Illinois Department of Transportation

ILLINOIS HIGHWAY MATERIALS SUSTAINABILITY EFFORTS 2024

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EXECUTIVE SUMMARY

The Illinois Department of Transportation (IDOT) continues to use various reclaimed and recycled materials in highway construction and maintenance. Recycled materials are used in highway construction to supplement