalt pavement and recycled asphalt shingles, consult the NAPA publication *Best Practices for RAP and RAS Management* (Quality Improvement Series 129).

Cost Savings from RAP and RAS

The use of RAP and RAS both reduce the need for virgin materials, conserving valuable asphalt and aggregates. Beyond the environmental benefits of resource preservation, the use of RAP and RAS can help lower initial material costs for road construction, allowing road owners to achieve more roadway maintenance and construction activities within limited budgets. Table 13 summarizes the individual and cumulative savings from the use of RAP and RAS in asphalt mixtures realized during the 2019 construction season. In total, the use of RAP and RAS saved more than $3.3 billion during the 2019 construction season compared to the use of all virgin materials. This is $484 million more than in 2018 due primarily to increases in asphalt binder and aggregate prices (Table 14).

Table 13: Material Savings, 2018–2019

Material	Material Quantity, Million Tons		% Agg.	% AC	Aggregate Cost Savings, $ Billion		Asphalt Binder Cost Savings, $ Billion		Total Cost Savings, $ Billion	
	2018	2019			2018	2019	2018	2019	2018	2019
RAP	82.2	89.2	95	5	$0.822	$0.916	$1.981	$2.375	$2.803	$3.291
RAS	1.053	0.921	50*	20	$0.006	$0.005	$0.101	$0.098	$0.107	$0.103
Total					$0.828	$0.921	$2.082	$2.473	$2.910	$3.394

* Includes granules and mineral filler

The estimated savings shown in Table 13 were based on the cost factors shown in Table 14. Asphalt binder prices were estimated based upon an average of publicly available 2019 asphalt price indexes for 37 states (see Figure 14). The average price of unmodified asphalts from these states for 2019 was about $500.38 per ton, up from the 2018 average price of $468.93. Five of the states (Alabama, Florida, Louisiana, Tennessee, and Virginia) also provide price indexes for modified asphalts. The average modified asphalt prices from these states for 2019 was $646.63 per ton, up from $595.98

in 2018. Assuming 10 percent of asphalt mixtures use modified asphalt binders, the 2019 average price of asphalt binders used in asphalt mixtures was $532.46 per ton, up 10.5 percent from 2018.

Most asphalt mixtures today use crushed stone as the primary aggregate, but they often include a small percentage of natural sand. The U.S. Geological Survey (USGS) reports the average price of Stone (Crushed) increased to $11.12 per ton and Sand and Gravel (Construction) decreased to $8.01 per ton for 2019 (USGS, 2020). Assuming the average asphalt pavement mixture contains 10 percent natural sand and 90 percent crushed stone, the average price of aggregate in an asphalt mixture was $10.81 per ton for the 2019 construction season, up 2.8 percent from 2018.

Table 14: Material Cost Factors, 2016–2019

Material		% of Market	Cost/Ton			
			2016	2017*	2018*	2019
Asphalt	Unmodified	90	$333.46	$361.93	$468.93	$500.38
	Modified	10	$466.16	$480.04	$595.98	$646.63
	Weighted Average		$346.73	$390.44	$481.90	$532.46
Aggregate	Crushed Stone	90	$10.11	$10.39	$10.76	$11.12
	Sand and Gravel	10	$7.77	$7.84	$8.29	$8.01
	Weighted Average		$9.88	$10.13	$10.51	$10.81

*2017 and 2018 aggregate cost per ton values updated from Williams et al. (2019) to reflect updated USGS (2020) data.

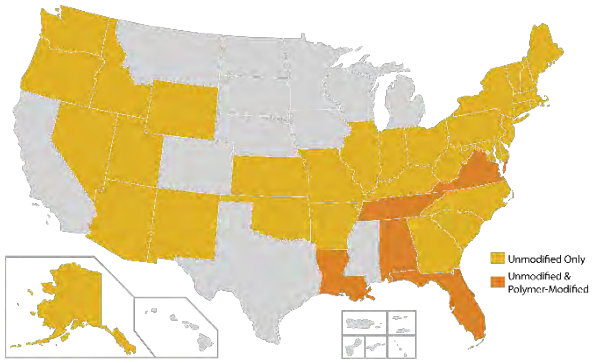


Figure 13: States With Publicly Available Asphalt Price Indexes, 2019

Minor additional cost savings, not calculated for this report, are associated with the use of RAS in stone-matrix asphalt and other specialty asphalt mixtures where shingle fibers may potentially replace mineral or cellulose fibers.

Additional cost savings are realized by diverting RAP and RAS from landfills. The national average gate fee for disposing of mixed construction and demolition (C&D) material in landfills is relatively close to the national average for municipal solid waste (MSW) landfill disposal (Tolaymat et al., 2017). Based upon a 2019 national average for MSW landfill gate fees of $55.36 per ton, not sending more than 97 million tons of RAP and RAS to landfills (nearly 60 million cubic yards of material) saved more than $5.3 billion dollars in gate fees, up from nearly $4.4 billion in 2018, due in part to a 5.2 percent increase in MSW gate fees from 2018 to 2019 (Kanter & Staley, 2019).

Warm-Mix Asphalt Technology

Table 4 includes the national summary of WMA technology usage data from the 2018 and 2019 construction season surveys. The information requested in the survey is detailed in Appendix A and summarized in Table A1, Section 4. State-level data is reported in Appendix B. Producers were also asked about the different WMA technologies used.

Prior to the 2018 construction season, producers were asked to report primarily the use of WMA technologies to reduce production temperatures by at least 10°F from typical mixture production temperatures. However, because of potential compaction, antistrip, and workability benefits, the use of WMA technologies at HMA temperatures is common. To better understand the use of WMA technologies at different temperatures, the 2018 and 2019 construction season surveys asked additional questions to ensure disaggregation of WMA technology use at different temperatures. The results indicate that prior survey reports have better captured the use of WMA technologies than the use of WMA technologies at reduced temperature. Table 4 and this section report both aggregated data on the use of WMA technologies and disaggregated data on its use by mixture temperature where possible.

The percentage of companies reporting the use of WMA technologies saw rapid increases from the 2009 to 2011 construction seasons, but has gradually declined from 78 percent of respondents in 2015 to 62 percent of respondents in the 2019 construction season, as shown in Figure 15. Increases in tonnage with WMA technologies as a percent of total tonnage have generally plateaued between 2013 and 2016, as seen in Figure 16. The 2019 construction season had a 4 percent increase in the production of asphalt with WMA technologies to 164.5 million tons, 38.9 percent of total asphalt pavement tonnage. A total of 130 companies, 62 percent of respondents, reported using WMA technologies during the 2019 construction season.

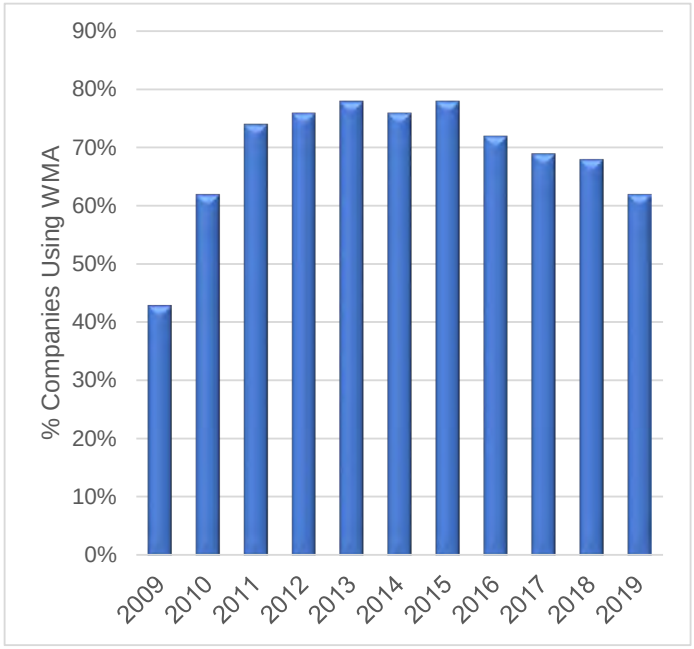


Figure 14: Percent of Companies Using WMA Technologies

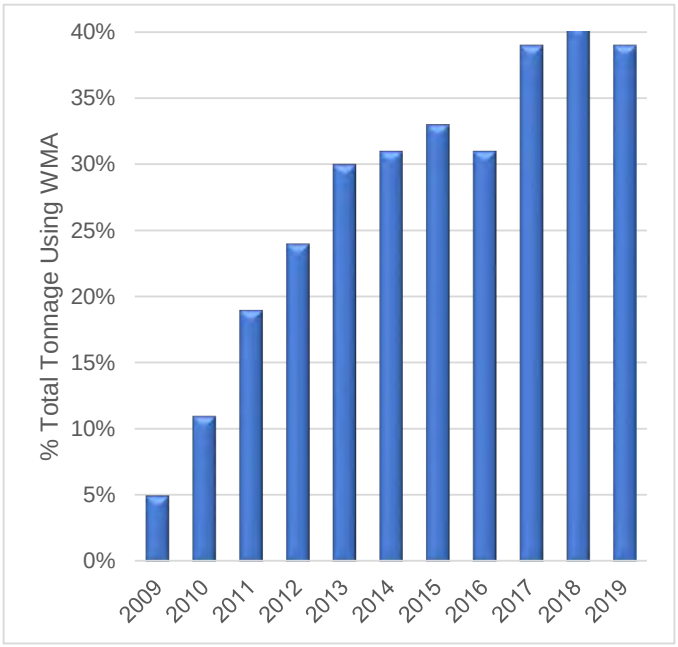
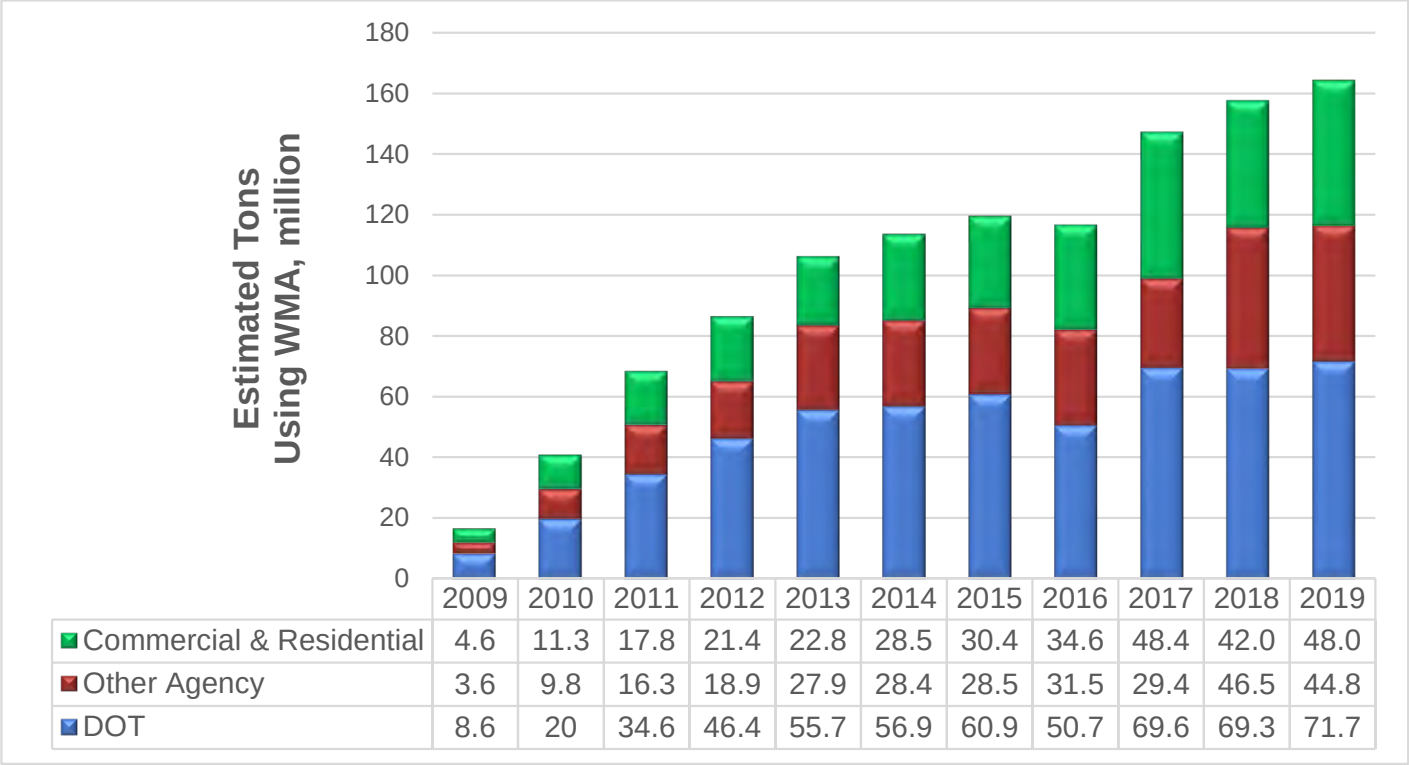


Figure 15: Percent Total Tonnage Produced Using WMA Technologies

WMA Technology Use by Sector

Figure 16 shows a steady increase in the number of tons of mixture produced using WMA technologies for each customer sector from 2011 to 2013, with use showing minor changes for the 2014 though 2016 construction seasons. In 2017, however, WMA technology use grew substantially due to notable increases in mixtures produced for the DOT and Commercial & Residential sectors. During 2018, growth in tonnage produced with WMA technologies was driven largely by a 58 percent increase in tons produced for the Other Agency sector. In 2019, tons produced with WMA technology in the Other Agency sector was down 3.7 percent, while the DOT sector was up 3.5 percent and the Commercial & Residential sector was up 14.3 percent from the 2018 construction season. All in all, during the 2019 construction season, 43.5 percent of all DOT sector tonnage, 40.6 percent of Other Agency sector tonnage, and 32.7 percent of Commercial & Residential sector tonnage was produced using WMA technologies.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Commercial & Residential	4.6	11.3	17.8	21.4	22.8	28.5	30.4	34.6	48.4	42.0	48.0
Other Agency	3.6	9.8	16.3	18.9	27.9	28.4	28.5	31.5	29.4	46.5	44.8
DOT	8.6	20	34.6	46.4	55.7	56.9	60.9	50.7	69.6	69.3	71.7

Figure 16: Estimated Tons (Millions) Produced With WMA Technologies by Sector, 2009–2019

WMA Technology Use in Each State

Figure 17 shows the estimated percentage of total tons produced as WMA in each state. The national trend from 2009 through 2019 shows increased tons of asphalt mixture produced with WMA technologies; however, a degree of fluctuation year-to-year is seen at the state level. The accuracy of data for individual states varies noticeably depending on the number of responses received from each state and the total number of tons represented by the respondents each year.

From 2018 to 2019, 17 states saw an increase of 10 percentage points or more in WMA production, while 19 states had a decrease of 10 percentage points or more. Eight states — California, Kansas, Maine, Nevada, North Dakota, Oregon, Vermont, and Wyoming — had an increase of 30 percentage points or more in mixture production with WMA technologies. Five states — Alabama, Illinois, Iowa, Massachusetts, and New Jersey — had a decrease of 30 percentage points or more in mixture production with WMA technologies.

Mixture production with WMA technologies made up over half of the total asphalt mixture production in 20 states during 2019, seven of these states — Kansas, Louisiana, Maine, Nebraska, Utah, Virginia, and Wyoming — reported WMA as 75 percent or more of total production in 2019. Alaska, American Samoa, Georgia, Hawaii, Montana, Rhode Island, and West Virginia had no reported asphalt production with WMA technologies in 2019.

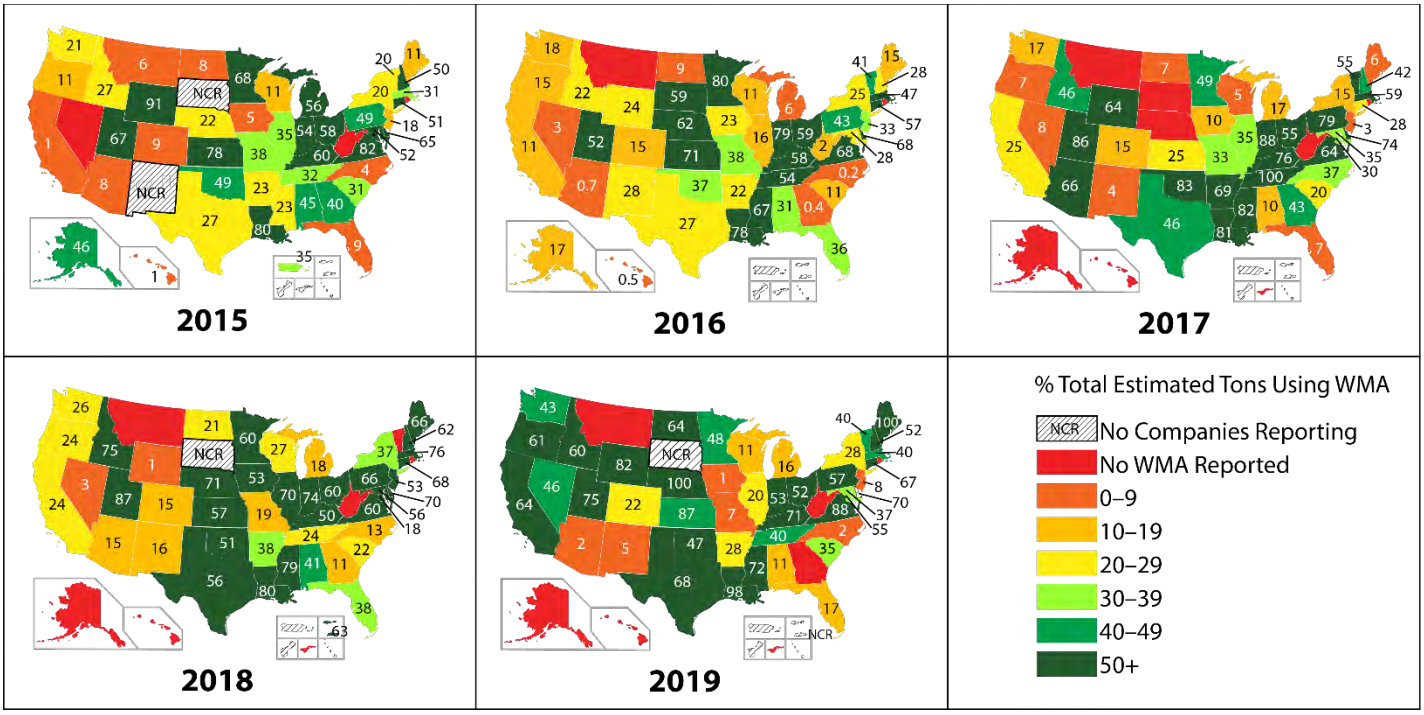


Figure 17: Estimated Percent of Total Production Using WMA Technologies in Each State, 2015–2019

WMA Technologies

As Table 15 and Figure 18 show, production plant foaming remains the most commonly used WMA production technology, being used for around 51 percent of the WMA produced in 2019. This is a decrease of about 12.2 percent from the 2018 season. However, the use of chemical additive technologies at 48.3 percent represents a 14.0 percent increase for the 2019 construction season compared to 2018. Organic additives represented 0.7 percent of the market. There was no reported use of additive foaming technologies during 2019. The percentage of WMA produced with additive technologies has grown significantly since 2011 when they made up less than 5 percent of the WMA technologies used, and plant-based foaming has seen a general decrease over the same time period.

Table 15: Percent Production of WMA Technologies, 2009–2019

WMA Technology	% Production										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Production Plant Foaming %	83.0%	92.0%	95.4%	88.3%	87.0%	84.5%	72.0%	76.9%	64.7%	63.2%	51.0%
Additive Foaming %	2.0%	1.0%	0.2%	2.0%	0.3%	0.0%	2.1%	0.0%	0.0%	0.7%	0.0%
Chemical Additive %	15.0%	6.0%	4.1%	9.4%	12.1%	15.0%	25.2%	21.1%	32.2%	34.3%	48.3%
Organic Additive %	0.3%	1.0%	0.3%	0.2%	0.0%	0.5%	0.7%	1.9%	3.1%	1.8%	0.7%

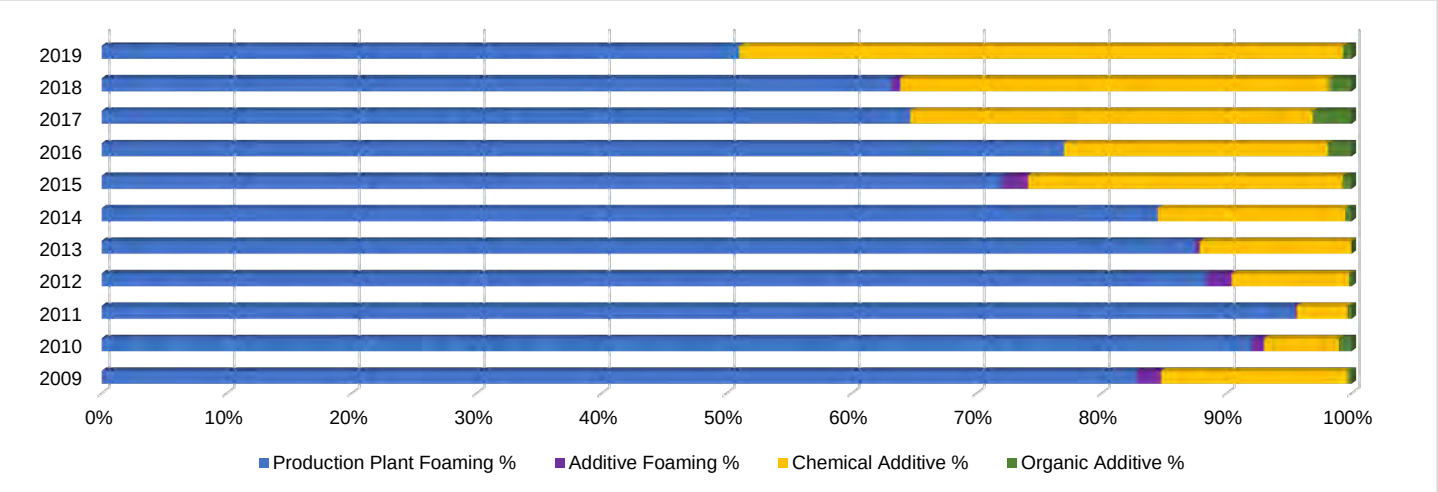


Figure 18: WMA Technologies Used as Percent of WMA Production, 2009–2019

Use of WMA Technologies at Different Temperatures

WMA additives can have compaction, workability, antistrip, and other benefits that encourage their use even when a reduction in production temperature is not sought or achieved by the producer. For this reason, producers were asked to report use of WMA technologies for asphalt production both at traditional HMA temperatures and at reduced temperatures. About 47.9 percent (78.8 million tons) of total tonnage produced using WMA technologies was produced with a temperature reduction of at least 10°F.

Of the respondents, 130 producers in 44 states, reported using WMA technologies. Of these, 63 producers reporting using WMA technologies at both reduced and HMA temperatures; 36 producers used WMA technologies only at reduced temperatures; and 31 producers reported using WMA technologies only at HMA temperatures.

Table 16 shows the percentage of reported tons produced using each WMA technologies at both reduced temperatures and at traditional HMA temperatures, along with the total tonnages produced with WMA technologies. While there is variation in the utilization of different WMA technologies at different production temperatures, producers reporting the use of WMA technologies at all temperatures typically did not report varying the technology by temperature. Therefore, much of the difference between the Reduced Temperatures and the HMA Temperatures columns in Table 16 is attributable to the technologies employed by producers that only utilize WMA technologies at either reduced temperatures or HMA temperatures.

The national average of the responses is shown in Table 16.

Table 16: WMA Technologies Utilization Detail, 2019

WMA Technology	% of Market		
	Reduced Temperatures	HMA Temperatures	At All Temperatures
Chemical Additive	43.2%	52.9%	48.3%
Plant Foaming	56.0%	46.5%	51.0%
Additive Foaming	0.0%	0.0%	0.0%
Organic Additive	0.8%	0.6%	0.7%
2018 Tons (Millions)	78.8	85.7	164.5

Energy and Greenhouse Gas Emission Benefits from WMA and RAP

Energy and greenhouse gas (GHG) emission benefits from use of WMA technologies to produce asphalt mixtures at reduced temperature and use of RAP in new asphalt mixtures are estimated to provide contextual information regarding the potential environmental impacts of these industry practices. These calculations are based on publicly available data and emission factors published by government agencies, industry, and non-governmental organizations. A detailed overview of the methodology and assumptions used to calculate energy and greenhouse gas (GHG) emission benefits is provided in Appendix C. GHG emissions are reported in metric tons (tonne) of CO_2-equivalent (CO_2e) emissions to be consistent with emission inventories published by the U.S. EPA and other government agencies.

Energy and GHG Emission Benefits from Production of WMA at Reduced Temperature

To estimate reductions in energy consumption and GHG emissions associated with the production of WMA at reduced temperature, we start by estimating the average temperature reduction achieved by plants that reduce mix production temperature when using WMA technologies. We then estimate the expected energy savings (Btu) from reduced temperature, convert that to fuel volume (natural gas), and use emission factors to estimate the combustion-related GHG emission reduction from producing WMA at reduced temperature. Two scenarios for mix production temperature were evaluated. The conservative and optimistic scenarios assume average reductions in mix production temperature of 10 °F and 40 °F, respectively.

The estimated reductions in energy consumption and GHG emissions for WMA produced at reduced temperature are provided in Table 17. The data in Table 17 are rounded to two significant digits to reflect the underlying uncertainties and approximate level of precision for these estimates. The calculated reduction of GHG emissions from production of WMA at reduced temperature is 0.05 or 0.21 million tonne for the conservative and optimistic scenarios for mix production temperature, respectively. The assumptions for the energy consumption and GHG emission reductions are explained in Appendix C.

Table 17: Estimated GHG emission reduction for three scenarios of WMA produced at reduced temperature

Scenario	Mix Production Energy Reduction (thousand MMBtu)	GHG Emission Reduction (million tonne CO_2e)	Equivalent Number of Passenger Vehicles[1]
Conservative (10° F temp Reduction)	790	0.05	11,000
Optimistic (40° F temp Reduction)	3,200	0.21	46,000

1. Assumes that each vehicle emits 4.6 tonne CO_2e/yr (U.S. EPA, 2018).

Upstream GHG emission burdens for producing WMA at reduced temperature are not included in Table 17 because either the quantity is insignificant (as is the case for foamed asphalt) or insufficient data are publicly available to confidently estimate these emission burdens (as is the case for chemical and organic additives). Considerations regarding the upstream GHG emission burdens for producing WMA at reduced temperature are provided in Appendix C.

GHG Emission Benefits from Use of RAP

A summary of GHG emission reductions and burdens from use of RAP is provided in Table 18. Net reduction of GHG emissions from use of RAP in new asphalt mixtures in 2019 is estimated to be 2.4 million tonne CO_2e, equivalent to the annual emissions from approximately 520,000 passenger vehicles. The data in Table 18 are rounded to two significant digits to reflect the underlying uncertainties and approximate level of precision for these estimates. The underlying assumptions for calculating the GHG emission reductions and burdens from use of RAP in new asphalt mixtures are explained in Appendix C.

Table 18: Summary of GHG Emission Reductions and Burdens from use of RAP in New Asphalt Mixtures in 2019 (million tonne CO_2e)

Description	GHG Reduction (Burden)
Avoided Emissions	
Asphalt Binder Replacement	2.6
Aggregate Replacement	0.36
Transportation of Asphalt Binder and Aggregates	0.46
Subtotal Avoided Emissions	**3.4**
Emission Burdens	
RAP Processing	(0.11)
Transportation of RAP	(0.90)
Subtotal Emission Burdens	(1.0)
Net GHG Emissions Reduction	**2.4**
Equivalent Number of Passenger Vehicles[1]	**520,000**

1. Assumes that each vehicle emits 4.6 tonne CO_2e/yr (U.S. EPA, 2018).

Annual and cumulative GHG emission reductions from use of RAP in new asphalt mixtures from previous years of survey data are provided in Figure 19. The cumulative reduction of GHG emissions from use of RAP in new asphalt mixtures for the period 2009-2019 is estimated to be 21.2 million tonne CO_2e.

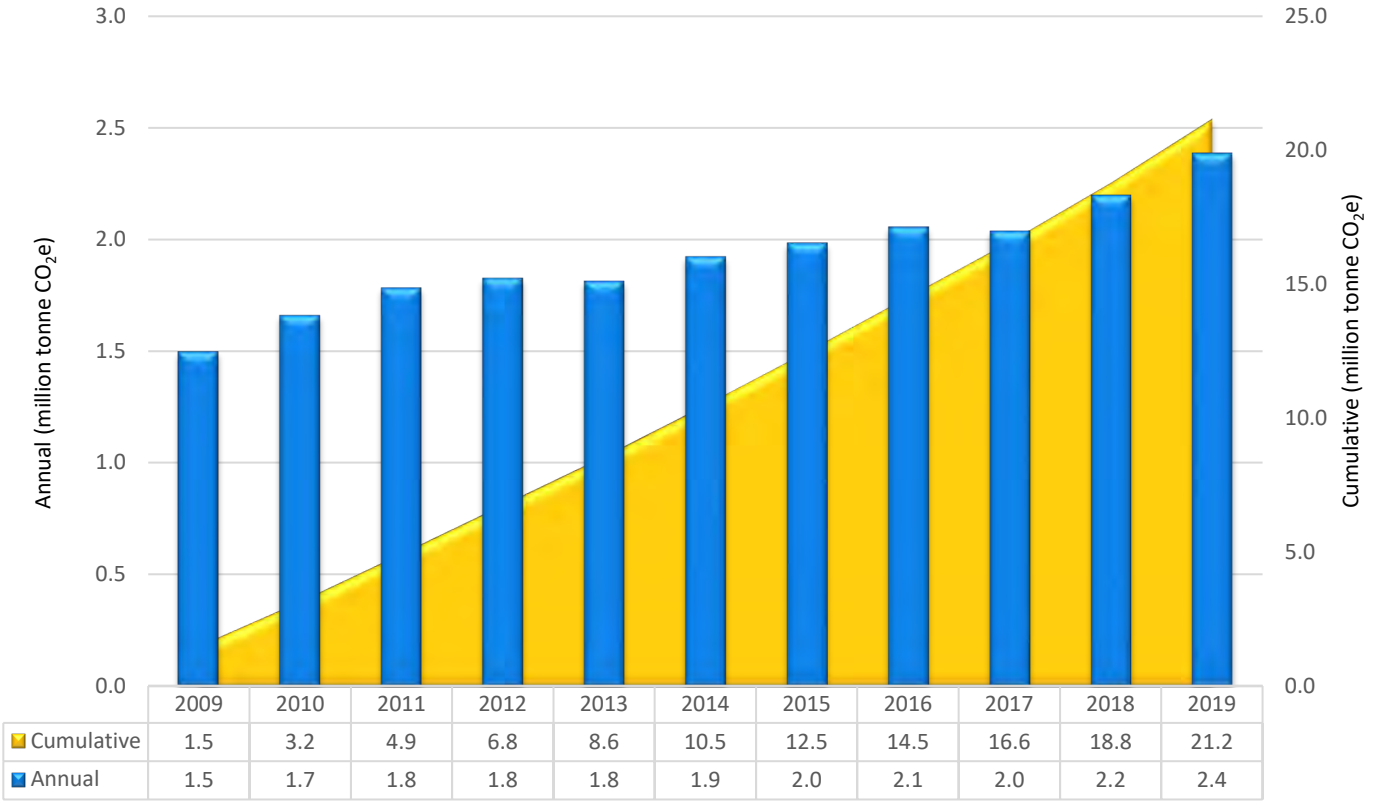


Figure 19: GHG Emissions Reduction from Use of RAP in New Asphalt Mixtures, 2009–2019

Other Recycled Materials

Starting with the 2012 construction season survey, a series of questions was asked about the use of other recycled materials in asphalt mixtures. The information requested in the survey is detailed in Appendix A and summarized in Table A1, Section 5.

Producers were asked how many tons of mixture were produced that incorporated other recycled materials, as well as how many tons of specific materials were used in mixture production during the 2019 construction season. In some cases, respondents provided only the tons of asphalt mixture produced using other recycled materials or only the tons of the other recycled materials used, not both. Four recycled materials — recycled tire rubber (RTR), steel slag, blast furnace slag, and cellulose fibers — were specifically listed in the survey. Respondents could specify up to two additional recycled materials used in mixtures.

Because the response rate to these questions about other recycled materials was expected to be low and because producers may not track the use of these materials, state and national estimates of total quantities used for these materials were not calculated. **All values in this section are reported values *only* and do not represent estimates of the total quantity of these materials used in each state or nationally.** Year-to-year variation in reported values is entirely dependent upon the makeup of the respondents to each year's survey. Where available, third-party data is referenced to provide an understanding of the estimated total usage of these materials.

A total of 52 companies from 24 states, 25 percent of survey respondents, reported using nearly 1.3 million tons of other recycled materials in more than 8.3 million tons of asphalt mixtures during the 2019 construction season.

Recycled Tire Rubber

Table 19 summarizes reported information on the use of RTR, also referred to as ground tire rubber (GTR). Fourteen producers from 10 states reported using RTR in some asphalt mixtures. Information about the use of RTR in surface treatments, such as chip seals, was not within the scope of this survey. About 58 percent of the total reported asphalt mixture tonnage produced using RTR came from California, where legislative mandates require the wide-spread use of RTR in asphalt pavements (Caltrans, 2017). The total reported tons of asphalt mixture using RTR decreased approximately 25 percent to 1,223,249 tons (about 0.29 percent of total reported tons for 2019) in the 2019 construction season survey, which aligns with the decrease in producers responding to the 2019 survey.

While the tonnage produced that incorporates RTR is relatively straightforward to track and report, the tons of RTR used is harder to document due to different methods of producing mixtures that incorporate RTR and the likelihood that RTR is either preblended with binder at the terminal or blended onsite by a third party. Given these factors, producer reports of tons of RTR used versus tons of asphalt mixture produced using RTR were given a heightened level of scrutiny to determine if the reported data was within a reasonable range. When reported tons of RTR fell outside the expected range, producers were contacted to obtain correct values.

To give a picture of the total market size for RTR, the U.S. Tire Manufacturers Association (USTMA) reports that 24.2 percent of U.S. scrap tires were processed into an estimated 1 million tons of RTR in 2017. Of this, about 11.7 percent (118,900 tons) of RTR was used in asphalt pavement mixtures and surface treatments, such as seal coats, in 2017 (USTMA, 2018). USTMA has historically conducted its scrap tire analysis biennially, but has not released a 2019 report, so there is no data for 2019; however, using the 2017 USTMA estimate, the RTR use reported by 2019 construction season survey respondents makes up nearly 13 percent of the total RTR estimated by USTMA as used in asphalt pavement mixtures and surface treatments.

Table 19: Reported Tons of Asphalt Mixtures Using Recycled Tire Rubber and Reported Tons of RTR Used, 2015–2019

State	Reported Tons of Asphalt Mixtures Using RTR					Reported Tons of RTR Used				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Arizona	11,500	273,200	242,000	342,000	251,350	100	3,412	4,600	4,303	2,554
Arkansas	—	—	—	1,000	—	—	—	—	5	—
California	936,100	1,042,976	407,500	953,444	706,014	13,514	15,840	5,765	13,412	8,587
Delaware	—	8,000	—	2,500	—	—	40	—	10	—
Florida	110,000	32,288	22,392	9,895	—	356	135	145	136	—
Georgia	—	50,000	—	63,626	6,667	—	200	—	378	33
Illinois	3,500	15,500	—	125,000	—	36	79	—	750	—
Indiana	5,000	—	—	—	—	140	—	—	—	—
Kentucky	—	—	3,000	—	1,000	—	—	20	—	5
Louisiana	—	—	5,000	—	—	—	—	35	—	—
Massachusetts	79,680	71,500	145,333	77,000	145,218	1,090	841	1,603	710	2,463
Michigan	2,780	1,350	12,500	4,500	3,500	17	0.7	125	55	5
Missouri	—	—	100,000	36,000	30,000	—	—	1,500	260	1,500
Nevada	—	—	23,000	—	—	—	—	275	—	—
New Hampshire	8,400	365	—	—	—	114	—	—	—	—
New Mexico	—	15,000	—	—	—	—	—	—	—	—
Ohio	6,000	—	6,300	—	—	60	—	65	—	—
Oregon	5,000	6,000	—	—	—	—	—	—	—	—
Pennsylvania	—	5,260	—	—	40,000	—	25	—	—	160
South Carolina	—	10,000	—	—	—	—	18	—	—	—
Tennessee	—	10,000	—	—	—	—	50	—	—	—
Texas	50,000	—	11,000	6,280	5,500	—	—	40	98	52
Utah	3,500	—	—	—	—	61	—	—	—	—
Virginia	—	—	1,200	—	34,000	—	—	13	—	156
Washington	6,500	—	—	—	—	—	—	—	—	—
Wisconsin	5,000	—	—	—	—	30	—	—	—	—
Total	1,234,960	1,541,439	974,725	1,621,245	1,223,249	17,518	20,641	14,186	20,117	15,515
No. of Companies	22	26	19	21	14					

NCR = No Companies Responding

— = No Use Reported

Steel & Blast Furnace Slag

Table 20 summarizes the reported use of steel slag and blast furnace slag in asphalt mixtures. Producers in 12 states reported using steel slag, and in seven states reported using blast furnace slag during the 2019 construction season; in seven of these states — Alabama, Illinois, Indiana, Iowa, Kentucky, Michigan, and Ohio — producers reported using both. Also reported in Table 18 is the use of foundry sand, another byproduct material generated by metal-casting processes at foundries. Not surprisingly, the reported use of slags in asphalt pavement mixtures is most common in regions with steel and iron production industries and thus a relatively available supply of slag aggregates (NSA, n.d.), as seen in Figure 20.

While the total tons of asphalt mixture and materials for each slag type vary from year to year, there was a downward trend in the reported combined use of both slags for 2014 through 2016, as illustrated in Figure 21, but rebounded significantly in 2017 and 2018. The reported slag utilization in 2019 decreased 36 percent when compared to the 2018 season, but the fluctuating number of companies reporting slag use and the specific companies that did or did not participate in each survey impact these utilization trends. While there was no reported use of foundry sand in 2019, Missouri had consistently reported the use of a modest amount of foundry sand each year prior to 2018.

The U.S. Geologic Survey estimates that about 18.7 million tons of iron and steel slag was sold in 2019, divided equally by weight between blast furnace slag and steel slag (USGS, 2020). About 14 percent of this (2.62 million tons) was estimated as used in asphalt pavement mixtures in 2017 (van Oss, 2020). With 1.24 million tons of slag materials reported as being used in asphalt mixtures during the 2019 construction season, this survey captures nearly 47 percent of total slag estimated to be used in asphalt pavement mixtures. For the states reporting slag use, slightly more than 17 percent of their total reported asphalt pavement mixture tonnage includes steel and/or blast furnace slag. According to the American Foundry Society, between 4 million and 7 million tons of foundry sand are available for recycling annually (AFS, n.d.), identifying there remains a significant potential for use in asphalt pavement mixtures in the future.

Table 20: Reported Tons for Steel Slag, Blast Furnace Slag, & Foundry Sand and Tons of Asphalt Mixture Using Each Material, 2015–2019

State & Material	Reported Tons of Mixture Using Material					Reported Tons of Material Used				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Steel Slag										
Alabama	400,000	475,000	755,764	985,000	985,015	95,000	55,000	164,229	195,500	190,252
Arkansas	229,800	60,210	49,005	148,533	63,901	60,000	9,109	10,238	26,658	5,195
Illinois	70,000	5,271	10,000	4,002	1,466	19,000	2,600	8,100	869	450
Indiana	245,000	140,000	132,500	328,214	84,997	90,000	64,000	45,929	110,777	72,937
Iowa	27,623	—	25,000	75,000	2,500	4,111	—	4,500	13,000	900
Kentucky	—	—	45,853	—	25,000	—	—	4,603	—	2,500
Michigan	1,549,291	—	367,652	1,847,249	1,400,000	225,819	—	259,252	225,818	215,000
Minnesota	268,000	134,000	140,000	115,000	102,000	37,500	17,800	28,500	20,000	15,000
Mississippi	22,803	35,000	—	5,000	36,187	3,000	500	—	250	1,394
Missouri	—	—	—	38,599	22,430				6,431	3,645
Ohio	220,000	85,000	145,868	145,000	155,000	40,000	18,000	30,556	30,000	32,000
Tennessee	40,000	—	—	30,000	—	8,000	—	—	3,000	—
Washington	305,000	—	413,000	395,000	367,000	56,700	—	53,300	48,000	36,000
Total	3,382,517	934,481	2,064,642	4,116,597	3,245,496	639,130	167,009	609,207	680,303	575,273
No. of Companies	19	12	18	23	14					
Blast Furnace Slag										
Alabama	15,000	210,000	177,933	375,000	252,653	10,000	30,000	39,379	85,500	54,530
Illinois	20,000	—	—	—	505	15,000	—	—	—	100
Indiana	—	1,007,000	1,001,700	1,660,356	972,970	—	179,900	336,413	548,431	319,465
Iowa	—	—	—	—	1,000	—	—	—	—	350
Kentucky	100,000	500,000	600,000	150,000	80,000	25,000	80,000	100,000	30,000	20,000
Michigan	500,000	—	393,239	470,015	319,449	2,000	—	156,741	110,220	116,670
Mississippi	—	—	11,534	—	—	—	—	1,150	—	—
Missouri	—	—	—	1,630	—	—	—	—	489	—
Ohio	884,000	696,219	660,395	595,263	623,238	208,268	176,333	164,861	149,580	155,758
Tennessee	—	—	—	60,000	—	—	—	—	6,000	—
West Virginia	748,922	695,572	150,000	1,052,500	—	183,357	100,987	22,500	137,958	—
Wisconsin	5,500	—	—	—	—	795	—	—	—	—
Total	2,273,422	3,108,791	2,994,801	4,364,764	2,249,815	444,420	567,220	821,044	1,068,178	666,873
No. of Companies	12	13	13	18	14					
Foundry Sand										
Missouri	10,000	15,960	10,000	—	—	500	1,596	1,000	—	—
Texas	—	—	—	50,000	—	—	—	—	4,800	—

— = No Use Reported

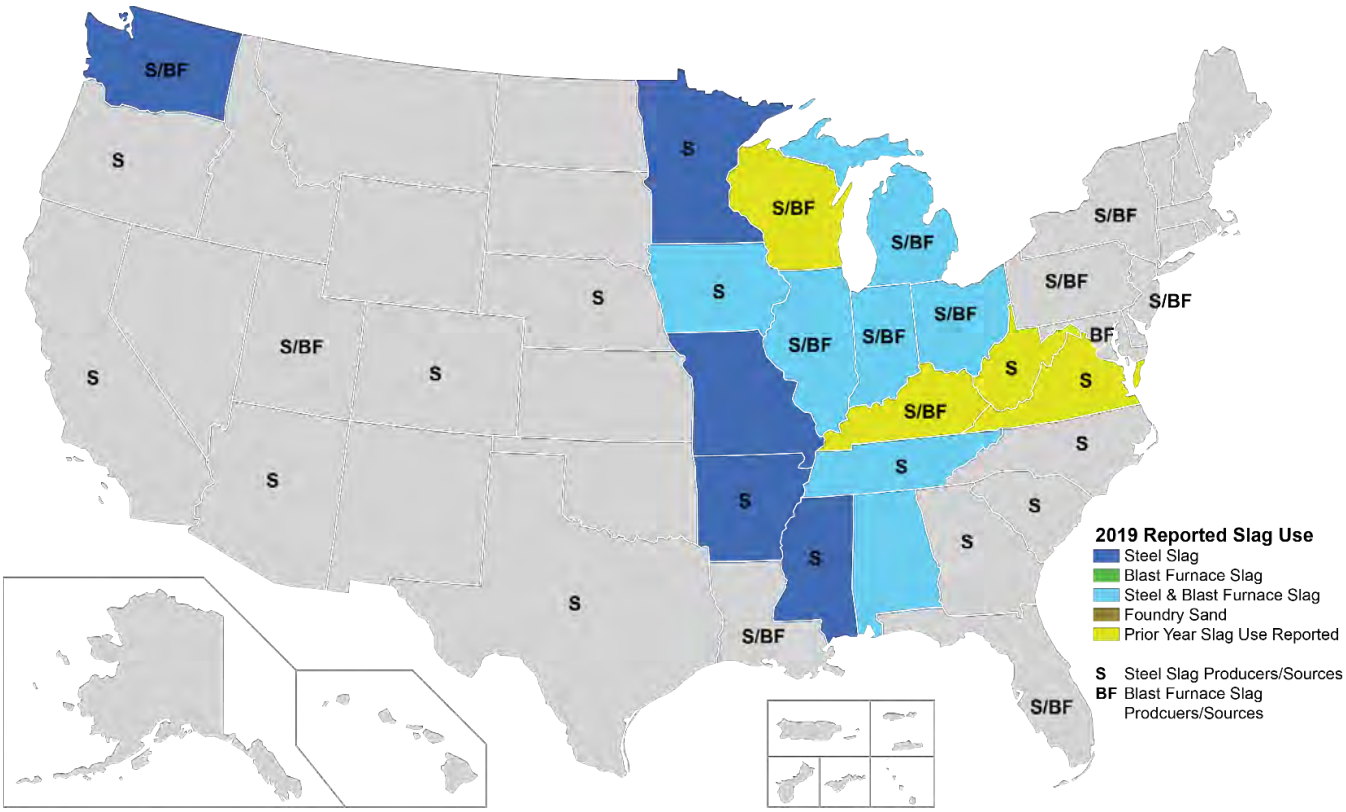


Figure 20: States Reporting Steel and/or Blast Furnace Slag Use and Slag Producers/Sources, 2019

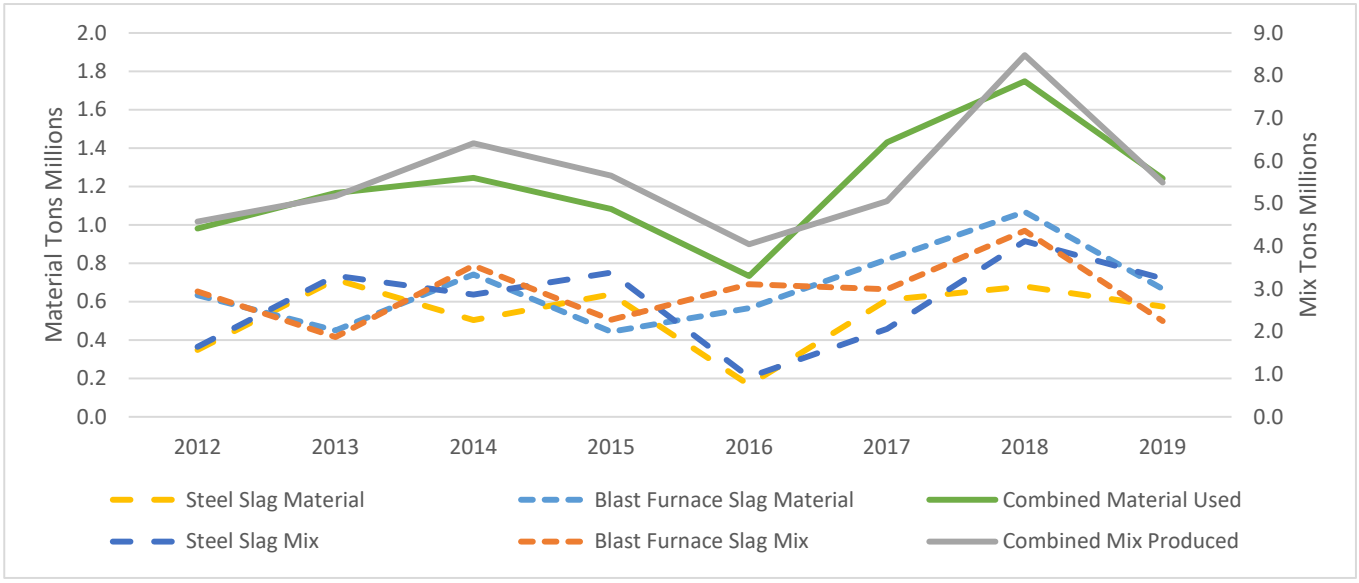


Figure 21: Steel and Blast Furnace Slag Use, 2012–2019

Recycled Fibers

Table 21 summarizes the use of various types of recycled fibers used in asphalt mixtures. For the 2019 construction season, producers only reported using recycled cellulose fibers. In 2016 a small amount of recycled poly fibers were reported. The reported use of cellulose fiber increased significantly beginning in 2015, due to the specific request for data about cellulose fiber starting with the 2015 construction season survey. As explained in Appendix A, in previous years, reporting data about cellulose fiber use was at the discretion of the respondent. During the 2019 construction season, producers from 16 states reported using more than 3,600 tons of recycled fibers in nearly 1.4 million tons of asphalt pavement mixture.

Table 21: Recycled Fibers, 2015–2019

State & Material	Reported Tons of Mixture Produced Using Recycled Fibers*					Reported Tons of Other Recycled Fibers*				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Cellulose Fibers										
Alabama	100,000	—	193,268	196,000	4,232	500	—	720	655	18
Alaska	1,000	—	—	—	—	—	—	—	—	—
Arkansas	—	—	—	250	—	—	—	—	1	—
California	—	—	—	36,865	33,621	—	—	—	55	109
Connecticut	—	—	—	500	—	—	—	—	2	—
Delaware	—	20,000	—	12,000	—	—	60	—	36	—
Dist. of Columbia	—	—	—	1,006	28,000	—	—	—	5	100
Florida	92,000	94,903	165,863	193,450	35,500	147	71	663	362	124
Georgia	—	—	—	370,934	304,877	—	—	—	1,170	1,045
Idaho	—	—	—	1,500	—	—	—	—	5	—
Illinois	126,150	—	—	—	—	240	—	—	—	—
Indiana	22,000	—	—	—	—	1	—	—	—	—
Kentucky	—	—	—	35,000	—	—	—	—	105	—
Louisiana	22,260	—	—	—	—	45	—	—	—	—
Maryland	85,000	100,000	125,000	138,000	—	230	300	373	414	—
Massachusetts	—	2,000	—	—	—	—	3	—	—	—
Michigan	—	—	145,200	151,728	152,865	—	—	84	231	174
Minnesota	—	—	—	14,000	12,000	—	—	—	22	100
Mississippi	—	53,998	40,173	60,000	133,236	—	153	121	400	513
Missouri	56,000	—	60,000	136,000	36,458	100	—	180	3,108	166
New Jersey	5,000	—	—	—	—	—	—	—	—	—
New York	1,605	1,640	—	500	1,160	—	9	—	1	5
North Dakota	—	65,000	—	—	—	—	195	—	—	—
Ohio	10,220	3,000	6	16,750	1,350	90	—	0	50	3
Oregon	20,000	—		—	50,000	8	—		—	165
Pennsylvania	12,952	45,000	21,000	84,300	17,717	—	90	88	211	52
South Carolina	20,000	—	—	—	—	—	—	—	—	—
Tennessee	175,940	127,845	113,000	27,000	—	80	201	300	180	—
Texas	50,300	—	20,000	79,700	215,000	15	—	60	554	235
Utah	—	122,317	120,696	149,135	277,000	—	570	336	746	530
Virginia	61,000	30,000	—	116,000	90,000	183	90	—	348	271
Washington	—	—	—	5,000	—	—	—	—	100	—
Carbon Fibers										
Washington	—	—	—	2,000	—	—	—	—	50	—
Poly Fibers										
Maine	—	—	—	—	—	—	2	—	—	—
New Hampshire	—	—	—	—	—	—	5	—	—	—
Vermont	—	—	—	—	—	—	3	—	—	—
Total	861,427	665,703	1,004,206	1,825,618	1,393,016	1,643	1,754	2,925	8,761	3,610
No. of Companies	18	28	20	43	28					

*Not all producers reporting tonnages of mixtures using other recycled materials provided quantities of recycled materials used and vice versa.
NCR = No Companies Responding; — = No Use Reported

Coal Combustion Products

Several waste and by-products associated with the burning of coal to produce electricity, including fly ash, bottom ash, boiler slag and flue-gas desulfurization (FGD) materials, are used in asphalt pavement mixtures as a cost-effective mineral filler that can help increase mixture stiffness and reduce asphalt drain down. In the 2019 construction season survey, fly ash was the only of these coal combustion products (CCP) reported as being used, as shown in Table 22. In previous survey years, limited use of bottom ash was reported in 2012 in South Dakota and in 2015 in Texas.

To give a picture of the total use of CCP in asphalt pavement mixtures, the American Coal Ash Association found that some 10,424 tons of fly ash, no bottom ash, no boiler slag, and 173 tons of FGD material from dry scrubbers were used as mineral filler in asphalt in 2018 (ACAA, 2019). Assuming utilization of CCP in asphalt pavement mixtures remained steady,[1] fly ash usage reported for the 2019 construction season survey is about 100 percent of total fly ash used as a mineral filler in asphalt pavements; however, only a very small amount (0.029 percent) of the 36.2 million tons of fly ash produced in 2018 was used in asphalt mixtures, according to ACAA (2019). Unlike with slags, there is no apparent correlation between the location of coal-fired power plants and the use of CCP in asphalt pavement mixtures.

Table 22: Reported Tons of Asphalt Mixtures Using Coal Combustion Products and Reported Tons of CCP Used, 2015–2019

State & Material	Reported Tons of Asphalt Mixtures Using CCP*					Reported Tons of CCP Used*				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Fly Ash										
Alabama	—	—	58,253	160,000	—	—	—	2,625	5,100	—
Georgia	—	—	—	3,068	—	—	—	—	53	—
Illinois	—	—	95,750	—	—	—	—	1,500	—	—
Michigan	50,000	—	—	—	30,000	—	—	—	—	700
Mississippi	—	19,000	141,767	—	39,687	—	750	4,253	—	1,076
Missouri	—	—	60,000	—	—	—	—	4,000	—	—
Tennessee	15,940	—	—	—	—	616	—	—	—	—
Texas	—	30,000	20,000	110,000	175,000	—	—	600	3,300	8,750
Wisconsin	102,500	160,000	40,000	60,000	—	6,150	9,500	4,000	3,600	—
Bottom Ash										
Texas	1,000	—	—	—	—	1,000	—	—	—	—
Total (All CCP)	169,440	209,000	415,770	333,068	244,687	7,766	10,250	16,978	12,053	10,526
No. of Companies	4	3	10	5	4					

*Not all producers reporting tonnages of mixtures using other recycled materials provided quantities of recycled materials used and vice versa.
NCR = No Companies Responding
— = No Use Reported

Other Recycled Materials

Table 23 summarizes other recycled materials reported as used in asphalt mixtures, none of these materials were reported for the 2019 construction season. In previous years, producers have reported the use of crushed concrete aggregate, plant start-up waste, recycled glass, and petroleum-contaminated soil in asphalt pavement mixtures.

Table 23: Other Recycled Materials, 2015–2019

State & Material	Reported Tons of Mixture Produced Using Other Recycled Material*					Reported Tons of Other Recycled Material Used*				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
Crushed Concrete Aggregates										
Florida	—	—	—	10,000	—	—	—	—	1,000	—
Petroleum-Contaminated Soil										
Massachusetts	35,000	—	—	—	—	1,050	—	—	—	—
Plant Start-Up Waste										
Missouri	—	—	—	15,000	—	—	—	—	4,000	—
Recycled Glass										
Florida	1,000	—	—	—	—	200	—	—	—	—
Total	36,000	—	—	25,000	—	1,250	—	—	5,000	—

*Not all producers reporting tonnages of mixtures using other recycled materials provided quantities of recycled materials used and vice versa.
NCR = No Companies Responding; — = No Use Reported

[1] ACAA typically reports prior-year production and usage of CCP in the fourth quarter of the following year. Therefore, in this report, ACAA CCP usage data from 2018 is compared to reported CCP usage in asphalt mix production during the 2019 construction season.

In-place Recycling

Starting with the 2019 construction season survey, a supplemental survey was conducted to gather information about the use of in-place recycling techniques. The specific in-place recycling techniques the survey asked about included cold in-place recycling, hot in-place recycling, cold central plant recycling, and full-depth reclamation techniques. The information requested in the survey is detailed in Appendix A and summarized in Table A3, Sections 1 and 2.

Contractors were asked the quantity of recycled asphalt pavement processed as part of each in-place recycling technology during the 2019 construction season. Because different units of measurement may be used for each in-place recycling technology, respondents were asked to provide both a quantity and the unit of measure, for example tons, metric tonnes, cubic yards, square yards at inches of thickness, and so forth. All values provided within this report will be in tons; respondent quantities that were provided in a unit of volume were converted to tons with a compacted unit weight of 149.3 lbs. per cubic foot.

Because the response rate to the supplemental survey on in-place recycling was low, state and national estimates of total quantities used for these materials were not calculated. **All values in this section are reported values *only* and do not represent estimates of the total quantity of these materials used in each state or nationally.**

A total of 28 companies, from three of the four User Producer Group regions, reported using more than 4.2 million tons of recycled asphalt pavement while completing the in-place recycling process during the 2019 construction season.

In-Place Recycling Use by User Producer Group Region

Figure 22 shows the total reported tons for cold in-place recycling, hot in-place recycling, cold central plant recycling, and full-depth reclamation techniques separated by User/Producer Group (UPG) region during the 2019 construction season. The North Central Asphalt User/Producer Group (NCAUPG) region had the most respondents (20 companies); the region also accounted for more than 95 percent of the in-place recycling tonnage reported for 2019. The NCAUPG region had tonnage reported for all four techniques with CIR being, 51 percent and the highest tonnage for the region. The North East Asphalt User/Producer Group (NEAUPG) had no respondents to the in-place recycling survey. The Southeastern Asphalt User/Producer Group (SEAUPG) and the combined Rocky Mountains Asphalt User/Producer Group (RMAUPG) and Pacific Coast Conference on Asphalt Specification (PCCAS) regions, had 5 and 3 companies respond respectively. The SEAUPG region had no tonnage reported for CCPR and CIR, while the combined RMAUPG and PCCAS regions had no reported tonnage for HIR and CCPR.

		(tons)			
	Companies	HIR	CCPR	CIR	FDR
NCAUPG	20	213,200	8,400	2,074,072	1,767,980
SEAUPG	5	106,400	0	0	19,431
RMAUPG/PCCAS	3	0	0	26,880	43,005
NEAUPG	NCR	NCR	NCR	NCR	NCR
2019 Totals	**28**	**319,600**	**8,400**	**2,100,952**	**1,830,416**

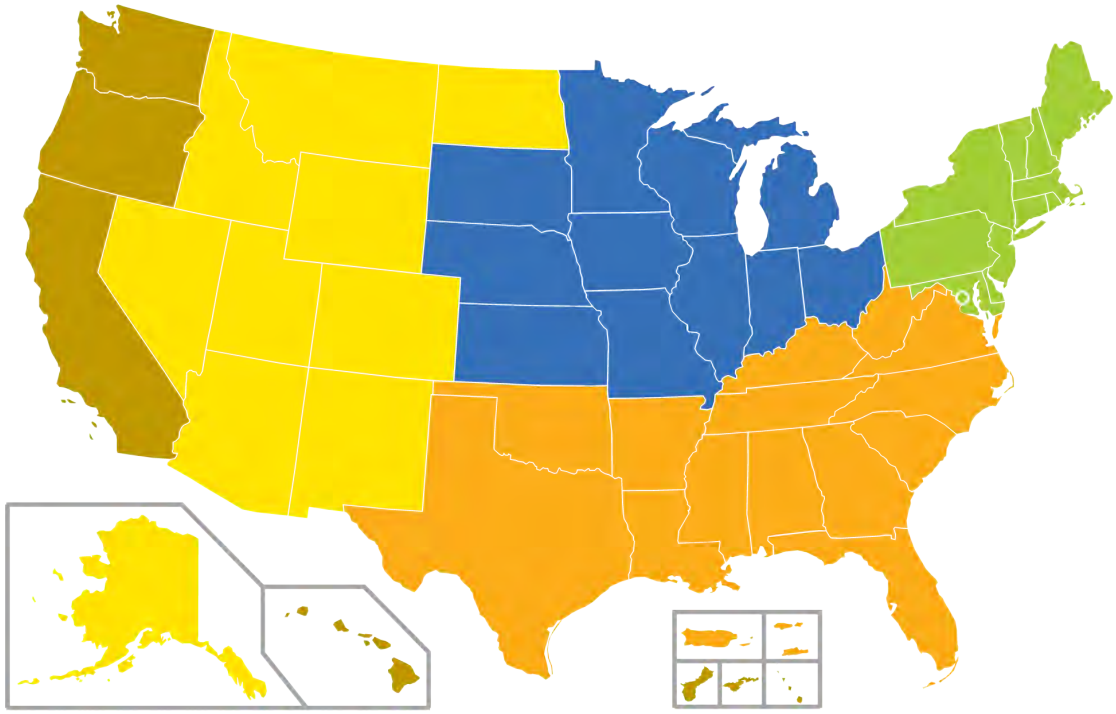


Figure 22: In-place Recycling Tonnages, 2019

Summary and Conclusions

The objective of this survey was to quantify the use of recycled materials and WMA produced by the asphalt pavement mixture production industry during the 2019 construction season. Asphalt mixture producers from 48 states, one territory, and the District of Columbia completed the 2019 survey. Responses came from 212 companies with data from 1,101 production plants. Data collected was compared to annual data from previous surveys since the 2009 construction season.

The survey findings for 2019 regarding the use of RAP, RAS, and WMA are summarized in Table 4.

Comparing the 2019 results to 2018 construction season, estimated total asphalt mixture production saw an increase from 389.3 million tons to 421.9 million tons, a 7.7 percent increase. DOT tonnage increased 2.7 percent, mixture production for the Other Agency sector increased by 5.0 percent, and the Commercial and Residential sector grew significantly (15.3 percent) for 2018 to 2019.

The use of RAP has risen dramatically since the 2009 construction season survey; 2019 saw an 8.5 percent increase over 2018.

The 2019 construction season survey shows:

Reclaimed Asphalt Pavement

- The total estimated tons of RAP used in asphalt mixtures reached 89.2 million tons in 2019. This represents a 59.3 percent increase in the total estimated tons of RAP used in 2009. During the same time frame, total asphalt mixture tonnage increased only 17.7 percent.
- The percentage of producers reporting use of RAP was 97.7 percent of respondents which is up 0.3 percent from 2018.
- The average percent RAP used by all sectors has seen variable growth from 2009 to 2018. The average estimated percentage of RAP used in asphalt mixtures has increased from 15.6 percent in 2009 to 21.1 percent in 2018 and 2019.
- Companies reporting having stockpiled RAP on hand at year-end decreased slightly from 94.5 percent in 2018 to 93.9 percent in 2019. In total, producers accepted an estimated 97.0 million tons and used an estimated 94.8 million tons in 2019.
- Reclaiming 97 million tons of RAP for future use saved about 58.9 million cubic yards of landfill space.
- The total estimated amount of RAP stockpiled nationwide at the end of the 2019 construction season was 138 million tons.
- Producers from 30 states reported fractionating RAP. Nationally, a reported 21 percent of RAP is fractionated.
- Producers from 31 states reported using softer binders and 15 states reported using recycling agents in RAP mixtures. There was little correlation between the percentage of RAP used in asphalt pavement mixtures and the use of softer binders and/or recycling agents in a given state.

Reclaimed Asphalt Shingles

- Use of both recycled MWAS and PCAS in asphalt mixtures decreased (12.3 percent) from an estimated 1.05 million tons in 2018 to 921,000 tons in 2019.
- The amount of unprocessed RAS accepted by asphalt mixture producers decreased from 890,000 tons in 2018 to 611,000 tons in 2019. An estimated 423,000 tons of processed RAS was also accepted by producers, which was about 7,000 tons less processed RAS than was accepted in 2018. The combined amount of unprocessed and processed RAS accepted in 2019 was 1.03 million tons, which was 95,000 tons more RAS than was used for all purposes during the 2019 construction season.
- Of the unprocessed RAS accepted by producers in 2019, 277,000 tons was PCAS and 334,000 tons was MWAS.
- Of the RAS used in 2019, more than 98 percent was used in asphalt mixtures. The remainder was combined with aggregates. No producers reported landfilling of RAS during the 2019 construction season.
- The percent of producers reporting use of RAS decreased from 24.6 percent of respondents in 2018 to 21.7 percent in 2019.
- The total estimated amount of RAS stockpiled nationwide at the end of the 2019 construction season was nearly 1.14 million tons.
- Accepting 611,00 tons of unprocessed RAS from both PCAS and MWAS sources diverted about 370,000 cubic yards of material from landfills.
- The number of states with producers reporting RAS use was 28 in 2019. New Jersey producers for the first time since the 2013 survey reported using RAS, while reporting that RAS is only allowed in some DOT mixtures.
- Commercial & Residential sectors allow the use of RAS in most states, with more limited use in DOT and Other Agency public sector mixtures, according to producer and SAPA reports. No states reportedly allow

the use of RAS in all mixes for all sectors, and ten states reportedly do not approve the use of RAS in asphalt pavement mixtures for any sector.

- Producers from 17 states reported using softer binders and eight states reported using recycling agents in RAS mixtures.

Material Cost Savings

- The use of RAP and RAS saved more than $3.3 billion during the 2019 construction season compared to the use of all virgin materials. This is about $484 million more savings realized than in 2018. These savings help reduce material costs for asphalt pavement mixtures, allowing road owners to achieve more roadway maintenance and construction activities within limited budgets.
- The diversion of RAP and RAS from landfills during the 2019 construction season save nearly 60 million cubic yards of space in construction and demolition landfills, as well as nearly $5.3 billion in gate fees associated with the disposal of RAP and RAS.

Other Recycled Materials

- A reported total of nearly 1.3 million tons of other recycled materials was used in nearly 8.3 million tons of asphalt mixtures by 52 companies in 24 states during the 2019 construction season.
- Fourteen producers from 10 states reported use of recycled tire rubber (RTR) in asphalt mixtures during the 2019 construction season. The total reported tons of asphalt mixture using RTR decreased 25 percent from 2018 to 1,223,000 tons in the 2019 construction season.
- Producers in 12 states reported use of steel or blast furnace slags, and no states reported the use of foundry sand in 2019. Compared to reported use in 2018, the reported tons of mixtures including steel slag and mixtures including blast furnace slag decreased 36 percent during the 2019 construction season. Reported use of these materials was concentrated along the Mississippi and Ohio River Valleys, where much of U.S. steel and iron production is concentrated.
- Producers in three states reported using fly ash in asphalt mixtures in 2019. Fly ash was the only coal combustion product (CCP) reported as being used in asphalt pavement mixtures during the 2019 construction season.
- Producers in 16 states reported use of more than 3,000 tons of recycled cellulose fiber in more than 1.3 million tons of asphalt pavement mixtures during 2019.

Warm Mix Asphalt

The use of WMA technologies continues to increase since 2009. The 2019 construction season survey shows:

- The estimated total tonnage of asphalt pavement mixtures produced with WMA technologies for the 2019 construction season was about 164.5 million tons. This was a 4 percent increase from the estimated 157.7 million tons of mixture produced with WMA technologies in 2018 and a more than 879 percent increase from the estimated 16.8 million tons in the 2009 construction season.
- Mixtures produced with WMA technologies made up 38.9 percent of the total estimated asphalt mixture market in 2019. About 47.9 percent (78.8 million tons) of these mixtures were produced with a temperature reduction of at least 10°F.
- In addition, producers using WMA technologies in seven states — Kansas, Louisiana, Maine, Nebraska, Utah, Virginia, and Wyoming — reported producing more than 75 percent of their total tonnage with WMA technologies.
- Production plant foaming, representing 51 percent of the market in 2019, remains the most commonly used warm-mix technology, despite decreasing about 44.4 percent since its peak in the 2011 construction season.

- Chemical additive technologies accounted for a little more than 48 percent of the market in 2019, an increase of 40 percent from their use in the 2018 construction season.
- An increase in the use of chemical additive WMA technologies and a decrease in plant-based foaming technologies been seen in the survey since 2011.
- There appears to be little variation in the use of WMA technology based upon production temperature.
- About 62 percent of survey respondents reported producing asphalt mixture with WMA technologies; 130 producers in 44 states reported using WMA technologies.

Conclusions

The 2019 survey results show that the asphalt pavement mixture production industry has a strong record of sustainable practices and continues to innovate through the use of recycled materials and WMA. Since the initial industry survey of the 2009 construction season, producers have significantly increased their use of recycled materials and WMA; however, since the 2013 survey, indicators are that the rate of increase of adoption has slowed.

The amount of RAP received was 2.2 million tons more than what producers utilized during the 2019 construction season, with 93.9 percent of producers indicated they have stockpiled RAP on hand. With an estimated 138.0 million tons of RAP stockpiled nationwide at year-end 2019, an 20 percent increase over year-end 2018 inventories, opportunities remain to increase the amount of RAP used in asphalt mixtures through engineering, performance-based specifications, education, improved RAP processing, production equipment, and procedures.

RAS use saw a 12.5 percent decrease in 2019 in asphalt pavement mixtures; by accepting 1.03 million tons of waste shingles during 2019, producers diverted about 7 percent of the nation's available waste shingles for use in asphalt mixtures. An estimated 1.14 million tons of RAS was stockpiled nationwide at year-end 2019. As with RAP, performance-based specifications, education, improved processing, production equipment, and procedures will help increase the amount and percentages of RAS used in asphalt mixtures.

The asphalt pavement mixture production industry repurposes many products from other industries. The survey shows that, for the 2019 construction season, slag use was reported in 12 states, RTR use was reported in 10 states, recycled cellulose use was reported in 16 states, and fly ash use in three states.

The tonnage of asphalt pavement mixtures produced with WMA technologies saw a 4 percent increase during the 2019 construction season with a total production of 164.5 million tons, which represents 38.9 percent of total estimated asphalt mixture production for the year. Producers in Alaska, American Samoa, Georgia, Hawaii, Montana, Rhode Island, and West Virginia reported not producing mixtures with WMA technologies in 2019.

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10th Annual Survey

Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2019 Appendix A

Appendix A to the tenth edition of *Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage* (Williams et al., 2020) provides details on the methodology used to collect and analyze the 2019 construction season survey data and reproduces the primary survey instruments used to collect data from asphalt pavement mixture producers and State Asphalt Pavement Associations (SAPA). Producers were asked primarily to provide company-/plant-level data, while SAPAs were asked to provide industry-level data for their state. In 2019, a supplemental survey was fielded to gather information about the use of in-place recycling techniques.

Survey Methodology

To collect and analyze the data summarized in the main *Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage* report for the 2019 construction season survey, the following tasks were conducted:

1. Develop a survey instrument that enables an analysis of the quantities of recycled materials being used in asphalt mixtures, as well as the total amount of WMA produced nationally.
2. Conduct a voluntary survey of asphalt mix producers throughout the United States and follow up via telephone, email, and in-person requests for information in locations where responses were low.
3. Estimate the total asphalt mixture market in each state or territory by using data provided by SAPAs through the survey instrument and the U.S. Department of Transportation federal-aid 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 in each state and to prepare a final report.

The survey was conducted using an online survey platform, SurveyMonkey®. Table A1 summarizes the questions asked in each section of the survey instrument. Sections 1 through 4 of the survey instrument remained consistent from the 2009 to 2014 construction seasons. Questions were added to or modified in Sections 2 through 4 for the 2015 to 2019 construction seasons to gather additional information about RAP and RAS stockpiling, fractionation, the use of softer binders and recycling agents, the acceptance of processed RAS, and the use of WMA technologies at HMA temperatures. In 2017, the Section 3 question about tons of unprocessed shingles accepted was modified to ask about the type of unprocessed shingles accepted. In 2018, the Section 4 questions about the use of WMA additives at HMA temperatures were modified to gather additional information. Section 5 was added in the 2012 construction season survey to collect information on the use of other recycled material in asphalt mixtures. Starting in 2015, the Section 5 question asking about specific recycled materials was modified to replace one user-provided response with cellulose fiber. A copy of the survey used to gather information for the 2019 construction season is provided in the Survey Instrument section of Appendix A.

Producers were notified of the survey through several forums and electronic media. Notice were placed in NAPA's e-newsletter, *ActionNews*, informing members of the survey and asking for their participation. SAPAs solicited participation by placing notices on their websites and in their newsletters. Announcements were made at NAPA meetings, as well as at several State Asphalt Pavement Association conferences. A press release was sent to construction industry trade media and was published in print and online. Notices of the survey and links were also shared through social media channels, primarily Twitter, Facebook, and LinkedIn. Follow up with producers and SAPAs was conducted via email, social media, and telephone.

Table A1: Survey Instrument Summary: Producer Questions, 2019

Section 1: General Information	Section 2: RAP	Section 3: RAS	Section 4: WMA	Section 5: Other Recycled Materials
Type of Survey Respondent	Tons RAP Accepted	Tons Unprocessed Tear-Off Shingles Accepted	Average % Produced for DOT Tons With ≥10°F Reduction	Other Recycled Materials Used (Y/N)
Contact Information	Tons Used in HMA/WMA Mixes	Tons Unprocessed Manufacturers' Waste Shingles Accepted	Average % Produced for Other Agency Tons With ≥10°F Reduction	Type of Other Recycled Materials Used (GTR, Steel Slag, Blast Furnace Slag, Cellulose Fiber, Up to Two User-Provided Responses)
State Information Is Provided for	Tons Used in Aggregate Base	Tons Processed Shingles Accepted	Average % Produced for Commercial & Residential Tons With ≥10°F reduction	Tons of HMA/WMA Produced Using Each Other Recycled Material
Number of Production Plants	Tons Used in Cold-Mix Asphalt	Tons Used in HMA/WMA Mixes	Chemical Admixture % With ≥10°F Reduction	Tons of Each Other Recycled Product Used
DOT Tons	Tons Used in Other	Tons Used in Aggregate Base	Additive Foaming % With ≥10°F Reduction	
Other Agency Tons	Tons Landfilled	Tons Used in Cold-Mix Asphalt	Production Plant Foaming % With ≥10°F Reduction	
Commercial & Residential Tons	Average % for DOT Mixtures	Tons Used in Other	Organic Additive % With ≥10°F Reduction	
	Average % for Other Agency Mixtures	Tons Landfilled	Average % Produced for DOT Tons at HMA Temperatures	
	Average % for Commercial & Residential Mixtures	Average % for DOT Mixtures	Average % Produced for Other Agency Tons at HMA Temperatures	
	Excess RAP (Y/N)	Average % for Other Agency Mixtures	Average % Produced for Commercial & Residential Tons at HMA Temperatures	
	Tons of RAP Stockpiled	Average % for Commercial & Residential Mixtures	Chemical Admixture % at HMA temperatures	
	Percentage of RAP Fractionated	Excess RAS (Y/N)	Additive Foaming % at HMA temperatures	
	Percentage of RAP Mixtures Using Softer Asphalt Binder	Tons of RAS Stockpiled	Plant Foaming % at HMA temperatures	
	Percentage of RAP Mixtures Using Recycling Agents	What Sectors Allow What Level of RAS	Organic Additive % at HMA temperatures	
		Percentage of RAP Mixtures Using Softer Asphalt Binder		
		Percentage of RAP Mixtures Using Recycling Agents		

Asphalt mixture producers then went to the SurveyMonkey website to complete the survey form. Because data was collected on a state-by-state basis, producers could complete the survey multiple times, providing information for operations in different states on each visit. Some producers submitted data through PDF versions of the survey instrument or through a Microsoft Excel spreadsheet developed by NAPA. After the initial data was gathered and analyzed, anomalies in individual producer records were identified and reconciled.

To collect industry-wide data from the SAPAs, the survey instrument included 10 questions focused on state-level information, as opposed to specific producer information. Table A2 summarizes these questions. In a handful of states without SAPAs, industry-wide data was provided by an Associated General Contractors (AGC) chapter or a similar knowledgeable source. Prior to 2018, this data was collected via a separate survey; starting in 2018, a single survey instrument was used with the first question ("Are you an Asphalt Producer, State Asphalt Pavement Association, or Other") determining whether the respondent should answer the producer or SAPA survey questions. Respondents indicating "Other" were not surveyed.

Table A2: Survey Instrument Summary: SAPA Questions, 2019

Section 1: General Information	Section 2: Tonnage	Section 3: RAP	Section 4: RAS	Section 5: Other Requirements
Type of Survey Respondent	Estimate of Total Tons Produced in State (All Sectors	Do Producers in State Fractionate RAP (Y/N)	What Sectors Allow What Level of RAS (DOT, Other Agency, Commercial & Residential)	Require, Allow, or Prohibit Use of Recycling Agents With RAP, RAS, RAP+RAS
Contact Information				What Limits the Use of RAP in Your State?
State Information Is Provided for				What Limits the Use of RAS in Your State?
				Do You Believe Increasing Utilization of Recycled Materials in Your State Is Possible? (Y/N)
				(If Yes) Two Ideas How to Increase Utilization.

Appendix B and certain tables in this report provide survey responses and estimated values at the state/territory level. To keep specific producer data confidential, no state-specific information is provided in the tables or appendixes if fewer than three producers from the state/territory responded to the survey. Information from states/territories with fewer than three responding companies is included in the estimated national values, however.

To gather information about the use of cold in-place recycling, hot in-place recycling, cold central plant recycling, and full-depth reclamation techniques, a supplemental survey was developed. All respondents to the main survey were asked to complete the supplemental survey if their company provided any in-place recycling or cold central plant recycling services. In addition to promoting the supplemental survey using the same channels as the main survey, NAPA worked with the Asphalt Recycling & Reclaiming Association (ARRA) to promote participation among its membership.

The supplemental survey was conducted using an online survey platform, SurveyMonkey®. Table A3 summarizes the six questions asked in the two sections of the survey instrument. A copy of the supplemental survey is also provided in the Survey Instrument section of Appendix A. Respondents were asked to complete separate copies of the survey for each state in which they operated. Because different units of measurement may be used for each in-place recycling technology, respondents were asked to provide both a quantity and the unit of measure, for example tons, metric tonnes, cubic yards, square yards at inches of thickness, and so forth.

Table A3: Survey Instrument Summary: Supplemental Survey on In-Place Recycling Questions, 2019

Section 1: General Information	Section 2: Total Quantities
Contact Information	Hot In-Place Recycling (HIR)
State Information Is Provided for	Cold Central Plant Recycling (CCPR)
	Cold In-Place Recycling (CIR)
	Full-Depth Reclamation (FDR)

Data Estimation Method

To determine the estimated total amount of RAP and RAS used and WMA produced nationwide and in each state/territory, the total amount of asphalt mix produced in each state/territory needed to be determined. Total tonnage of asphalt mix produced represents both commercial (i.e., private sector) and governmental (i.e., DOT and Other Agency) tonnages. Estimated tonnages for each sector were provided by SAPAs for 30 states, totaling more than 314 million tons.

To estimate the total tons in states where a SAPA estimate of total tonnage was not available, a power curve relationship based on an examination of the relationship between SAPA-estimated tons and FY2019 federal-aid highway apportionment (FHWA, 2019) for those states was determined, resulting in Equation A1. This is the same methodology used to estimate tonnage in previous versions of this survey, as detailed in Hansen & Newcomb (2011), with the formula updated annually as SAPA-reported estimates and federal apportionments for the states change.

$$\text{Total Estimated Tons} = 0.00009 \times (\text{State Federal Apportionment})^{1.2446} \quad [A1]$$

As shown in Figure A1, 40 states and territories, along with multiple counties and municipalities across the nation, have acted to raise and/or otherwise dedicate additional local funds to transportation since 2012 (T4America, n.d.; Davis, 2019; NCSL, 2019). These additional and/or dedicated funds are not accounted for in Equation A1, which can lead to underestimation of total tonnage in some states. Similarly, because federal funding for the U.S. territories is through the Territorial and Puerto Rico Highway Program instead of state apportionment, estimates for these jurisdictions were calculated using Equation A1 and Territorial and Puerto Rico Highway Program FY2019 funding levels (FHWA, 2017).

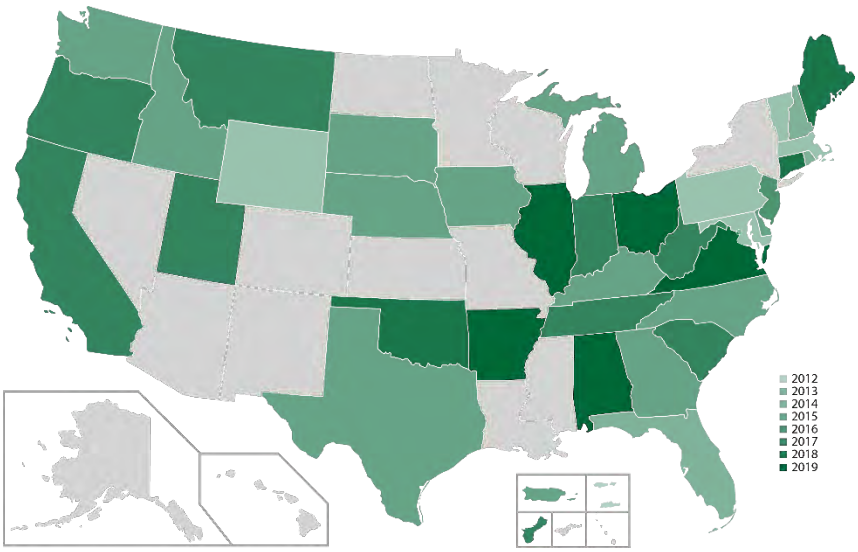

Figure A1: States Approving Measures to Increase and/or Dedicate Transportation Funding, 2012–2019

In addition, in some markets, asphalt pavement mixture may be produced in one state and placed in a neighboring state. Although producers are asked to report tonnage based upon the location where it is placed, it is possible that data about mixtures reported for one state may include data from mixtures placed in two or more states. This can lead to overreporting in one state and underreporting in another. For example, a producer in Washington, D.C., may have produced mixtures used in Virginia and Maryland too, but may report all tons produced as Washington, D.C., tonnage.

These caveats apply to the data reported in Appendix B and other state-level data included in this report; however, they have only minimal impact on the national values in the main report.

Survey Instrument

As outlined earlier, this appendix includes a copy of the survey instruments used to collect responses from participants. The majority of asphalt mixture producers participating in the survey used the online survey platform SurveyMonkey® to provide their responses. Some producers submitted their data through PDF forms or a Microsoft Excel spreadsheet developed by NAPA to collect the same information. The producer section of the survey instrument begins on page 7; the SAPA section begins on page 24. The supplemental survey begins on page 29.

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2019 Construction Season Survey Instrument — Producer Section

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Purpose

The National Asphalt Pavement Association is working with the Federal Highway Administration to determine the amount of hot-mix asphalt (HMA), warm-mix asphalt (WMA), and recycled materials being produced and used in each state. This survey will be used to collect this data.

It is important for the industry that you complete this survey so that we have accurate information regarding the use of recycled materials and WMA and to identify areas needing assistance in implementation.

DATA FROM THIS SURVEY WILL BE CONFIDENTIAL AND WILL BE USED ONLY FOR THE PURPOSES OF DETERMINING THESE QUANTITIES. IT WILL NOT BE USED FOR ANY OTHER PURPOSE. DATA WILL BE REPORTED BY STATE ONLY, AND NO STATE-SPECIFIC DATA WILL BE REPORTED WHEN FEWER THAN THREE COMPANIES/BRANCHES RESPOND WITHIN A STATE, NO COMPANY-SPECIFIC INFORMATION WILL BE DISCLOSED IN ANY WAY.

Survey results will be shared with industry, government agencies, and officials to help in the implementation of recycling and warm-mix technologies. The data collected from this survey provides insight into trends, current practice, and is utilized to highlight the sustainability of asphalt mixtures. These results are also used by FHWA, Energy Information Administration, Environmental Protection Agency, and other federal, state, and local agencies to determine the impact of recycled materials and WMA.

By completing this survey you will be eligible to receive a complimentary copy of the full report.

Your participation is greatly appreciated.

* 1. Are you a...

- ◯ Asphalt Producer
- ◯ State Asphalt Pavement Association (or similar)
- ◯ Other

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Industry Contact Information

It is recommended that you print a copy of the full survey — download a PDF — to make sure you have the necessary data at hand before beginning the online survey.

Companies with multi-state operations are encouraged to download a spreadsheet to report their data. Please return the completed spreadsheet to Brett Williams, NAPA Director of Engineering & Technical Support, at bwilliams@asphaltpavement.org.

The following information will be used only to confirm that we do not get duplicate information from a company and to contact you if we have any questions regarding your answers. Contact Brett Williams at bwilliams@asphaltpavement.org or NAPA by phone at 888-468-6499 if you have any questions.

* 2. Company/Branch Name:

* 3. Contact Person's Name & Address

* 4. Contact Person's Email

* 5. Contact Person's Phone Number

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

State

Please select the state for which you are providing the information.

If your branch operates in more than one state, please complete a separate questionnaire for each state. If a plant provides mix for more than one state, please divide the tonnage accordingly, using your best estimate if specific data is not available.

* 6. Which state is the information provided for?

- Alabama
- Alaska
- American Samoa
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Guam
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Jersey
- New Mexico
- New York
- North Carolina
- North Dakota
- Northern Mariana Islands
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Puerto Rico
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- US Virgin Islands
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

* 7. How many plants does this survey response cover?

Number of plants

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Total Asphalt Tonnage for 2019

Please complete the following information for the total tonnage of all asphalt production in 2019.

* 8. What was your total tonnage of asphalt mixes in 2019 for the following sectors? (Use best estimate if data is not available.)

State DOT	
Other Agency (City, County, FAA, Military, Toll Authorities)	
Commercial & Residential	

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

RAP Supply and Use 2019

Please complete the following information on the amount of RAP received and used for 2019.

* 9. Did you accept, process, or use RAP in the state during 2019?

- ◯ Yes
- ◯ No

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

RAP Supply and Use 2019

Please complete the following information regarding the amount of RAP received and used for 2019.

* 10. How many tons of reclaimed asphalt pavement and asphalt millings were accepted/delivered to your facilities in the state in 2019?

Tons:

* 11. How many tons of RAP were used in 2019 for the following purposes? (Use best estimate if data not available.)

Recycled Back into HMA/WMA Mixes:

Aggregate Base:

Cold Mix:

Other:

Landfilled:

* 12. What was the average RAP percentage used in asphalt mixes during 2019 for the following sectors? (Use best estimate if data not available.)

State DOT

Other Agency (City, County, FAA, Military, Toll Authorities)

Commercial & Residential

* 13. At the end of the year 2019 did you have excess RAP (processed or unprocessed) in inventory?

- ◯ Yes
- ◯ No

* 14. Please estimate how many tons of RAP you had stockpiled at the end of 2019. (Use best estimate if data not available.)

15. What percentage of the RAP processed is fractionated into two or more sizes? (Use best estimate if data not available.)

16. What percent of mixes using RAP were produced using a softer grade of asphalt binder? (Use best estimate if data not available.)

17. What percent of mixes using RAP were produced using recycling agents? (Use best estimate if data not available.)

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Reclaimed Asphalt Shingles (RAS) Supply and Use for 2019

Please complete the following information on the amount of waste shingles received (processed and unprocessed) and used for 2019.

* 18. Did you accept waste shingles and/or process or use reclaimed asphalt shingles (RAS) in 2019?

- ◯ Yes
- ◯ No

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Reclaimed Asphalt Shingles (RAS) Supply and Use for 2019

Please complete the following information regarding the amount of waste shingles received (processed and unprocessed) and used during 2019.

* 19. How many tons of shingles were accepted/delivered to your facilities in the state in 2019?

Unprocessed Tear-off Shingles:

Unprocessed Manufacturers' Waste Shingles:

Processed Shingles:

* 20. How many tons of reclaimed asphalt shingles (RAS) were used for the following purposes in 2019? (Use best estimate if data not available.)

Recycled into HMA/WMA Mixes:

Aggregate Base:

Cold Mix:

Other:

Landfilled:

* 21. What was average RAS percentage used in asphalt mixes in 2019 for the following sectors? (Use best estimate if data not available.)

State DOT

Other Agency (City, County, FAA, Military, Toll Authorities)

Commercial & Residential

* 22. At the end of the year 2019 did you have any surplus RAS stockpiled? (Include processed and unprocessed shingles.)

- ◯ Yes
- ◯ No

* 23. Please estimate how many tons of RAS you had stockpiled at the end of 2019. (Use best estimate if data not available.)

24. Is RAS allowed in

	ALL	SOME	NONE
DOT mixes	○	○	○
Other Agency mixes	○	○	○
Commercial and Residential mixes	○	○	○

25. What percent of mixes using RAS were produced using a softer grade of asphalt binder? (Use best estimate if data not available.)

26. What percent of mixes using RAS were produced using recycling agents? (Use best estimate if data not available.)

NAPA
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Recycled Materials and WMA Survey 2019

Warm-Mix Asphalt Production for 2019

Warm-mix asphalt is the generic term for a variety of technologies that allow the producers of asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road by at least 10°F. The survey will collect data for warm-mix technologies used at reduced temperature and at hot mix temperatures separately.

* 27. Did any of your plants in this state use warm-mix asphalt technologies in 2019?

- ◯ Yes
- ◯ No

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Warm-Mix Asphalt Production for 2019

Warm-mix asphalt is the generic term for a variety of technologies that allow the producers of asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road by at least 10°F.

* 28. What was average percent of mix tons produced using warm-mix asphalt technologies in 2019 for the different sectors? (Use best estimate if data not available.)

State DOT	
Other Agency (City, County, FAA, Military, Toll Authorities)	
Commercial & Residential	

* 29. What percentage of the total warm-mix asphalt (WMA) for 2019 was produced using the following technologies? (Use best estimate if data not available, entries should total 100%)

Chemical Admixture	
Additive (Zeolite) Foaming	
Plant Foaming	
Organic (Wax) Additive	
Blend	
*Please specify the Blend:	

30. What was average percent of mix tons using warm-mix technologies for mixes produced at hot-mix temperatures (i.e., without lowering temperatures by at least 10°F.)

State DOT	
Other Agency (City, County, FAA, Military, Toll Authorities)	
Commercial & Residential	

* 31. What percentage of the total warm-mix asphalt (WMA) produced at hot mix temperatures (i.e., without lowering temperatures by at least 10°F.) for 2019 was produced using the following technologies? (Use best estimate if data not available, entries should total 100%)

Chemical Admixture	
Additive (Zeolite) Foaming	
Plant Foaming	
Organic (Wax) Additive	
Blend	
*Please specify the Blend:	

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Other Recycled Material for 2019

Please let us know if you used any other recycled materials in HMA/WMA mixes in 2019.

* 32. Did you use other recycled materials (excluding RAP and RAS) in your mixes in 2019? (This includes materials added to the mix such as: ground tire rubber, blast furnace slag, steel slag, boiler slag, fly ash, bottom ash, foundry sand, other coal combustion products, glass, cellulose fibers, etc.)

- ◯ Yes
- ◯ No

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Other Recycled Material for 2019

* 33. What other recycled material (excluding RAP and RAS) did you use in your mixes in 2019?

	Yes	No
Ground Tire Rubber	◯	◯
Steel Slag	◯	◯
Blast Furnace Slag	◯	◯
Recycled Cellulose Fibers	◯	◯
Other 1*	◯	◯
Other 2*	◯	◯

* Please describe the other recycled materials used.

* 34. How many tons of HMA/WMA was produced using this product. (Use best estimate if data not available.)

Ground Tire Rubber	
Steel Slag	
Blast Furnace Slag	
Recycled Cellulose Fibers	
Other 1	
Other 2	

35. How many tons of the recycled product was used in 2019? (Enter 0 if you do not have a reasonable estimate of this quantity)

Ground Tire Rubber	
Steel Slag	
Blast Furnace Slag	
Recycled Cellulose Fibers	
Other 1	
Other 2	

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

Thank You

36. Would you like a complimentary copy of the final report?

- ◯ Yes
- ◯ No

If your company provides any of the following services: CIR, HIR, CCPR, or FDR, we ask that you to fill out a very short survey providing quantities of these activities in 2019. The link to the survey is here: https://www.surveymonkey.com/r/78QVDBK Thank you for your time in helping document some of the asphalt industries efforts in sustainability and recycling.

2019 Construction Season Survey Instrument — SAPA Section

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Recycled Materials and WMA Survey 2019

SAPA Contact Information

This survey is intended to collect information from State Asphalt Pavement Associations or similar associations. Please answer the following questions by April 1, 2020, to assist NAPA in preparing the 2019 Recycled Materials and WMA Survey. The additional information you provide us on RAP and RAS will enhance the information we provide in the survey report. Contact Brett Williams at bwilliams@asphaltpavement.org or NAPA by phone at 888-468-6499 if you have any questions.

* 37. Association Name:

Contact

* 38. Name

* 39. Which state is the information provided for?

- ◯ Alabama
- ◯ Alaska
- ◯ American Samoa
- ◯ Arizona
- ◯ Arkansas
- ◯ California
- ◯ Colorado
- ◯ Connecticut
- ◯ Delaware
- ◯ District of Columbia
- ◯ Florida
- ◯ Georgia
- ◯ Guam
- ◯ Hawaii
- ◯ Idaho
- ◯ Illinois
- ◯ Indiana
- ◯ Iowa
- ◯ Kansas
- ◯ Kentucky
- ◯ Louisiana
- ◯ Maine
- ◯ Maryland
- ◯ Massachusetts
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- ◯ Montana
- ◯ Nebraska
- ◯ Nevada
- ◯ New Hampshire
- ◯ New Jersey
- ◯ New Mexico
- ◯ New York
- ◯ North Carolina
- ◯ North Dakota
- ◯ Northern Mariana Islands
- ◯ Ohio
- ◯ Oklahoma
- ◯ Oregon
- ◯ Pennsylvania
- ◯ Puerto Rico
- ◯ Rhode Island
- ◯ South Carolina
- ◯ South Dakota
- ◯ Tennessee
- ◯ Texas
- ◯ US Virgin Islands
- ◯ Utah
- ◯ Vermont
- ◯ Virginia
- ◯ Washington
- ◯ West Virginia
- ◯ Wisconsin
- ◯ Wyoming

* 40. What is your best estimate of the total tons of asphalt mixture placed in your state in 2019? (This includes asphalt mixture tonnage for all sectors, ex. DOT, Other Agencies, Commercial & Residential) [2018 Estimates are provided below for your reference.]

Table 3: Summary of 2018 Estimated and Reported Asphalt Mixture Tons in Each State

State	Tons, Millions		Reported % of Estimated	State	Tons, Millions		Reported % of Estimated
	Estimated	Reported			Estimated	Reported	
Alabama	6.7	5.0	75%	Montana	4.2	*	*
Alaska	5.1	*	*	Nebraska	3	0.6	20%
American Samoa	0.03	*	*	Nevada	3.6	*	*
Arizona	7.6	3.7	49%	New Hampshire	1.7	1.7	100%
Arkansas	5.4	3.1	57%	New Jersey	10.2	4.0	39%
California	27.7	10.8	39%	New Mexico	3.8	0.7	18%
Colorado	7.8	2.0	26%	New York	17	5.8	34%
Connecticut	4.9	2.2	45%	North Carolina	20	7.2	36%
Delaware	1.6	*	*	North Dakota	2.8	*	*
District of Columbia	1.5	*	*	No. Mariana Isl.	0.03	NCR	NCR
Florida	16	10.2	64%	Ohio	16.9	12.3	73%
Georgia	14.2	5.7	40%	Oklahoma	4.7	2.2	47%
Guam	0.12	NCR	NCR	Oregon	5.2	2.2	42%
Hawaii	1.1	0.7	64%	Pennsylvania	20	6.3	32%
Idaho	2.9	1.5	52%	Puerto Rico	1.7	NCR	NCR
Illinois	12.5	3.2	26%	Rhode Island	2.1	*	*
Indiana	12.5	8.3	66%	South Carolina	7.5	4.1	55%
Iowa	3.8	1.8	47%	South Dakota	2.2	NCR	NCR
Kansas	2.5	2.4	96%	Tennessee	8.9	5.7	64%
Kentucky	5.8	4.7	81%	Texas	17.2	7.2	42%
Louisiana	7.4	0.9	12%	U.S. Virgin Isl.	0.12	*	*
Maine	1.7	*	*	Utah	4	3.7	93%
Maryland	6.8	4.4	65%	Vermont	1.9	*	*
Massachusetts	6.5	5.0	77%	Virginia	11	5.1	46%
Michigan	14.3	8.8	62%	Washington	5.9	5.5	93%
Minnesota	10	6.5	65%	West Virginia	3.5	2.5	71%
Mississippi	5.5	3.9	71%	Wisconsin	12.5	9.2	74%
Missouri	6.5	3.8	58%	Wyoming	2.5	*	*
				Total	389.3	189.6†	49%

NCR No Companies Responding
* Fewer than 3 Companies Reporting
† Total Reported Tons includes values from state with fewer than 3 Companies Reporting
SAPA Estimated Tons
Numbers do not add up exactly due to rounding

41. Tonnage Estimate Comments

* 42. Do producers in your state fractionate RAP?

- ◯ Yes
- ◯ No

* 43. Is RAS allowed in

	ALL	SOME	NONE
DOT mixes	○	○	○
Other Agency mixes	○	○	○
Commercial and Residential mixes	○	○	○

Comments:

* 44. Does your state require, allow, or prohibit the use of recycling agents or softer binders in high Asphalt Binder Replacement mixtures? (RAP, RAS, RAP & RAS)

	Require	Allow	Prohibit
Recycling Agent	○	○	○
Softer Binders	○	○	○

Comments:

45. Do you know of recent changes that have successfully increased the utilization of recycled materials in your state? If so, what have they been

- ☐ Performance Testing
- ☐ Balanced Mix Design
- ☐ Recycling Agent utilization
- ☐ Availability of Recycled products
- ☐ Education/Training
- ☐ Plant Capabilities
- ☐ Economics
- ☐ Other (please specify)

46. Do you know of recent changes that have successfully increased the utilization of WMA in your state? If so, what have they been

- [ ] Performance Testing
- [ ] Balanced Mix Design
- [ ] Agency Requirements
- [ ] Community concerns (i.e. reduced production odor)
- [ ] Worker Comfort
- [ ] Late Season / Cold Weather Paving
- [ ] Other (please specify)

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2019 In-Place Recycling Supplemental Survey Instrument

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Purpose

The National Asphalt Pavement Association is working with the Federal Highway Administration to determine the amount of recycled materials being utilized for in-place recycling (Cold-In-Place, Hot In-Place, Cold Central Plant Recycling, and Full-Depth Reclamation). This survey will be used to collect this data.

It is important for the industry that you complete this survey so that we have accurate information regarding the use of recycled materials and to identify areas needing assistance in implementation.

DATA FROM THIS SURVEY WILL BE CONFIDENTIAL AND WILL BE USED ONLY FOR THE PURPOSES OF DETERMINING THESE QUANTITIES. IT WILL NOT BE USED FOR ANY OTHER PURPOSE. DATA WILL BE REPORTED REGIONALLY, AND NO REGIONAl DATA WILL BE REPORTED WHEN FEWER THAN THREE COMPANIES/BRANCHES RESPOND, NO COMPANY-SPECIFIC INFORMATION WILL BE DISCLOSED IN ANY WAY.

Survey results will help the industry, government agencies, and officials with the continued implementation of recycling. The data collected from this survey provides insight into trends, current practice, and is utilized to highlight the sustainability of asphalt mixtures. These results are also used by FHWA, Energy Information Administration, Environmental Protection Agency, and other federal, state, and local agencies to determine the impact of recycled materials.

By completing this survey you will be eligible to receive a complimentary copy of the full report.

Your participation is greatly appreciated.

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Industry Contact Information

Companies with multi-state operations will need to fill in the survey for each state.

The following information will be used only to confirm that we do not get duplicate information from a company and to contact you if we have any questions regarding your answers. Contact Brett Williams at bwilliams@asphaltpavement.org or NAPA by phone at 888-468-6499 if you have any questions.

* 1. Company/Branch Name:

* 2. Contact Person's Name & Address

* 3. Contact Person's Email

* 4. Contact Person's Phone Number

NATIONAL ASPHALT PAVEMENT ASSOCIATION

State

Please select the state for which you are providing the information.

If your branch operates in more than one state, please complete a separate questionnaire for each state. If a plant provides mix for more than one state, please divide the tonnage accordingly, using your best estimate if specific data is not available.

* 5. Which state is the information provided for?

- Alabama
- Alaska
- American Samoa
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Guam
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota
- Mississippi
- Missouri
- Montana
- Nebraska
- Nevada
- New Hampshire
- New Jersey
- New Mexico
- New York
- North Carolina
- North Dakota
- Northern Mariana Islands
- Ohio
- Oklahoma
- Oregon
- Pennsylvania
- Puerto Rico
- Rhode Island
- South Carolina
- South Dakota
- Tennessee
- Texas
- US Virgin Islands
- Utah
- Vermont
- Virginia
- Washington
- West Virginia
- Wisconsin
- Wyoming

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Total Quantities for 2019

Please complete the following information for the total quantities of all CIR, HIR, CCPR, and FDR in 2019.

* 6. What was your state-wide total quantity of in-place recycling in 2019? (Use best estimate if exact data is not available. Please provide the units in your answer, either weight or volume can be submitted, so examples of units could be Tons, Metric Tons, Cubic Yards, Square Yards @ inches of thickness, and the list goes on...)

Hot In-Place Recycling (HIR)	
Cold Central Plant Recycling (CCPR)	
Cold In-Place Recycling (CIR)	
Full-Depth Reclamation (FDR)	

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Thank You

7. Would you like a complimentary copy of the final report?

- ◯ Yes
- ◯ No

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10th Annual Asphalt Pavement Industry Survey
IS 138 — Appendix A

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Asphalt Pavement Industry Survey on

Recycled Materials and Warm-Mix Asphalt Usage 2019

IS-138 Appendix B:
State-by-State Use of
Recycled Materials and Warm-Mix Asphalt
In Asphalt Pavement Mixtures

10th Annual Survey

Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2019 Appendix B

Introduction

Appendix B provides a state-by-state breakdown of data reported in the *Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage* report for the 2019 construction season survey (Williams et al., 2020), including information from Tables 5, 6, 7, 8, 11, 12 and 15. **The accuracy of the state-level data and estimates will vary depending upon the number of companies participating in the survey in a given state and the tonnage produced by each respondent.** Appendix A outlines the methodology used to collect data and to generate estimates.

Appendix B reports data for all 50 U.S. states, as well as the District of Columbia and the five U.S. territories. In instances where fewer than three companies in a state/territory responded to the survey, only estimated total tonnages are reported to protect proprietary company data. Table 1 in the main report, republished below, summarizes the number of respondents from each state and territory. A total of 212 companies representing 1,101 production plants responded to the 2019 construction season survey. Branches, subsidiaries, and operating units are counted as unique companies in Table 1 and throughout the report. Throughout the tables, where percentages and totals are calculated, the numbers may not add up exactly due to rounding.

A degree of fluctuation in year-to-year comparisons of data is influenced by which companies responded to the 2019 construction season survey versus prior-year survey respondents. Approximately 66 percent of 2018 responding companies participated in the 2019 survey, too. Additional factors influencing the reliability of state-level data in this appendix are explained in the Data Estimation Method section of Appendix A.

Table 1: Number of Companies Completing 2019 Construction Season Survey in Each State/Territory

State	Cos.	Prod. Plants	State	Cos.	Prod. Plants	State	Cos.	Prod. Plants
Alabama	6	29	Kentucky	5	29	Ohio	9	90
Alaska	*	*	Louisiana	4	4	Oklahoma	7	18
American Samoa	*	*	Maine	*	*	Oregon	3	11
Arizona	3	21	Maryland	6	9	Pennsylvania	5	24
Arkansas	8	28	Massachusetts	3	9	Puerto Rico	NCR	NCR
California	3	43	Michigan	5	35	Rhode Island	*	*
Colorado	5	21	Minnesota	3	24	South Carolina	5	17
Connecticut	3	15	Mississippi	4	21	South Dakota	NCR	NCR
Delaware	NCR	NCR	Missouri	8	26	Tennessee	5	49
District of Columbia	*	*	Montana	*	*	Texas	4	34
Florida	9	52	Nebraska	*	*	U.S. Virgin Islands	NCR	NCR
Georgia	*	*	Nevada	*	*	Utah	8	18
Guam	NCR	NCR	New Hampshire	*	*	Vermont	*	*
Hawaii	4	12	New Jersey	4	30	Virginia	7	38
Idaho	5	18	New Mexico	2	4	Washington	8	38
Illinois	7	15	New York	14	65	West Virginia	3	15
Indiana	5	19	North Carolina	6	53	Wisconsin	3	62
Iowa	3	6	North Dakota	*	*	Wyoming	*	*
Kansas	*	*	No. Mariana Islands	NCR	NCR	**Total**[†]	212	1101

NCR = No companies responding
* = Fewer than 3 companies reporting
[†] = Total includes companies/production plants from states with fewer than 3 companies reporting.

ALABAMA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.0	3.2	6.7	6.5
DOT	3.4	1.8	4.6	3.7
Other Agency	0.9	0.6	1.2	1.1
Commercial & Residential	0.7	0.8	0.9	1.7
No. of Companies Reporting	9	6		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.8	0.8	1.1	1.6
Used in HMA/WMA Mixtures	1.3	0.8	1.7	1.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.80	0.80	2.41	1.62
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	23.6%	24.9%		
Average % for Other Agency Mixtures[1]	25.2%	21.1%		
Average % for Commercial & Residential Mixtures[1]	27.8%	25.3%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			26.0%	24.6%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	16%	19%		
% of RAP Mixtures Using Softer Binders	0%	0%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	10.0	0.2	13.4	0.3
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	5.0	0.2	6.7	0.3
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	40.5	15.0	54.3	30.5
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.10%	0.00%		
Average % for Other Agency Mixtures[1]	0.10%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.20%	0.02%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.10%	0.01%
	Other Reported Data			
% Companies Reporting Using RAS	11%	17%		
% of RAS Mixtures Using Softer Binders	0%	8%		
% of RAS Mixtures Using Recycling Agents	0%	1%		
WMA Technologies	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.5	0.7
Total Tons Produced With WMA Technology at HMA Temperatures			1.3	0.0
DOT	40%	14%	1.8	0.5
Other Agency	55%	0%	0.7	0.0
Commercial & Residential	30%	9%	0.3	0.2
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	34%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	66%	0%		
Organic Additive, % of Market	0%	0%		
Other Reported Data			Tons, Millions	
% Companies Reporting Using WMA Technologies	33%	17%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

ALASKA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	2.0	
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

	Reported Values	Estimated Values

AMERICAN SAMOA	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	0.03	0.03
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]				*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

ARIZONA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	3.7	3.9	7.6	8.4
DOT	1.9	1.7	3.9	3.7
Other Agency	0.1	0.1	0.1	0.3
Commercial & Residential	1.7	2.0	3.5	4.4
No. of Companies Reporting	5	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.8	0.6	1.6	1.3
Used in HMA/WMA Mixtures	0.4	0.4	0.9	0.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.58	0.46	1.18	0.99
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	12.3%	8.0%		
Average % for Other Agency Mixtures[1]	11.0%	8.0%		
Average % for Commercial & Residential Mixtures[1]	13.5%	12.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			11.6%	9.2%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	10%	0%		
% of RAP Mixtures Using Softer Binders	11%	2%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.3	0.1
Total Tons Produced With WMA Technology at HMA Temperatures			0.8	0.0
DOT	6%	2%	0.2	0.1
Other Agency	0%	15%	0.0	0.0
Commercial & Residential	25%	1%	0.9	0.0
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	45%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	55%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	40%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

ARKANSAS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	3.1	2.3	5.4	6.0
DOT	0.6	1.4	1.0	3.7
Other Agency	1.9	0.4	3.4	1.1
Commercial & Residential	0.6	0.5	1.0	1.3
No. of Companies Reporting	7	8		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.2	0.2	0.3	0.6
Used in HMA/WMA Mixtures	0.4	0.3	0.6	0.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.30	0.18	0.52	0.46
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	12.1%	15.6%		
Average % for Other Agency Mixtures[1]	11.3%	13.1%		
Average % for Commercial & Residential Mixtures[1]	13.4%	10.8%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			11.5%	12.9%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	21%	15%		
% of RAP Mixtures Using Softer Binders	14%	8%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	8.0	12.0	13.9	31.3
Processed Shingles Accepted	11.6	10.6	20.2	27.6
Used in HMA/WMA Mixtures	49.4	9.6	86.1	25.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	33.0	10.8	57.5	28.1
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	1.32%	0.41%		
Average % for Other Agency Mixtures[1]	1.58%	0.41%		
Average % for Commercial & Residential Mixtures[1]	1.61%	0.44%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			1.59%	0.42%
	Other Reported Data			
% Companies Reporting Using RAS	71%	50%		
% of RAS Mixtures Using Softer Binders	0%	2%		
% of RAS Mixtures Using Recycling Agents	0%	13%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.4	0.5
Total Tons Produced With WMA Technology at HMA Temperatures			1.6	1.1
DOT	53%	36%	0.5	1.3
Other Agency	35%	7%	1.2	0.1
Commercial & Residential	30%	20%	0.3	0.3
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	0%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	100%	100%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	29%	38%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

CALIFORNIA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	10.8	7.9	27.7	25.9
DOT	2.9	1.5	7.4	4.8
Other Agency	2.1	1.0	5.4	3.4
Commercial & Residential	5.8	5.4	14.9	17.7
No. of Companies Reporting	6	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	2.4	1.4	6.2	4.7
Used in HMA/WMA Mixtures	1.7	1.2	4.4	4.1
Used as Aggregate	0.2	0.0	0.6	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.52	0.69	3.90	2.29
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	15.4%	14.7%		
Average % for Other Agency Mixtures[1]	15.3%	9.7%		
Average % for Commercial & Residential Mixtures[1]	18.1%	16.3%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			15.7%	15.7%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	28%	3%		
% of RAP Mixtures Using Softer Binders	28%	5%		
% of RAP Mixtures Using Recycling Agents	8%	32%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	10.0	0.0	25.6	0.0
Processed Shingles Accepted	0.0	2.4	0.0	7.9
Used in HMA/WMA Mixtures	7.0	2.0	18.0	6.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	10.0	3.3	25.6	10.9
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.03%		
Average % for Other Agency Mixtures[1]	0.06%	0.03%		
Average % for Commercial & Residential Mixtures[1]	0.07%	0.03%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.06%	0.03%
	Other Reported Data			
% Companies Reporting Using RAS	17%	33%		
% of RAS Mixtures Using Softer Binders	100%	15%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			4.5	9.0
Total Tons Produced With WMA Technology at HMA Temperatures			2.0	7.6
DOT	26%	64%	1.9	3.1
Other Agency	39%	77%	2.1	2.6
Commercial & Residential	17%	62%	2.5	11.0
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	40%	6%		
Additive Foaming, % of Market	4%	0%		
Plant Foaming, % of Market	56%	94%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	100%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

COLORADO	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	2.0	4.4	7.8	8.7
DOT	0.3	0.8	1.2	1.5
Other Agency	0.9	1.9	3.5	3.7
Commercial & Residential	0.8	1.7	3.1	3.5
No. of Companies Reporting	3	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.6	1.2	2.4	2.5
Used in HMA/WMA Mixtures	0.4	0.8	1.6	1.7
Used as Aggregate	0.1	0.3	0.3	0.6
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.37	0.66	1.46	1.32
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	19.7%	18.0%		
Average % for Other Agency Mixtures[1]	19.7%	19.6%		
Average % for Commercial & Residential Mixtures[1]	21.7%	20.4%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			20.0%	19.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	33%	43%		
% of RAP Mixtures Using Softer Binders	25%	21%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	7.2	0.0	28.1	0.0
	Avg. % Used in Mixtures			
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.0	0.3
Total Tons Produced With WMA Technology at HMA Temperatures			0.2	1.7
DOT	11%	27%	0.1	0.4
Other Agency	16%	27%	0.6	1.0
Commercial & Residential	15%	15%	0.5	0.5
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	82%	77%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	18%	23%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	67%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

CONNECTICUT	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	2.2	2.3	4.9	5.0
DOT	0.5	0.4	1.1	0.9
Other Agency	0.6	0.9	1.3	1.9
Commercial & Residential	1.1	1.0	2.5	2.2
No. of Companies Reporting	3	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.4	0.5	0.9	1.1
Used in HMA/WMA Mixtures	0.3	0.5	0.8	1.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.00	0.20	2.22	0.44
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	15.0%	20.0%		
Average % for Other Agency Mixtures[1]	15.7%	19.4%		
Average % for Commercial & Residential Mixtures[1]	16.3%	23.1%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			15.3%	20.7%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	17%	20%		
% of RAP Mixtures Using Softer Binders	0%	0%		
% of RAP Mixtures Using Recycling Agents	0%	16%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.7	0.4	1.6	0.9
Used in HMA/WMA Mixtures	0.7	0.4	1.6	0.9
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.1	0.2	0.2	0.4
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.06%	0.06%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.03%	0.02%
	Other Reported Data			
% Companies Reporting Using RAS	33%	33%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.0	0.1
Total Tons Produced With WMA Technology at HMA Temperatures			3.4	3.3
DOT	94%	96%	1.0	0.9
Other Agency	68%	62%	0.9	1.2
Commercial & Residential	57%	62%	1.4	1.3
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	6%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	100%	94%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	33%	66%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

DELAWARE	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	NCR	1.6	1.3
DOT	*	NCR	*	NCR
Other Agency	*	NCR	*	NCR
Commercial & Residential	*	NCR	*	NCR
No. of Companies Reporting	*	NCR		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	NCR	*	NCR
Used in HMA/WMA Mixtures	*	NCR	*	NCR
Used as Aggregate	*	NCR	*	NCR
Used in Cold-Mix Asphalt	*	NCR	*	NCR
Used in Other	*	NCR	*	NCR
Landfilled	*	NCR	*	NCR
Total Tons of RAP Stockpiled at Year-End	*	NCR	*	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	NCR		
Average % for Other Agency Mixtures[1]	*	NCR		
Average % for Commercial & Residential Mixtures[1]	*	NCR		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	NCR
	Other Reported Data			
% Companies Reporting Using RAP	*	NCR		
% of RAP Fractionated	*	NCR		
% of RAP Mixtures Using Softer Binders	*	NCR		
% of RAP Mixtures Using Recycling Agents	*	NCR		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	NCR	*	NCR
Processed Shingles Accepted	*	NCR	*	NCR
Used in HMA/WMA Mixtures	*	NCR	*	NCR
Used as Aggregate	*	NCR	*	NCR
Used in Cold-Mix Asphalt	*	NCR	*	NCR
Used in Other	*	NCR	*	NCR
Landfilled	*	NCR	*	NCR
Total Tons of RAS Stockpiled at Year-End	*	NCR	*	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	NCR		
Average % for Other Agency Mixtures[1]	*	NCR		
Average % for Commercial & Residential Mixtures[1]	*	NCR		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	NCR
	Other Reported Data			
% Companies Reporting Using RAS	*	NCR		
% of RAS Mixtures Using Softer Binders	*	NCR		
% of RAS Mixtures Using Recycling Agents	*	NCR		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	NCR
Total Tons Produced With WMA Technology at HMA Temperatures			*	NCR
DOT	*	NCR	*	NCR
Other Agency	*	NCR	*	NCR
Commercial & Residential	*	NCR	*	NCR
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	NCR		
Additive Foaming, % of Market	*	NCR		
Plant Foaming, % of Market	*	NCR		
Organic Additive, % of Market	*	NCR		
% Companies Reporting Using WMA Technologies	*	NCR		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

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DISTRICT OF COLUMBIA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	1.5	1.3
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

FLORIDA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	10.2	9.7	16.0	16.0
DOT	3.7	3.5	5.8	5.8
Other Agency	3.7	1.9	5.7	3.2
Commercial & Residential	2.8	4.2	4.5	7.0
No. of Companies Reporting	13	9		
RAP	Tons, Millions		Tons, Millions	
Accepted	2.4	2.3	3.7	3.9
Used in HMA/WMA Mixtures	2.8	3.0	4.4	4.9
Used as Aggregate	0.1	0.1	0.2	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.29	2.24	0.45	3.69
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	23.8%	22.9%		
Average % for Other Agency Mixtures[1]	26.7%	30.4%		
Average % for Commercial & Residential Mixtures[1]	28.8%	32.6%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			27.3%	30.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	23%	15%		
% of RAP Mixtures Using Softer Binders	55%	64%		
% of RAP Mixtures Using Recycling Agents	12%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	6.5	0.0	10.2	0.0
Processed Shingles Accepted	5.0	0.0	7.8	0.0
Used in HMA/WMA Mixtures	4.5	0.0	7.1	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	1.0	0.0	1.6	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.04%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.06%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.04%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	8%	0%		
% of RAS Mixtures Using Softer Binders	100%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			2.1	1.3
Total Tons Produced With WMA Technology at HMA Temperatures			4.0	1.4
DOT	37%	29%	2.2	1.7
Other Agency	45%	18%	2.6	0.6
Commercial & Residential	30%	7%	1.3	0.5
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	100%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	0%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	15%	22%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

GEORGIA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.7	*	14.2	17.4
DOT	2.8	*	7.0	*
Other Agency	1.1	*	2.7	*
Commercial & Residential	1.8	*	4.5	*
No. of Companies Reporting	6	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	2.5	*	6.3	*
Used in HMA/WMA Mixtures	1.5	*	3.6	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.7	*	1.7	*
Landfilled	0.0	*	0.0	*
Total Tons of RAP Stockpiled at Year-End	3.80	*	9.47	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	24.8%	*		
Average % for Other Agency Mixtures[1]	24.8%	*		
Average % for Commercial & Residential Mixtures[1]	25.7%	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			25.4%	*
	Other Reported Data			
% Companies Reporting Using RAP	100%	*		
% of RAP Fractionated	3%	*		
% of RAP Mixtures Using Softer Binders	14%	*		
% of RAP Mixtures Using Recycling Agents	0%	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	*	0.0	*
Processed Shingles Accepted	0.0	*	0.0	*
Used in HMA/WMA Mixtures	0.0	*	0.0	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAS Stockpiled at Year-End	0.0	*	0.0	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	*		
Average % for Other Agency Mixtures[1]	0.00%	*		
Average % for Commercial & Residential Mixtures[1]	0.00%	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	*
	Other Reported Data			
% Companies Reporting Using RAS	0%	*		
% of RAS Mixtures Using Softer Binders	0%	*		
% of RAS Mixtures Using Recycling Agents	0%	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.0	*
Total Tons Produced With WMA Technology at HMA Temperatures			1.5	*
DOT	14%	*	1.0	*
Other Agency	1%	*	0.0	*
Commercial & Residential	11%	*	0.5	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	*		
Additive Foaming, % of Market	0%	*		
Plant Foaming, % of Market	100%	*		
Organic Additive, % of Market	0%	*		
% Companies Reporting Using WMA Technologies	17%	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

GUAM	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	NCR	NCR	0.12	0.12
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
No. of Companies Reporting	NCR	NCR		
RAP	Tons, Millions		Tons, Millions	
Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAP Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAP	NCR	NCR		
% of RAP Fractionated	NCR	NCR		
% of RAP Mixtures Using Softer Binders	NCR	NCR		
% of RAP Mixtures Using Recycling Agents	NCR	NCR		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	NCR	NCR	NCR	NCR
Processed Shingles Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAS Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAS	NCR	NCR		
% of RAS Mixtures Using Softer Binders	NCR	NCR		
% of RAS Mixtures Using Recycling Agents	NCR	NCR		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			NCR	NCR
Total Tons Produced With WMA Technology at HMA Temperatures			NCR	NCR
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	NCR	NCR		
Additive Foaming, % of Market	NCR	NCR		
Plant Foaming, % of Market	NCR	NCR		
Organic Additive, % of Market	NCR	NCR		
% Companies Reporting Using WMA Technologies	NCR	NCR		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

HAWAII	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	0.7	0.7	1.1	0.9
DOT	0.3	0.3	0.5	0.4
Other Agency	0.3	0.2	0.5	0.3
Commercial & Residential	0.1	0.2	0.1	0.2
No. of Companies Reporting	3	4		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.1	0.2	0.2	0.2
Used in HMA/WMA Mixtures	0.2	0.1	0.3	0.2
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.10	0.15	0.17	0.19
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	26.7%	20.0%		
Average % for Other Agency Mixtures[1]	23.3%	15.0%		
Average % for Commercial & Residential Mixtures[1]	20.0%	22.5%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			23.1%	18.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	67%	50%		
% of RAP Mixtures Using Softer Binders	0%	0%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.0	0.0
Total Tons Produced With WMA Technology at HMA Temperatures			0.0	0.0
DOT	0%	0%	0.0	0.0
Other Agency	0%	0%	0.0	0.0
Commercial & Residential	0%	0%	0.0	0.0
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	0%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	0%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	0%	0%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

IDAHO	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	1.5	1.5	2.9	2.7
DOT	0.8	0.8	1.5	1.5
Other Agency	0.4	0.3	0.8	0.5
Commercial & Residential	0.3	0.4	0.6	0.7
No. of Companies Reporting	5	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.5	0.4	0.9	0.8
Used in HMA/WMA Mixtures	0.4	0.3	0.8	0.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.73	0.98	1.41	1.80
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	26.0%	25.2%		
Average % for Other Agency Mixtures[1]	27.4%	21.0%		
Average % for Commercial & Residential Mixtures[1]	32.2%	25.8%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			27.3%	23.9%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	28%	0%		
% of RAP Mixtures Using Softer Binders	79%	62%		
% of RAP Mixtures Using Recycling Agents	2%	20%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.5	0.5
Total Tons Produced With WMA Technology at HMA Temperatures			0.7	1.1
DOT	76%	67%	1.2	1.0
Other Agency	95%	77%	0.7	0.4
Commercial & Residential	47%	31%	0.3	0.2
WMA Technologies‡	Other Reported Data			
Chemical Additive, % of Market	73%	75%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	27%	25%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	80%	80%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

ILLINOIS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	3.2	1.5	12.5	13.6
DOT	0.8	0.7	3.1	6.6
Other Agency	1.1	0.3	4.3	2.7
Commercial & Residential	1.3	0.5	5.1	4.3
No. of Companies Reporting	12	7		
RAP	Tons, Millions		Tons, Millions	
Accepted	2.6	0.4	10.2	3.5
Used in HMA/WMA Mixtures	0.9	0.3	3.5	3.1
Used as Aggregate	0.4	0.0	1.4	0.2
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.1
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.00	0.70	3.91	6.33
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	25.7%	20.8%		
Average % for Other Agency Mixtures[1]	27.0%	20.4%		
Average % for Commercial & Residential Mixtures[1]	29.6%	24.5%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			28.1%	22.9%
	Other Reported Data			
% Companies Reporting Using RAP	83%	100%		
% of RAP Fractionated	39%	25%		
% of RAP Mixtures Using Softer Binders	23%	22%		
% of RAP Mixtures Using Recycling Agents	3%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	24.5	4.1	95.7	37.3
Processed Shingles Accepted	57.1	0.0	223.0	0.0
Used in HMA/WMA Mixtures	70.1	5.5	273.8	50.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	1.0	0.2	3.9	1.8
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	2.33%	0.58%		
Average % for Other Agency Mixtures[1]	2.11%	0.21%		
Average % for Commercial & Residential Mixtures[1]	2.20%	0.21%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			2.19%	0.37%
	Other Reported Data			
% Companies Reporting Using RAS	50%	29%		
% of RAS Mixtures Using Softer Binders	40%	0%		
% of RAS Mixtures Using Recycling Agents	7%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			4.6	1.2
Total Tons Produced With WMA Technology at HMA Temperatures			4.2	1.5
DOT	38%	17%	1.2	1.1
Other Agency	84%	55%	3.6	1.5
Commercial & Residential	79%	3%	4.0	0.1
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	21%	54%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	79%	46%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	50%	43%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

INDIANA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	8.3	4.6	12.5	13.0
DOT	3.4	1.7	5.1	4.9
Other Agency	2.3	1.7	3.5	4.7
Commercial & Residential	2.6	1.2	3.9	3.4
No. of Companies Reporting	7	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.9	0.9	2.9	2.5
Used in HMA/WMA Mixtures	2.0	0.9	3.0	2.7
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	2.37	1.16	3.57	3.30
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	22.0%	18.4%		
Average % for Other Agency Mixtures[1]	23.4%	19.8%		
Average % for Commercial & Residential Mixtures[1]	26.1%	22.4%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			24.1%	20.8%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	69%	57%		
% of RAP Mixtures Using Softer Binders	8%	21%		
% of RAP Mixtures Using Recycling Agents	8%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.9	6.4	1.4	18.3
Processed Shingles Accepted	8.4	8.7	12.7	24.9
Used in HMA/WMA Mixtures	17.5	18.0	26.4	51.4
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	9.0	16.5	13.6	47.1
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.22%	0.60%		
Average % for Other Agency Mixtures[1]	0.19%	0.30%		
Average % for Commercial & Residential Mixtures[1]	0.21%	0.30%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.21%	0.40%
	Other Reported Data			
% Companies Reporting Using RAS	71%	40%		
% of RAS Mixtures Using Softer Binders	10%	10%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			3.7	0.0
Total Tons Produced With WMA Technology at HMA Temperatures			5.5	6.7
DOT	82%	71%	4.2	3.4
Other Agency	56%	43%	1.9	2.1
Commercial & Residential	79%	41%	3.1	1.4
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	100%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	57%	20%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

IOWA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	1.8	0.9	3.8	3.7
DOT	1.0	0.5	2.1	2.0
Other Agency	0.6	0.2	1.3	0.9
Commercial & Residential	0.2	0.2	0.4	0.7
No. of Companies Reporting	4	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.3	0.2	0.6	0.8
Used in HMA/WMA Mixtures	0.3	0.2	0.7	0.7
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.12	0.34	0.25	1.38
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	17.0%	17.3%		
Average % for Other Agency Mixtures[1]	19.3%	18.7%		
Average % for Commercial & Residential Mixtures[1]	20.0%	19.7%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			18.3%	18.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	1%	0%		
% of RAP Mixtures Using Softer Binders	19%	5%		
% of RAP Mixtures Using Recycling Agents	3%	3%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	2.5	0.0	5.3	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	4.2	0.3	8.9	1.2
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	14.5	6.2	30.6	25.1
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.20%	0.05%		
Average % for Other Agency Mixtures[1]	0.27%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.27%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.23%	0.03%
	Other Reported Data			
% Companies Reporting Using RAS	50%	33%		
% of RAS Mixtures Using Softer Binders	25%	0%		
% of RAS Mixtures Using Recycling Agents	5%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.1	0.0
Total Tons Produced With WMA Technology at HMA Temperatures			0.9	0.0
DOT	64%	0%	1.4	0.0
Other Agency	30%	2%	0.4	0.0
Commercial & Residential	69%	2%	0.3	0.0
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	51%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	49%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	75%	33%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

KANSAS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	2.4	*	2.5	2.8
DOT	1.4	*	1.5	*
Other Agency	0.5	*	0.5	*
Commercial & Residential	0.5	*	0.5	*
No. of Companies Reporting	4	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.0	*	1.0	*
Used in HMA/WMA Mixtures	0.5	*	0.5	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAP Stockpiled at Year-End	0.83	*	0.86	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	21.3%	*		
Average % for Other Agency Mixtures[1]	17.5%	*		
Average % for Commercial & Residential Mixtures[1]	20.0%	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			20.8%	*
	Other Reported Data			
% Companies Reporting Using RAP	100%	*		
% of RAP Fractionated	29%	*		
% of RAP Mixtures Using Softer Binders	68%	*		
% of RAP Mixtures Using Recycling Agents	15%	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	2.0	*	2.1	*
Processed Shingles Accepted	13.0	*	13.5	*
Used in HMA/WMA Mixtures	13.0	*	13.5	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAS Stockpiled at Year-End	2.0	*	2.1	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.67%	*		
Average % for Other Agency Mixtures[1]	0.43%	*		
Average % for Commercial & Residential Mixtures[1]	0.00%	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.54%	*
	Other Reported Data			
% Companies Reporting Using RAS	75%	*		
% of RAS Mixtures Using Softer Binders	67%	*		
% of RAS Mixtures Using Recycling Agents	34%	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.7	*
Total Tons Produced With WMA Technology at HMA Temperatures			0.7	*
DOT	62%	*	0.9	*
Other Agency	50%	*	0.3	*
Commercial & Residential	48%	*	0.3	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	58%	*		
Additive Foaming, % of Market	0%	*		
Plant Foaming, % of Market	42%	*		
Organic Additive, % of Market	0%	*		
% Companies Reporting Using WMA Technologies	75%	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

KENTUCKY	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	4.7	2.5	5.8	6.0
DOT	2.6	1.5	3.2	3.6
Other Agency	1.2	0.6	1.5	1.5
Commercial & Residential	0.9	0.4	1.1	0.9
No. of Companies Reporting	10	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.8	0.4	1.0	0.9
Used in HMA/WMA Mixtures	0.7	0.4	0.9	0.9
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.97	0.33	1.20	0.80
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	15.1%	14.7%		
Average % for Other Agency Mixtures[1]	17.3%	17.2%		
Average % for Commercial & Residential Mixtures[1]	15.8%	18.6%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			15.7%	15.6%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	42%	48%		
% of RAP Mixtures Using Softer Binders	22%	17%		
% of RAP Mixtures Using Recycling Agents	18%	20%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	8.0	7.0	9.9	16.9
Processed Shingles Accepted	13.4	12.0	16.5	29.0
Used in HMA/WMA Mixtures	1.1	12.0	1.4	29.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	15.3	40.0	18.9	96.5
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.02%	0.61%		
Average % for Other Agency Mixtures[1]	0.02%	0.60%		
Average % for Commercial & Residential Mixtures[1]	0.02%	0.32%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.02%	0.48%
	Other Reported Data			
% Companies Reporting Using RAS	20%	20%		
% of RAS Mixtures Using Softer Binders	45%	10%		
% of RAS Mixtures Using Recycling Agents	90%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.6	2.5
Total Tons Produced With WMA Technology at HMA Temperatures			1.3	1.8
DOT	65%	76%	2.1	2.8
Other Agency	42%	64%	0.6	1.0
Commercial & Residential	19%	64%	0.2	0.5
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	53%	61%		
Additive Foaming, % of Market	9%	0%		
Plant Foaming, % of Market	38%	39%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	60%	60%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

LOUISIANA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	0.9	1.2	7.4	6.8
DOT	0.5	0.5	4.1	3.0
Other Agency	0.2	0.4	1.6	2.3
Commercial & Residential	0.2	0.3	1.7	1.5
No. of Companies Reporting	4	4		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.2	0.3	1.8	1.5
Used in HMA/WMA Mixtures	0.2	0.3	1.6	1.5
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.16	0.19	1.32	1.08
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	23.3%	22.3%		
Average % for Other Agency Mixtures[1]	18.0%	17.8%		
Average % for Commercial & Residential Mixtures[1]	22.3%	25.2%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			22.2%	22.2%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	95%	92%		
% of RAP Mixtures Using Softer Binders	25%	10%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			5.9	5.7
Total Tons Produced With WMA Technology at HMA Temperatures			0.0	0.9
DOT	74%	100%	3.0	3.0
Other Agency	81%	100%	1.3	2.3
Commercial & Residential	90%	91%	1.6	1.3
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	2%	0%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	98%	100%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	100%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MAINE	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	1.7	1.1
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.20%	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MARYLAND	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	4.4	1.7	6.8	7.0
DOT	1.5	0.3	2.3	1.1
Other Agency	1.1	0.6	1.7	2.6
Commercial & Residential	1.8	0.8	2.8	3.3
No. of Companies Reporting	11	6		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.6	0.4	2.5	1.7
Used in HMA/WMA Mixtures	1.2	0.5	1.8	2.1
Used as Aggregate	0.3	0.0	0.5	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.2
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.02	0.16	1.58	0.68
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	23.2%	24.6%		
Average % for Other Agency Mixtures[1]	21.3%	24.5%		
Average % for Commercial & Residential Mixtures[1]	29.3%	32.3%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			26.4%	29.7%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	14%	0%		
% of RAP Mixtures Using Softer Binders	19%	33%		
% of RAP Mixtures Using Recycling Agents	4%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	3.0	0.0	4.6	0.0
Processed Shingles Accepted	0.0	7.0	0.0	29.6
Used in HMA/WMA Mixtures	0.0	0.2	0.0	0.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	3.0	7.0	4.6	29.6
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.02%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.01%
	Other Reported Data			
% Companies Reporting Using RAS	0%	17%		
% of RAS Mixtures Using Softer Binders	0%	18%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			3.2	2.4
Total Tons Produced With WMA Technology at HMA Temperatures			0.6	0.2
DOT	72%	48%	1.7	0.5
Other Agency	59%	30%	1.0	0.8
Commercial & Residential	40%	39%	1.1	1.3
WMA Technologies‡	Other Reported Data			
Chemical Additive, % of Market	36%	14%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	64%	86%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	55%	33%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MASSACHUSETTS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.0	2.1	6.5	6.5
DOT	1.7	0.4	2.2	1.3
Other Agency	1.3	0.7	1.7	2.2
Commercial & Residential	2.0	1.0	2.6	3.0
No. of Companies Reporting	7	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.3	0.4	1.7	1.3
Used in HMA/WMA Mixtures	0.8	0.3	1.0	1.1
Used as Aggregate	0.2	0.0	0.2	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.1	0.0	0.1	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.28	0.54	1.66	1.65
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	16.1%	13.6%		
Average % for Other Agency Mixtures[1]	15.1%	15.6%		
Average % for Commercial & Residential Mixtures[1]	16.0%	22.3%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			15.6%	16.4%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	14%	0%		
% of RAP Mixtures Using Softer Binders	2%	35%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	24.0	8.9	31.2	27.4
Processed Shingles Accepted	2.3	4.9	3.0	15.1
Used in HMA/WMA Mixtures	2.3	2.4	3.0	7.4
Used as Aggregate	24.0	0.0	31.2	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	25.0	22.2	32.5	68.3
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.07%	0.18%		
Average % for Commercial & Residential Mixtures[1]	0.07%	0.18%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.05%	0.11%
	Other Reported Data			
% Companies Reporting Using RAS	29%	66%		
% of RAS Mixtures Using Softer Binders	0%	18%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			2.2	1.9
Total Tons Produced With WMA Technology at HMA Temperatures			2.8	0.7
DOT	96%	99%	2.1	1.3
Other Agency	43%	36%	0.8	0.8
Commercial & Residential	81%	18%	2.1	0.5
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	78%	65%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	0%	0%		
Organic Additive, % of Market	22%	35%		
% Companies Reporting Using WMA Technologies	100%	66%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MICHIGAN	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	8.8	7.9	14.3	15.1
DOT	2.7	2.5	4.4	4.8
Other Agency	2.1	2.0	3.4	3.9
Commercial & Residential	4.0	3.4	6.5	6.4
No. of Companies Reporting	5	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	2.4	2.4	3.9	4.6
Used in HMA/WMA Mixtures	2.5	2.3	4.1	4.3
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	3.17	14.75	5.15	28.12
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	21.8%	20.6%		
Average % for Other Agency Mixtures[1]	26.2%	22.5%		
Average % for Commercial & Residential Mixtures[1]	34.4%	32.6%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			28.4%	28.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	17%	21%		
% of RAP Mixtures Using Softer Binders	35%	36%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	2.0	1.5	3.3	2.9
Processed Shingles Accepted	0.0	1.0	0.0	1.9
Used in HMA/WMA Mixtures	0.5	0.5	0.8	1.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	1.5	1.0	2.4	1.9
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.01%	0.03%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.01%	0.01%
	Other Reported Data			
% Companies Reporting Using RAS	20%	20%		
% of RAS Mixtures Using Softer Binders	0%	100%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.1	0.0
Total Tons Produced With WMA Technology at HMA Temperatures			2.4	2.4
DOT	29%	25%	1.3	1.2
Other Agency	18%	16%	0.5	0.6
Commercial & Residential	10%	9%	0.7	0.6
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	100%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	20%	40%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MINNESOTA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	6.5	5.6	10.0	11.0
DOT	1.8	1.9	2.8	3.8
Other Agency	3.0	2.2	4.6	4.2
Commercial & Residential	1.7	1.5	2.6	3.0
No. of Companies Reporting	5	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.9	2.1	2.9	4.1
Used in HMA/WMA Mixtures	1.6	1.3	2.5	2.6
Used as Aggregate	0.8	0.4	1.2	0.8
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	2.13	1.50	3.28	2.93
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	23.3%	21.0%		
Average % for Other Agency Mixtures[1]	23.5%	22.8%		
Average % for Commercial & Residential Mixtures[1]	27.3%	24.7%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			24.6%	23.6%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	11%	15%		
% of RAP Mixtures Using Softer Binders	28%	16%		
% of RAP Mixtures Using Recycling Agents	1%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	12.7	0.0	19.5	0.0
Processed Shingles Accepted	0.0	9.7	0.0	19.0
Used in HMA/WMA Mixtures	14.5	10.7	22.3	20.9
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	25.0	12.6	38.5	24.6
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.18%	0.06%		
Average % for Other Agency Mixtures[1]	0.20%	0.24%		
Average % for Commercial & Residential Mixtures[1]	0.26%	0.24%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.22%	0.19%
	Other Reported Data			
% Companies Reporting Using RAS	40%	66%		
% of RAS Mixtures Using Softer Binders	20%	25%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			5.4	4.3
Total Tons Produced With WMA Technology at HMA Temperatures			0.6	1.1
DOT	40%	25%	1.1	1.0
Other Agency	67%	74%	3.1	3.1
Commercial & Residential	69%	44%	1.8	1.3
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	1%	1%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	99%	99%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	80%	33%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MISSISSIPPI	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	3.9	2.2	5.5	2.9
DOT	2.2	1.6	3.1	2.1
Other Agency	1.0	0.1	1.4	0.2
Commercial & Residential	0.7	0.5	1.0	0.6
No. of Companies Reporting	9	4		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.1	0.3	1.6	0.4
Used in HMA/WMA Mixtures	0.8	0.5	1.1	0.7
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.1
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.49	0.43	0.69	0.57
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	18.3%	20.0%		
Average % for Other Agency Mixtures[1]	20.2%	20.3%		
Average % for Commercial & Residential Mixtures[1]	21.1%	26.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			19.7%	22.7%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	19%	0%		
% of RAP Mixtures Using Softer Binders	0%	0%		
% of RAP Mixtures Using Recycling Agents	1%	2%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.1	0.0	0.1	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.1	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.1	1.0
Total Tons Produced With WMA Technology at HMA Temperatures			3.2	1.1
DOT	84%	72%	2.6	1.5
Other Agency	81%	100%	1.1	0.2
Commercial & Residential	58%	62%	0.6	0.4
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	0%		
Additive Foaming, % of Market	3%	100%		
Plant Foaming, % of Market	97%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	89%	75%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MISSOURI	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	3.8	2.7	6.5	6.8
DOT	1.2	0.8	2.1	2.0
Other Agency	1.0	0.8	1.7	2.0
Commercial & Residential	1.6	1.1	2.7	2.7
No. of Companies Reporting	9	8		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.8	0.6	1.4	1.6
Used in HMA/WMA Mixtures	0.8	0.7	1.4	1.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.55	1.66	2.65	4.13
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	20.8%	20.9%		
Average % for Other Agency Mixtures[1]	20.0%	21.5%		
Average % for Commercial & Residential Mixtures[1]	21.3%	30.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			21.1%	26.7%
	Other Reported Data			
% Companies Reporting Using RAP	89%	88%		
% of RAP Fractionated	16%	22%		
% of RAP Mixtures Using Softer Binders	35%	27%		
% of RAP Mixtures Using Recycling Agents	4%	4%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	25.0	10.0	42.8	24.9
Processed Shingles Accepted	4.5	2.8	7.7	7.0
Used in HMA/WMA Mixtures	19.0	11.4	32.5	28.4
Used as Aggregate	0.0	4.0	0.0	10.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	42.4	42.5	72.5	105.9
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.70%	0.50%		
Average % for Other Agency Mixtures[1]	0.35%	0.38%		
Average % for Commercial & Residential Mixtures[1]	0.35%	0.38%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.50%	0.42%
	Other Reported Data			
% Companies Reporting Using RAS	67%	63%		
% of RAS Mixtures Using Softer Binders	66%	45%		
% of RAS Mixtures Using Recycling Agents	8%	5%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.0	0.1
Total Tons Produced With WMA Technology at HMA Temperatures			0.2	0.4
DOT	26%	13%	0.5	0.3
Other Agency	20%	7%	0.3	0.1
Commercial & Residential	12%	3%	0.3	0.1
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	41%	15%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	59%	85%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	22%	38%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

MONTANA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	4.2	4.2
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NEBRASKA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	0.6	*	3.0	2.8
DOT	0.3	*	1.5	*
Other Agency	0.2	*	1.0	*
Commercial & Residential	0.1	*	0.5	*
No. of Companies Reporting	3	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.2	*	1.0	*
Used in HMA/WMA Mixtures	0.2	*	0.8	*
Used as Aggregate	0.1	*	0.3	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAP Stockpiled at Year-End	0.32	*	1.60	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	25.0%	*		
Average % for Other Agency Mixtures[1]	25.0%	*		
Average % for Commercial & Residential Mixtures[1]	26.7%	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			25.7%	*
	Other Reported Data			
% Companies Reporting Using RAP	66%	*		
% of RAP Fractionated	17%	*		
% of RAP Mixtures Using Softer Binders	17%	*		
% of RAP Mixtures Using Recycling Agents	0%	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	1.2	*	6.0	*
Processed Shingles Accepted	0.0	*	0.0	*
Used in HMA/WMA Mixtures	0.0	*	0.0	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAS Stockpiled at Year-End	4.4	*	22.0	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	*		
Average % for Other Agency Mixtures[1]	0.00%	*		
Average % for Commercial & Residential Mixtures[1]	0.00%	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	*
	Other Reported Data			
% Companies Reporting Using RAS	0%	*		
% of RAS Mixtures Using Softer Binders	0%	*		
% of RAS Mixtures Using Recycling Agents	0%	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.9	*
Total Tons Produced With WMA Technology at HMA Temperatures			1.2	*
DOT	81%	*	1.2	*
Other Agency	55%	*	0.5	*
Commercial & Residential	74%	*	0.4	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	100%	*		
Additive Foaming, % of Market	0%	*		
Plant Foaming, % of Market	0%	*		
Organic Additive, % of Market	0%	*		
% Companies Reporting Using WMA Technologies	67%	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NEVADA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	3.6	3.4
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NEW HAMPSHIRE	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	1.7	*	1.7	1.3
DOT	0.5	*	0.5	*
Other Agency	0.3	*	0.3	*
Commercial & Residential	0.9	*	0.9	*
No. of Companies Reporting	4	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.3	*	0.3	*
Used in HMA/WMA Mixtures	0.3	*	0.3	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAP Stockpiled at Year-End	0.15	*	0.15	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	20.8%	*		
Average % for Other Agency Mixtures[1]	13.0%	*		
Average % for Commercial & Residential Mixtures[1]	18.5%	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.6%	*
	Other Reported Data			
% Companies Reporting Using RAP	100%	*		
% of RAP Fractionated	0%	*		
% of RAP Mixtures Using Softer Binders	0%	*		
% of RAP Mixtures Using Recycling Agents	0%	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	*	0.0	*
Processed Shingles Accepted	1.4	*	1.4	*
Used in HMA/WMA Mixtures	1.4	*	1.4	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAS Stockpiled at Year-End	0.0	*	0.0	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	*		
Average % for Other Agency Mixtures[1]	0.10%	*		
Average % for Commercial & Residential Mixtures[1]	0.10%	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.08%	*
	Other Reported Data			
% Companies Reporting Using RAS	50%	*		
% of RAS Mixtures Using Softer Binders	0%	*		
% of RAS Mixtures Using Recycling Agents	0%	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.1	*
Total Tons Produced With WMA Technology at HMA Temperatures			0.9	*
DOT	86%	*	0.4	*
Other Agency	67%	*	0.2	*
Commercial & Residential	44%	*	0.4	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	11%	*		
Additive Foaming, % of Market	0%	*		
Plant Foaming, % of Market	69%	*		
Organic Additive, % of Market	20%	*		
% Companies Reporting Using WMA Technologies	75%	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NEW JERSEY	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	4.0	6.8	10.2	11.8
DOT	0.4	1.5	1.0	2.6
Other Agency	2.3	3.4	5.9	5.9
Commercial & Residential	1.3	1.9	3.3	3.3
No. of Companies Reporting	3	4		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.5	2.5	3.8	4.3
Used in HMA/WMA Mixtures	0.7	1.4	1.8	2.4
Used as Aggregate	0.2	0.5	0.6	0.9
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	4.24	6.32	10.81	11.04
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	13.3%	16.3%		
Average % for Other Agency Mixtures[1]	17.7%	17.5%		
Average % for Commercial & Residential Mixtures[1]	25.0%	24.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.5%	20.3%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	0%	10%		
% of RAP Mixtures Using Softer Binders	2%	8%		
% of RAP Mixtures Using Recycling Agents	0%	8%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.2	0.0	0.3
Used in HMA/WMA Mixtures	0.0	1.5	0.0	2.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.02%		
Average % for Other Agency Mixtures[1]	0.00%	0.02%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.02%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.02%
	Other Reported Data			
% Companies Reporting Using RAS	0%	25%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.0	0.0
Total Tons Produced With WMA Technology at HMA Temperatures			5.4	0.9
DOT	46%	2%	0.5	0.1
Other Agency	61%	5%	3.6	0.3
Commercial & Residential	40%	18%	1.3	0.6
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	100%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	67%	50%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NEW MEXICO	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	0.7	*	3.8	3.7
DOT	0.1	*	0.5	*
Other Agency	0.3	*	1.6	*
Commercial & Residential	0.3	*	1.6	*
No. of Companies Reporting	3	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.2	*	1.3	*
Used in HMA/WMA Mixtures	0.1	*	0.7	*
Used as Aggregate	0.0	*	0.1	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAP Stockpiled at Year-End	0.14	*	0.78	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	14.7%	*		
Average % for Other Agency Mixtures[1]	17.0%	*		
Average % for Commercial & Residential Mixtures[1]	19.7%	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			18.6%	*
	Other Reported Data			
% Companies Reporting Using RAP	100%	*		
% of RAP Fractionated	40%	*		
% of RAP Mixtures Using Softer Binders	0%	*		
% of RAP Mixtures Using Recycling Agents	0%	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	*	0.0	*
Processed Shingles Accepted	0.0	*	0.0	*
Used in HMA/WMA Mixtures	0.0	*	0.0	*
Used as Aggregate	0.0	*	0.0	*
Used in Cold-Mix Asphalt	0.0	*	0.0	*
Used in Other	0.0	*	0.0	*
Landfilled	0.0	*	0.0	*
Total Tons of RAS Stockpiled at Year-End	0.0	*	0.0	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	*		
Average % for Other Agency Mixtures[1]	0.00%	*		
Average % for Commercial & Residential Mixtures[1]	0.00%	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	*
	Other Reported Data			
% Companies Reporting Using RAS	0%	*		
% of RAS Mixtures Using Softer Binders	0%	*		
% of RAS Mixtures Using Recycling Agents	0%	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.5	*
Total Tons Produced With WMA Technology at HMA Temperatures			0.1	*
DOT	31%	*	0.2	*
Other Agency	26%	*	0.4	*
Commercial & Residential	1%	*	0.0	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	16%	*		
Additive Foaming, % of Market	0%	*		
Plant Foaming, % of Market	84%	*		
Organic Additive, % of Market	0%	*		
% Companies Reporting Using WMA Technologies	67%	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NEW YORK	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.8	6.7	17.0	17.5
DOT	2.0	1.6	5.9	4.2
Other Agency	2.1	2.6	6.2	6.7
Commercial & Residential	1.7	2.5	5.0	6.6
No. of Companies Reporting	12	14		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.7	1.1	2.1	2.8
Used in HMA/WMA Mixtures	1.0	1.1	2.9	3.0
Used as Aggregate	0.0	0.0	0.1	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.1	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	2.02	1.20	5.92	3.14
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	17.7%	17.0%		
Average % for Other Agency Mixtures[1]	16.6%	17.1%		
Average % for Commercial & Residential Mixtures[1]	18.0%	17.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.2%	17.0%
	Other Reported Data			
% Companies Reporting Using RAP	92%	100%		
% of RAP Fractionated	20%	7%		
% of RAP Mixtures Using Softer Binders	2%	3%		
% of RAP Mixtures Using Recycling Agents	8%	7%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			2.9	2.5
Total Tons Produced With WMA Technology at HMA Temperatures			3.4	2.4
DOT	45%	44%	2.6	1.9
Other Agency	44%	37%	2.7	2.5
Commercial & Residential	18%	9%	0.9	0.6
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	23%	40%		
Additive Foaming, % of Market	3%	0%		
Plant Foaming, % of Market	74%	60%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	75%	64%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NORTH CAROLINA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	7.2	7.7	20.0	15.0
DOT	4.9	5.9	13.6	11.5
Other Agency	0.8	0.9	2.2	1.7
Commercial & Residential	1.5	0.9	4.2	1.8
No. of Companies Reporting	7	6		
RAP	Tons, Millions		Tons, Millions	
Accepted	2.2	1.9	6.1	3.6
Used in HMA/WMA Mixtures	1.9	1.8	5.3	3.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.14	1.63	3.17	3.16
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	26.8%	24.8%		
Average % for Other Agency Mixtures[1]	25.4%	20.7%		
Average % for Commercial & Residential Mixtures[1]	25.9%	23.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			26.4%	23.8%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	21%	7%		
% of RAP Mixtures Using Softer Binders	19%	44%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	75.0	33.0	208.3	64.1
Processed Shingles Accepted	30.8	19.5	85.6	37.9
Used in HMA/WMA Mixtures	59.0	118.3	163.9	229.9
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	131.3	115.5	364.7	224.4
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	1.00%	2.50%		
Average % for Other Agency Mixtures[1]	0.70%	1.17%		
Average % for Commercial & Residential Mixtures[1]	0.70%	1.17%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.82%	1.53%
	Other Reported Data			
% Companies Reporting Using RAS	43%	67%		
% of RAS Mixtures Using Softer Binders	100%	75%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.4	0.1
Total Tons Produced With WMA Technology at HMA Temperatures			2.1	0.3
DOT	13%	3%	1.8	0.3
Other Agency	25%	4%	0.6	0.1
Commercial & Residential	5%	2%	0.2	0.0
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	100%	74%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	0%	26%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	14%	33%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NORTH DAKOTA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	2.8	2.3
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

NORTHERN MARIANA ISLANDS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	NCR	NCR	0.03	0.03
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
No. of Companies Reporting	NCR	NCR		
RAP	Tons, Millions		Tons, Millions	
Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAP Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAP	NCR	NCR		
% of RAP Fractionated	NCR	NCR		
% of RAP Mixtures Using Softer Binders	NCR	NCR		
% of RAP Mixtures Using Recycling Agents	NCR	NCR		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	NCR	NCR	NCR	NCR
Processed Shingles Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAS Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAS	NCR	NCR		
% of RAS Mixtures Using Softer Binders	NCR	NCR		
% of RAS Mixtures Using Recycling Agents	NCR	NCR		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			NCR	NCR
Total Tons Produced With WMA Technology at HMA Temperatures			NCR	NCR
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	NCR	NCR		
Additive Foaming, % of Market	NCR	NCR		
Plant Foaming, % of Market	NCR	NCR		
Organic Additive, % of Market	NCR	NCR		
% Companies Reporting Using WMA Technologies	NCR	NCR		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

OHIO	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	12.3	11.2	16.9	19.4
DOT	4.3	3.8	5.9	6.6
Other Agency	4.4	3.9	6.1	6.8
Commercial & Residential	3.6	3.5	4.9	6.0
No. of Companies Reporting	9	9		
RAP	Tons, Millions		Tons, Millions	
Accepted	3.4	4.6	4.7	7.9
Used in HMA/WMA Mixtures	3.4	3.6	4.7	6.3
Used as Aggregate	0.1	0.0	0.1	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	8.15	6.37	11.20	11.07
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	27.3%	29.4%		
Average % for Other Agency Mixtures[1]	27.1%	28.9%		
Average % for Commercial & Residential Mixtures[1]	30.4%	34.8%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			28.0%	32.2%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	7%	13%		
% of RAP Mixtures Using Softer Binders	33%	31%		
% of RAP Mixtures Using Recycling Agents	0%	7%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	9.8	10.4	13.5	18.1
Processed Shingles Accepted	5.0	0.0	6.9	0.0
Used in HMA/WMA Mixtures	15.9	7.0	21.8	12.2
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	30.2	24.4	41.5	42.4
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.09%	0.02%		
Average % for Other Agency Mixtures[1]	0.17%	0.02%		
Average % for Commercial & Residential Mixtures[1]	0.16%	0.08%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.13%	0.06%
	Other Reported Data			
% Companies Reporting Using RAS	44%	33%		
% of RAS Mixtures Using Softer Binders	71%	33%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			7.0	8.6
Total Tons Produced With WMA Technology at HMA Temperatures			3.2	1.8
DOT	72%	70%	4.3	4.6
Other Agency	54%	47%	3.3	3.2
Commercial & Residential	53%	43%	2.6	2.6
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	1%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	100%	99%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	78%	78%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

OKLAHOMA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	2.2	2.0	4.7	5.5
DOT	1.2	0.8	2.6	2.2
Other Agency	0.3	0.4	0.6	1.1
Commercial & Residential	0.7	0.8	1.5	2.3
No. of Companies Reporting	6	7		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.4	0.5	0.9	1.3
Used in HMA/WMA Mixtures	0.4	0.4	0.8	1.1
Used as Aggregate	0.0	0.0	0.0	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.36	0.39	0.77	1.10
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	17.0%	19.6%		
Average % for Other Agency Mixtures[1]	17.9%	20.4%		
Average % for Commercial & Residential Mixtures[1]	17.8%	18.5%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.3%	19.4%
	Other Reported Data			
% Companies Reporting Using RAP	83%	86%		
% of RAP Fractionated	52%	32%		
% of RAP Mixtures Using Softer Binders	7%	10%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	6.3	2.0	13.5	5.6
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.8	1.0	1.7	2.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	52.5	5.0	112.2	14.1
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.05%		
Average % for Other Agency Mixtures[1]	0.05%	0.05%		
Average % for Commercial & Residential Mixtures[1]	0.05%	0.05%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.04%	0.05%
	Other Reported Data			
% Companies Reporting Using RAS	33%	14%		
% of RAS Mixtures Using Softer Binders	63%	100%		
% of RAS Mixtures Using Recycling Agents	13%	50%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			2.0	1.9
Total Tons Produced With WMA Technology at HMA Temperatures			0.4	0.7
DOT	44%	60%	1.1	1.3
Other Agency	74%	42%	0.5	0.5
Commercial & Residential	54%	39%	0.8	0.9
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	17%	23%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	32%	77%		
Organic Additive, % of Market	51%	0%		
% Companies Reporting Using WMA Technologies	50%	43%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

OREGON	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	2.2	1.9	5.2	5.3
DOT	0.4	0.4	0.9	1.0
Other Agency	0.7	0.8	1.7	2.3
Commercial & Residential	1.1	0.7	2.6	2.0
No. of Companies Reporting	4	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.5	0.6	1.2	1.6
Used in HMA/WMA Mixtures	0.6	0.5	1.4	1.4
Used as Aggregate	0.0	0.0	0.0	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.35	0.82	0.83	2.25
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	25.0%	24.6%		
Average % for Other Agency Mixtures[1]	26.3%	25.7%		
Average % for Commercial & Residential Mixtures[1]	27.8%	28.7%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			26.8%	26.2%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	11%	1%		
% of RAP Mixtures Using Softer Binders	3%	7%		
% of RAP Mixtures Using Recycling Agents	3%	25%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	11.0	13.0	26.0	36.0
Used in HMA/WMA Mixtures	9.3	12.2	22.0	33.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	1.9	1.0	4.5	2.8
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.10%	0.76%		
Average % for Other Agency Mixtures[1]	0.35%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.60%	0.41%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.42%	0.64%
	Other Reported Data			
% Companies Reporting Using RAS	25%	33%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	100%	75%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.5	0.5
Total Tons Produced With WMA Technology at HMA Temperatures			0.8	2.8
DOT	28%	84%	0.4	0.8
Other Agency	32%	52%	0.5	1.2
Commercial & Residential	17%	60%	0.4	1.2
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	1%	7%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	99%	93%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	75%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

PENNSYLVANIA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	6.3	2.6	20.0	20.5
DOT	3.1	0.9	9.8	6.8
Other Agency	1.3	0.8	4.2	6.2
Commercial & Residential	1.9	0.9	6.0	7.5
No. of Companies Reporting	8	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.0	0.4	3.2	3.3
Used in HMA/WMA Mixtures	1.0	0.3	3.2	2.7
Used as Aggregate	0.0	0.0	0.1	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.93	0.40	2.95	3.18
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	15.1%	12.6%		
Average % for Other Agency Mixtures[1]	15.0%	12.6%		
Average % for Commercial & Residential Mixtures[1]	16.3%	15.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			15.9%	13.1%
	Other Reported Data			
% Companies Reporting Using RAP	88%	80%		
% of RAP Fractionated	13%	0%		
% of RAP Mixtures Using Softer Binders	13%	0%		
% of RAP Mixtures Using Recycling Agents	3%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	35.0	30.0	111.1	238.3
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	49.2	25.0	156.2	198.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	33.9	5.0	107.6	39.7
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.78%	0.97%		
Average % for Other Agency Mixtures[1]	0.78%	0.97%		
Average % for Commercial & Residential Mixtures[1]	0.78%	0.97%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.78%	0.97%
	Other Reported Data			
% Companies Reporting Using RAS	13%	20%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			8.6	4.9
Total Tons Produced With WMA Technology at HMA Temperatures			4.6	7.6
DOT	73%	98%	7.2	6.6
Other Agency	83%	55%	3.5	3.4
Commercial & Residential	42%	33%	2.5	2.5
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	18%	17%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	82%	83%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	75%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

PUERTO RICO	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	NCR	NCR	1.7	1.4
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
No. of Companies Reporting	NCR	NCR		
RAP	Tons, Millions		Tons, Millions	
Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAP Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAP	NCR	NCR		
% of RAP Fractionated	NCR	NCR		
% of RAP Mixtures Using Softer Binders	NCR	NCR		
% of RAP Mixtures Using Recycling Agents	NCR	NCR		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	NCR	NCR	NCR	NCR
Processed Shingles Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAS Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAS	NCR	NCR		
% of RAS Mixtures Using Softer Binders	NCR	NCR		
% of RAS Mixtures Using Recycling Agents	NCR	NCR		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			NCR	NCR
Total Tons Produced With WMA Technology at HMA Temperatures			NCR	NCR
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	NCR	NCR		
Additive Foaming, % of Market	NCR	NCR		
Plant Foaming, % of Market	NCR	NCR		
Organic Additive, % of Market	NCR	NCR		
% Companies Reporting Using WMA Technologies	NCR	NCR		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

RHODE ISLAND	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	2.1	1.9
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

SOUTH CAROLINA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	4.1	3.3	7.5	8.9
DOT	2.5	2.4	4.6	6.3
Other Agency	0.7	0.6	1.3	1.6
Commercial & Residential	0.9	0.4	1.6	1.0
No. of Companies Reporting	6	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.9	0.5	1.6	1.4
Used in HMA/WMA Mixtures	0.9	0.7	1.7	2.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.09	0.71	1.99	1.91
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	21.9%	21.2%		
Average % for Other Agency Mixtures[1]	23.2%	21.6%		
Average % for Commercial & Residential Mixtures[1]	23.2%	24.6%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			22.4%	22.0%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	61%	46%		
% of RAP Mixtures Using Softer Binders	29%	0%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.8	3.0	1.5	8.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.8	0.0	2.1
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	2.5	7.0	4.6	18.7
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.03%		
Average % for Other Agency Mixtures[1]	0.00%	0.03%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.02%
	Other Reported Data			
% Companies Reporting Using RAS	0%	20%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.0	3.1
Total Tons Produced With WMA Technology at HMA Temperatures			0.6	0.0
DOT	26%	33%	1.1	2.1
Other Agency	22%	50%	0.3	0.8
Commercial & Residential	13%	25%	0.2	0.2
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	66%	97%		
Additive Foaming, % of Market	34%	0%		
Plant Foaming, % of Market	0%	3%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	100%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

SOUTH DAKOTA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	NCR	NCR	2.2	2.6
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
No. of Companies Reporting	NCR	NCR		
RAP	Tons, Millions		Tons, Millions	
Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAP Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAP	NCR	NCR		
% of RAP Fractionated	NCR	NCR		
% of RAP Mixtures Using Softer Binders	NCR	NCR		
% of RAP Mixtures Using Recycling Agents	NCR	NCR		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	NCR	NCR	NCR	NCR
Processed Shingles Accepted	NCR	NCR	NCR	NCR
Used in HMA/WMA Mixtures	NCR	NCR	NCR	NCR
Used as Aggregate	NCR	NCR	NCR	NCR
Used in Cold-Mix Asphalt	NCR	NCR	NCR	NCR
Used in Other	NCR	NCR	NCR	NCR
Landfilled	NCR	NCR	NCR	NCR
Total Tons of RAS Stockpiled at Year-End	NCR	NCR	NCR	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	NCR	NCR		
Average % for Other Agency Mixtures[1]	NCR	NCR		
Average % for Commercial & Residential Mixtures[1]	NCR	NCR		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			NCR	NCR
	Other Reported Data			
% Companies Reporting Using RAS	NCR	NCR		
% of RAS Mixtures Using Softer Binders	NCR	NCR		
% of RAS Mixtures Using Recycling Agents	NCR	NCR		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			NCR	NCR
Total Tons Produced With WMA Technology at HMA Temperatures			NCR	NCR
DOT	NCR	NCR	NCR	NCR
Other Agency	NCR	NCR	NCR	NCR
Commercial & Residential	NCR	NCR	NCR	NCR
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	NCR	NCR		
Additive Foaming, % of Market	NCR	NCR		
Plant Foaming, % of Market	NCR	NCR		
Organic Additive, % of Market	NCR	NCR		
% Companies Reporting Using WMA Technologies	NCR	NCR		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

TENNESSEE	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.7	8.2	8.9	10.1
DOT	3.6	3.2	5.6	4.0
Other Agency	0.7	1.8	1.1	2.2
Commercial & Residential	1.4	3.2	2.2	4.0
No. of Companies Reporting	5	5		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.6	2.0	0.9	2.4
Used in HMA/WMA Mixtures	1.0	1.9	1.6	2.4
Used as Aggregate	0.1	0.0	0.1	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.2	0.0	0.3
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.39	4.02	2.17	4.94
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	16.6%	24.0%		
Average % for Other Agency Mixtures[1]	17.8%	20.4%		
Average % for Commercial & Residential Mixtures[1]	19.5%	24.2%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.5%	23.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	22%	15%		
% of RAP Mixtures Using Softer Binders	5%	0%		
% of RAP Mixtures Using Recycling Agents	2%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	13.1	15.4	20.5	18.9
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	21.1	21.3	32.9	26.1
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	9.6	8.5	15.0	10.4
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.35%	0.31%		
Average % for Other Agency Mixtures[1]	0.35%	0.16%		
Average % for Commercial & Residential Mixtures[1]	0.40%	0.17%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.37%	0.26%
	Other Reported Data			
% Companies Reporting Using RAS	40%	40%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	50%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.0	0.3
Total Tons Produced With WMA Technology at HMA Temperatures			1.2	3.7
DOT	21%	57%	1.2	2.3
Other Agency	40%	8%	0.5	0.2
Commercial & Residential	24%	40%	0.5	1.6
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	82%	93%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	18%	7%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	40%	60%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

TEXAS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	7.2	5.9	17.2	40.0
DOT	3.7	2.5	8.8	17.0
Other Agency	2.0	2.1	4.8	14.3
Commercial & Residential	1.5	1.3	3.6	8.7
No. of Companies Reporting	6	4		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.1	0.8	2.6	5.2
Used in HMA/WMA Mixtures	1.2	0.9	2.9	6.4
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.68	0.77	4.01	5.27
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	18.9%	13.0%		
Average % for Other Agency Mixtures[1]	15.6%	16.8%		
Average % for Commercial & Residential Mixtures[1]	18.8%	21.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.1%	16.0%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	63%	50%		
% of RAP Mixtures Using Softer Binders	38%	14%		
% of RAP Mixtures Using Recycling Agents	8%	20%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	48.8	32.0	116.6	218.3
Processed Shingles Accepted	17.6	4.0	42.0	27.3
Used in HMA/WMA Mixtures	55.0	39.6	131.4	270.2
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	15.0	42.0	77.9	286.5
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	1.23%	0.66%		
Average % for Other Agency Mixtures[1]	0.44%	0.59%		
Average % for Commercial & Residential Mixtures[1]	0.65%	0.72%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.76%	0.68%
	Other Reported Data			
% Companies Reporting Using RAS	83%	75%		
% of RAS Mixtures Using Softer Binders	70%	13%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			3.6	8.7
Total Tons Produced With WMA Technology at HMA Temperatures			6.1	18.6
DOT	61%	77%	5.4	13.1
Other Agency	52%	65%	2.5	9.3
Commercial & Residential	51%	56%	1.8	4.9
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	97%	88%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	3%	12%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	100%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

U.S. VIRGIN ISLANDS	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	NCR	0.12	0.09
DOT	*	NCR	*	NCR
Other Agency	*	NCR	*	NCR
Commercial & Residential	*	NCR	*	NCR
No. of Companies Reporting	*	NCR		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	NCR	*	NCR
Used in HMA/WMA Mixtures	*	NCR	*	NCR
Used as Aggregate	*	NCR	*	NCR
Used in Cold-Mix Asphalt	*	NCR	*	NCR
Used in Other	*	NCR	*	NCR
Landfilled	*	NCR	*	NCR
Total Tons of RAP Stockpiled at Year-End	*	NCR	*	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	NCR		
Average % for Other Agency Mixtures[1]	*	NCR		
Average % for Commercial & Residential Mixtures[1]	*	NCR		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	NCR
	Other Reported Data			
% Companies Reporting Using RAP	*	NCR		
% of RAP Fractionated	*	NCR		
% of RAP Mixtures Using Softer Binders	*	NCR		
% of RAP Mixtures Using Recycling Agents	*	NCR		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	NCR	*	NCR
Processed Shingles Accepted	*	NCR	*	NCR
Used in HMA/WMA Mixtures	*	NCR	*	NCR
Used as Aggregate	*	NCR	*	NCR
Used in Cold-Mix Asphalt	*	NCR	*	NCR
Used in Other	*	NCR	*	NCR
Landfilled	*	NCR	*	NCR
Total Tons of RAS Stockpiled at Year-End	*	NCR	*	NCR
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	NCR		
Average % for Other Agency Mixtures[1]	*	NCR		
Average % for Commercial & Residential Mixtures[1]	*	NCR		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	NCR
	Other Reported Data			
% Companies Reporting Using RAS	*	NCR		
% of RAS Mixtures Using Softer Binders	*	NCR		
% of RAS Mixtures Using Recycling Agents	*	NCR		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	NCR
Total Tons Produced With WMA Technology at HMA Temperatures			*	NCR
DOT	*	NCR	*	NCR
Other Agency	*	NCR	*	NCR
Commercial & Residential	*	NCR	*	NCR
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	NCR		
Additive Foaming, % of Market	*	NCR		
Plant Foaming, % of Market	*	NCR		
Organic Additive, % of Market	*	NCR		
% Companies Reporting Using WMA Technologies	*	NCR		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

UTAH	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	3.7	2.9	4.0	4.2
DOT	1.4	0.8	1.5	1.2
Other Agency	0.9	0.5	1.0	0.7
Commercial & Residential	1.4	1.6	1.5	2.4
No. of Companies Reporting	9	8		
RAP	Tons, Millions		Tons, Millions	
Accepted	0.8	0.8	0.9	1.1
Used in HMA/WMA Mixtures	1.0	0.8	1.1	1.2
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.43	1.17	1.55	1.66
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	23.1%	21.6%		
Average % for Other Agency Mixtures[1]	20.2%	18.5%		
Average % for Commercial & Residential Mixtures[1]	33.3%	36.1%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			27.0%	27.8%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	29%	13%		
% of RAP Mixtures Using Softer Binders	40%	52%		
% of RAP Mixtures Using Recycling Agents	12%	7%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			1.6	1.5
Total Tons Produced With WMA Technology at HMA Temperatures			1.9	1.6
DOT	94%	64%	1.4	0.8
Other Agency	77%	68%	0.7	0.4
Commercial & Residential	87%	84%	1.3	2.0
WMA Technologies‡	Other Reported Data			
Chemical Additive, % of Market	16%	31%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	84%	69%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	78%	75%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

VERMONT	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	1.9	1.7
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

VIRGINIA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.1	5.8	11.0	12.0
DOT	2.2	2.2	4.7	4.5
Other Agency	1.1	0.6	2.4	1.2
Commercial & Residential	1.8	3.0	3.9	6.2
No. of Companies Reporting	7	7		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.7	2.3	3.7	4.9
Used in HMA/WMA Mixtures	1.4	1.6	3.0	3.4
Used as Aggregate	0.1	0.0	0.3	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.1
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.81	1.73	3.90	3.60
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	26.5%	25.6%		
Average % for Other Agency Mixtures[1]	26.0%	24.9%		
Average % for Commercial & Residential Mixtures[1]	29.0%	29.1%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			27.5%	28.0%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	26%	27%		
% of RAP Mixtures Using Softer Binders	5%	19%		
% of RAP Mixtures Using Recycling Agents	1%	7%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.1	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	14%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			3.6	8.3
Total Tons Produced With WMA Technology at HMA Temperatures			3.0	2.3
DOT	69%	80%	3.3	3.6
Other Agency	46%	86%	1.1	1.0
Commercial & Residential	58%	94%	2.3	5.9
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	47%	93%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	53%	7%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	71%	71%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

WASHINGTON	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	5.5	4.4	5.9	6.3
DOT	0.9	0.9	1.0	1.2
Other Agency	1.9	1.8	2.0	2.6
Commercial & Residential	2.7	1.7	2.9	2.5
No. of Companies Reporting	9	8		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.2	1.1	1.3	1.6
Used in HMA/WMA Mixtures	1.3	1.0	1.4	1.4
Used as Aggregate	0.1	0.1	0.1	0.1
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.02	1.26	1.09	1.79
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	20.1%	17.7%		
Average % for Other Agency Mixtures[1]	18.7%	21.3%		
Average % for Commercial & Residential Mixtures[1]	25.8%	24.8%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			23.6%	22.5%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	12%	23%		
% of RAP Mixtures Using Softer Binders	19%	27%		
% of RAP Mixtures Using Recycling Agents	9%	1%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	14.7	12.6	15.8	17.9
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	14.5	11.1	15.6	15.8
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	7.2	3.5	7.7	5.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.19%	0.18%		
Average % for Other Agency Mixtures[1]	0.19%	0.17%		
Average % for Commercial & Residential Mixtures[1]	0.36%	0.36%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.26%	0.25%
	Other Reported Data			
% Companies Reporting Using RAS	33%	38%		
% of RAS Mixtures Using Softer Binders	33%	37%		
% of RAS Mixtures Using Recycling Agents	7%	5%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.4	0.4
Total Tons Produced With WMA Technology at HMA Temperatures			1.1	2.3
DOT	14%	35%	0.1	0.4
Other Agency	23%	41%	0.5	1.1
Commercial & Residential	33%	47%	0.9	1.2
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	5%	1%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	95%	99%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	56%	88%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

WEST VIRGINIA	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	2.5	2.3	3.5	4.2
DOT	2.2	1.7	3.1	3.1
Other Agency	0.2	0.4	0.3	0.8
Commercial & Residential	0.1	0.2	0.1	0.3
No. of Companies Reporting	3	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.1	0.3	1.5	0.5
Used in HMA/WMA Mixtures	0.5	0.4	0.7	0.7
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	0.56	0.33	0.78	0.60
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	20.0%	17.5%		
Average % for Other Agency Mixtures[1]	20.0%	17.7%		
Average % for Commercial & Residential Mixtures[1]	20.0%	17.7%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			20.0%	17.6%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	0%	0%		
% of RAP Mixtures Using Softer Binders	0%	0%		
% of RAP Mixtures Using Recycling Agents	0%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	0.0	0.0	0.0	0.0
Processed Shingles Accepted	0.0	0.0	0.0	0.0
Used in HMA/WMA Mixtures	0.0	0.0	0.0	0.0
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	0.0	0.0	0.0	0.0
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.00%	0.00%		
Average % for Other Agency Mixtures[1]	0.00%	0.00%		
Average % for Commercial & Residential Mixtures[1]	0.00%	0.00%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.00%	0.00%
	Other Reported Data			
% Companies Reporting Using RAS	0%	0%		
% of RAS Mixtures Using Softer Binders	0%	0%		
% of RAS Mixtures Using Recycling Agents	0%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			0.0	0.0
Total Tons Produced With WMA Technology at HMA Temperatures			0.0	0.0
DOT	0%	0%	0.0	0.0
Other Agency	0%	0%	0.0	0.0
Commercial & Residential	0%	0%	0.0	0.0
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	0%	0%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	0%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	0%	0%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

WISCONSIN	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	9.2	8.7	12.5	12.0
DOT	4.2	5.0	5.7	6.9
Other Agency	2.2	1.9	3.0	2.6
Commercial & Residential	2.8	1.8	3.8	2.5
No. of Companies Reporting	6	3		
RAP	Tons, Millions		Tons, Millions	
Accepted	1.3	1.6	1.8	2.2
Used in HMA/WMA Mixtures	1.6	1.8	2.2	2.5
Used as Aggregate	0.1	0.0	0.1	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAP Stockpiled at Year-End	1.87	2.00	2.54	2.77
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	14.2%	20.3%		
Average % for Other Agency Mixtures[1]	19.5%	20.3%		
Average % for Commercial & Residential Mixtures[1]	19.3%	23.0%		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			17.4%	20.7%
	Other Reported Data			
% Companies Reporting Using RAP	100%	100%		
% of RAP Fractionated	5%	3%		
% of RAP Mixtures Using Softer Binders	21%	5%		
% of RAP Mixtures Using Recycling Agents	3%	0%		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	80.4	36.0	109.2	49.8
Processed Shingles Accepted	15.8	28.2	21.5	39.0
Used in HMA/WMA Mixtures	59.9	38.0	81.4	52.6
Used as Aggregate	0.0	0.0	0.0	0.0
Used in Cold-Mix Asphalt	0.0	0.0	0.0	0.0
Used in Other	0.0	0.0	0.0	0.0
Landfilled	0.0	0.0	0.0	0.0
Total Tons of RAS Stockpiled at Year-End	129.4	46.2	175.8	63.9
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	0.50%	0.44%		
Average % for Other Agency Mixtures[1]	0.73%	0.44%		
Average % for Commercial & Residential Mixtures[1]	0.73%	0.44%		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			0.65%	0.44%
	Other Reported Data			
% Companies Reporting Using RAS	100%	100%		
% of RAS Mixtures Using Softer Binders	55%	75%		
% of RAS Mixtures Using Recycling Agents	7%	0%		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			2.4	1.0
Total Tons Produced With WMA Technology at HMA Temperatures			1.0	0.3
DOT	41%	11%	2.3	0.8
Other Agency	17%	15%	0.6	0.4
Commercial & Residential	13%	7%	0.5	0.2
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	100%	100%		
Additive Foaming, % of Market	0%	0%		
Plant Foaming, % of Market	0%	0%		
Organic Additive, % of Market	0%	0%		
% Companies Reporting Using WMA Technologies	67%	100%		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

WYOMING	Reported Values		Estimated Values	
	2018	2019	2018	2019
Tons of HMA/WMA Produced	Tons, Millions		Tons, Millions	
Total	*	*	2.5	2.3
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
No. of Companies Reporting	*	*		
RAP	Tons, Millions		Tons, Millions	
Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAP Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAP Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAP	*	*		
% of RAP Fractionated	*	*		
% of RAP Mixtures Using Softer Binders	*	*		
% of RAP Mixtures Using Recycling Agents	*	*		
RAS	Tons, Thousands		Tons, Thousands	
Unprocessed Shingles Accepted	*	*	*	*
Processed Shingles Accepted	*	*	*	*
Used in HMA/WMA Mixtures	*	*	*	*
Used as Aggregate	*	*	*	*
Used in Cold-Mix Asphalt	*	*	*	*
Used in Other	*	*	*	*
Landfilled	*	*	*	*
Total Tons of RAS Stockpiled at Year-End	*	*	*	*
	Avg. % Used in Mixtures		Avg. % Used in Mixtures	
Average % for DOT Mixtures[1]	*	*		
Average % for Other Agency Mixtures[1]	*	*		
Average % for Commercial & Residential Mixtures[1]	*	*		
State Average All Mixtures Based on RAS Tons Used in HMA/WMA[2]			*	*
	Other Reported Data			
% Companies Reporting Using RAS	*	*		
% of RAS Mixtures Using Softer Binders	*	*		
% of RAS Mixtures Using Recycling Agents	*	*		
WMA	% of Total Production		Tons, Millions	
Total Tons Produced With WMA Technology at Reduced Temperature			*	*
Total Tons Produced With WMA Technology at HMA Temperatures			*	*
DOT	*	*	*	*
Other Agency	*	*	*	*
Commercial & Residential	*	*	*	*
WMA Technologies	Other Reported Data			
Chemical Additive, % of Market	*	*		
Additive Foaming, % of Market	*	*		
Plant Foaming, % of Market	*	*		
Organic Additive, % of Market	*	*		
% Companies Reporting Using WMA Technologies	*	*		

[1] Average percent based on contractor's reported percentage for each sector, adjusted based upon reported tonnage.
[2] Average percent based on total reported tons of RAP or RAS used in HMA/WMA divided by reported total tons HMA/WMA produced.

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10th Annual Asphalt Pavement Industry Survey
IS 138 — Appendix B

NATIONAL ASPHALT PAVEMENT ASSOCIATION

Asphalt Pavement Industry Survey on

Recycled Materials and Warm-Mix Asphalt Usage 2019

IS-138 Appendix C:
Methodology for Calculating Energy and Greenhouse Gas Emission Benefits From Production of WMA and Use of RAP

10th Annual Survey

Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage: 2019 Appendix C

Introduction

Appendix C provides a detailed overview of the methodology and assumptions used to calculate energy and greenhouse gas (GHG) emission benefits from production of WMA at reduced temperature and use of RAP in new asphalt mixtures. These calculations are based on publicly available data published by government agencies, industry, and non-governmental organizations. For many of these calculations, multiple data sources exist for the underlying emission factors. In such cases, the most recent and comprehensive data sources were selected.

Methodology for Calculating Energy and GHG Emissions Reduction from Production of WMA at Reduced Temperature

To estimate reductions in energy consumption and GHG emissions associated with the production of WMA at reduced temperature, we start by estimating the average temperature reduction achieved by plants that reduce mix production temperature when using WMA technologies. We then estimate the expected energy savings (Btu) from reduced temperature, convert that to fuel volume (natural gas), and use emission factors to estimate the combustion-related GHG emissions reduction from producing WMA at reduced temperature.

Temperature Reduction

The survey classifies reduced-temperature WMA as having a temperature reduction of at least 10° F. This represents a conservative low-end estimate for the average temperature reduction achieved. Since the survey does not collect data on actual temperature reductions achieved, we assign an optimistic estimate for average temperature reduction of 40° F. As a point of reference, the average temperature reduction achieved by plants tested in NCHRP Report 779 was 48° F (National Academies of Science, Engineering, and Medicine (NASEM), 2014), suggesting that the 40° F optimistic scenario is reasonable.

Energy Savings

NCHRP Report 779 provides an estimated energy savings of 1,100 Btu/°F per ton of WMA produced (NASEM, 2014). Here, we use a slightly more conservative value of 1,000 Btu/°F/ton, which is the same value used for NAPA's GHG Calculator tool. It should be noted that this estimate only accounts for reduced burner fuel combustion and does not account for the electricity savings associated with the improved efficiency of baghouse fans handling WMA exhaust gas at reduced temperature.

GHG Emissions Reduction

We assume that all of the plants burn natural gas for their burner fuel and utilize emission factors published by NREL (Deru & Torcellini, 2007), which provides both pre-combustion and on-site combustion emission factors. The pre-combustion emission factors account for the energy required to extract, process, and deliver the fuel. On-site combustion emission factors are simply the emissions released during combustion of fuel in the burner. The sum of the pre-combustion and on-site combustion emission factors for natural gas burned in a commercial boiler is 150.8 lb CO_2e/1000 ft^3 natural gas, which can be converted to 65.96 kg CO_2e/MMBtu natural gas, assuming that natural gas has a higher heating value of 1,037 Btu/ft^3 (EIA, 2020).

The following information would help constrain the estimate of GHG emissions reduction for WMA produced at reduced temperature:

- Actual reductions in mix temperature achieved by plants that produce WMA at reduced temperature,
- Characterization of the types and relative amounts of burner fuel consumed by asphalt plants, and
- Reliable estimates of electricity savings associated with the improved efficiency of baghouse fans handling WMA exhaust gas at reduced temperature.

WMA GHG Burdens – General Considerations

WMA production requires the use of additional materials, such as water or chemical additives, that are not typically used for asphalt mixture production. GHG emissions associated with extracting, processing, and transporting those materials are referred to as the upstream WMA GHG burdens. The magnitude of these burdens depends on the type of WMA technology utilized and application-specific parameters. For foamed asphalt WMA technologies, the primary upstream GHG burden is associated with extracting, treating (if applicable), and delivering water to the facility. For chemical and organic additives, the upstream GHG burdens stem from extracting, processing, and transporting the chemical or organic additives to the asphalt plant.

GHG Burdens from Foamed Asphalt Water Consumption

Foamed asphalt consumes approximately 1-2 percent water by weight of virgin asphalt binder. For this analysis, we use a conservative estimate of 2 percent. If we assume the average binder content of foamed asphalt WMA mixtures is 5 percent, approximately 44,100 tons of water are consumed to produce WMA at reduced temperature. This can be converted to 10.6 million gallons (MG) assuming 8.33 lbs of water per gallon.

To our knowledge, no federal agencies have published nationwide data regarding the carbon footprint of supplying water. However, Griffiths-Sattenspiel and Wilson (2009) provide a sector-specific analysis of water consumption and related greenhouse gas emissions. Based on the data reported by Griffiths-Sattenspiel and Wilson (2009), municipal water supply has the highest carbon intensity at 1.25 tonne CO_2e/MG water. Industrial and mining water supplies have carbon intensities of 0.33 and 0.25 tonne CO_2e/MG water, respectively. Information on which type of water supply asphalt plants use is not collected in the industry survey, but it's likely a mix of municipal, industrial, and mining water supply sources. For this report, we use the more conservative estimate for municipal water supply carbon intensity, which likely over-estimates the carbon intensity for supplying water to asphalt plants, perhaps by as much as a factor of four or five.

The GHG burden for supplying water for foamed WMA produced at reduced temperature is estimated to be 13 tonne CO_2e/year, which is less than a tenth of a percent of the most conservative estimate of GHG emissions reduction for WMA produced at reduced temperature. Thus, the upstream GHG burdens for foamed water consumption are negligible.

GHG Burdens from Chemical and Organic Additives

Estimating the upstream emissions for producing chemical and organic WMA additives is more complex than doing so for water. There are numerous suppliers for these additives, each of which uses different chemical compositions and proprietary manufacturing processes, with dosage rates that vary by type of additive and application-specific parameters. Collecting the necessary data to constrain these variables would be a substantial effort and is outside the scope of this survey. Some additives are used for other purposes, such as anti-strip or recycling agents, and the WMA functionality is a co-benefit, creating additional challenges with respect to allocation of burdens to WMA.

Even if the types and quantities of WMA additives could be estimated, there is very little publicly available information about the upstream GHG emissions associated with manufacturing and transporting WMA additives. Recently, Ingevity published an analysis of the environmental impacts and benefits of producing its Evotherm M1 WMA additive (ERM, 2020). To our knowledge, this is the only publicly available data that offers insight into the upstream GHG burdens for WMA additives.

It would not be prudent to extrapolate the Ingevity data to the entire population of WMA produced at reduced temperature using chemical and organic additives. Thus, the upstream GHG burdens from WMA additives are not included in Table 17 of the report. However, there is an opportunity to calculate an order-of-magnitude estimate based on the Ingevity data to provide some insight to the upstream burdens.[1] The order-of-magnitude estimate suggests that upstream WMA GHG burdens for chemical additives can be significant, although they are likely to be

[1] Assuming a 5 percent binder content for WMA produced at reduced temperature using a chemical additive and a dosage rate of 0.5 percent Evotherm M1 by weight of binder, 8,525 tons of WMA additive would be utilized under this hypothetical but unrealistic scenario. Using Ingevity's published value of 4.4 kg CO_2e/kg Evotherm M1, the upstream GHG emissions would be approximately 0.034 million tonne CO_2e if it were the only additive used to produce WMA using a chemical additive at reduced temperature.

lower than even the most conservative estimate for GHG emission reduction for WMA produced at reduced temperature. The following information would allow for a more accurate estimate of upstream WMA GHG emissions:

- Characterization and quantification of the types and amounts of chemical and organic WMA additives that are used,
- More robust data regarding the upstream GHG emissions for commonly used WMA additives, and
- Development of an allocation procedure to address co-benefits of WMA additives such as anti-strip and recycling agent functionalities.

Methodology for Calculating GHG Emissions Reduction from Use of RAP in New Asphalt Mixtures

GHG emissions reduction from use of RAP in new asphalt mixtures is quantified by estimating the avoided upstream emissions that would be associated with extracting, processing, and transporting virgin materials (aggregate and asphalt binder) that the RAP replaces in asphalt mixtures. To quantify the GHG emission burdens from using RAP, the emissions associated with transporting and processing RAP are estimated. Considerations regarding the use of recycling agents and softer binders is also discussed. This approach relies on several assumptions to address the impacts of recycled and secondary materials from an emissions accounting perspective:

- Emissions associated with materials production, transportation, construction, maintenance, use, and end-of-life (including milling or excavation) of the original pavement from which the RAP was sourced are outside the system boundary and are not included in this analysis. This cut-off method for recycled materials is consistent with Mukherjee (2016) and the Product Category Rules (PCR) for Asphalt Mixtures (NAPA, 2017).
- The average asphalt binder content of RAP is 5 percent, consistent with calculations used elsewhere in this report. The asphalt binder in the RAP is completely mixed and utilized, allowing for a comparable reduction in the use of virgin asphalt binder.
- The use of RAP does not significantly affect asphalt plant energy consumption and related GHG emissions.

GHG Emission Reduction from Avoided Use of Asphalt Binder

Starting with an estimated 89.2 million tons of RAP utilized in asphalt mixtures, approximately 4.46 million tons of virgin asphalt binder is avoided, assuming an average binder content of 5 percent.

Several studies have estimated the carbon footprint associated with extracting, processing, and transporting virgin asphalt binder, and the differences between them are substantial. For this analysis, we use an estimate of 577.9 kg CO_2e/ton as published in the Asphalt Institute's Life Cycle Assessment (LCA) of Asphalt Binder (Wildnauer et al., 2019), which relies on a thermodynamic allocation approach for refinery operations and a bottom-up approach for crude slate allocation based on refinery data specific to asphalt binder production. The LCA of Asphalt Binder also includes the emissions associated with terminal operations, which is not included in many of the other available datasets. The avoided GHG emissions from asphalt binder replacement through the use of RAP is estimated to be 2.58 million tonne CO_2e.

GHG Emission Reduction from Avoided Use of Aggregates

Starting with an estimated 89.2 million tons of RAP utilized in asphalt mixtures, approximately 84.74 million tons of virgin aggregate is avoided, assuming an average aggregate content of 95 percent.

The estimate for the carbon footprint of crushed stone extraction and processing is derived from the Life Cycle Inventory of Portland Cement Concrete (Marceau et al., 2007), who provide a detailed breakdown of the energy sources and quantities for crushed stone production. Emission factors for each energy source were derived from Deru & Torcellini (2007). A summary of the energy and emissions associated with crushed aggregate production in the U.S. is provided in Table C1.

Table C1: Crushed Stone GHG Emission Factor

Energy Source	Energy Used (unit/ton aggregate)[1]	Energy Emission Factor (kg CO_2e/unit)[2]	GHG Emissions (kg CO_2e/ton aggregates)[3]
Coal, ton	0.0000275	2,657[4]	0.073072
Distillate Fuel Oil, gal	0.0932	12.16[5]	1.132966
Residual Fuel Oil, gal	0.0145	13.64[6]	0.197773
Natural Gas, 1000 ft^3	0.00345	150.80[6]	0.52026
Gasoline, gal	0.00939	9.57[5]	0.08987
Electricity, 1000 kWh	0.00296	758[7]	2.24368
Total			**4.26**

1. Source: Marceau et al. (2007)
2. Source: Deru and Torcellini (2007)
3. GHG Emissions is the product of Energy Used and the respective Energy Emission Factor
4. From bituminous coal values in Tables 6 and 8 of Deru and Torcellini (2007)
5. From Tables 6 and 10 of Deru and Torcellini (2007), assuming combustion in a stationary reciprocating engine
6. From Tables 6 and 8 of Deru and Torcellini (2007)
7. From the national average in Table 4 of Deru and Torcellini (2007)

Using the emission factor of 4.26 kg CO_2e/ton aggregates, the avoided GHG emissions from aggregate replacement through the use of RAP is approximately 0.36 million tonne CO_2e.

GHG Emission Reduction from Avoided Transportation of Asphalt Binder and Aggregates

The emission factors for asphalt binder and aggregates derived from Wildnauer et al. (2019) and Marceau et al. (2007) are based on a cradle-to-gate scope, which does not include transportation to the asphalt plant. To estimate the avoided emissions for transporting asphalt binder and aggregates to the asphalt plant, we assume the average haul distance for virgin asphalt binder and aggregates to be 3.9 and 21.5 ton·miles/ton of mix produced, respectively (Mukherkee, 2016). Using the total RAP quantity of 89.2 million tons as the basis for the amount of virgin mix offset by the use of RAP, this yields a combined of 2.27 billion ton·miles of avoided transport.

The emission factors for transportation and distribution via medium- and heavy-duty truck published by the U.S. EPA (2018) for CO_2, CH_4, and N_2O have a combined value of 0.202497 kg CO_2e /ton·mile. This emission factor is multiplied by the estimate of 2.27 billion ton·miles of avoided transport to yield a GHG emission reduction of approximately 0.46 million tonne CO_2e.

GHG Emission Burdens from Use of RAP – General Considerations

Potential GHG emission burdens from use of RAP include a variety of factors, the most straightforward of which are the emissions associated with transporting and processing RAP. For this report, the system boundary begins with transportation of RAP. Activities that occur prior to transportation, such as milling or excavation, are considered part of the end-of-life of phase for the previous pavement and are not included in this estimate.

GHG Emission Burdens from RAP Processing

RAP is often processed by crushing and screening prior to use in asphalt mixture production to improve the quality and consistency of the finished product. The energy required to process the RAP is estimated to be 0.1 gallons of distillate fuel per ton of RAP processed (Mukherjee 2016). Approximately 8.92 million gallons of distillate fuel oil are consumed to process 89.2 million tons of RAP. Using the combined pre-combustion and combustion emission factor of 12.16 kg CO_2e per gallon of distillate fuel oil (Table 19), GHG emissions from RAP processing are estimated to be approximately 0.11 million tonne CO_2e. This estimate assumes that all RAP is processed prior to use, and the processing equipment is powered by a diesel engine.

GHG Emission Burdens from Transportation of RAP

Transportation of RAP from the jobsite to the asphalt plant is included in the system boundary. To estimate the emissions for transporting RAP to the asphalt plant, we assume the average haul distance for RAP to be 50 miles, which is consistent with the typical market area for an asphalt plant (Mukherjee, 2016). The 50-mile haul distance is multiplied by 89.2 million tons to yield 4.46 billion ton·miles. Using the emission factor of 0.202497 kg CO_2e/ton·mile (U.S. EPA, 2018), GHG emissions for transporting RAP to the plant are estimated to be approximately 0.90 million tonne CO_2e.

GHG Emission Burdens from Use of Softer Binders and Recycling Agents

Asphalt plants sometimes use recycling agents or softer binders to improve the quality of asphalt mixtures that contain RAP. On average, survey respondents reported that 18% of RAP mixes used a softer binder and 4% of RAP mixes used a recycling agent in 2019 (Table 8). Specific data regarding the PG grade of binders used and the types and quantities of recycling agents used are not collected in the survey. Additionally, there is no publicly available data regarding the carbon footprint of specific binder grades or recycling agents. Thus, GHG emission burdens from use of softer binders and recycling agents are not estimated in this report.

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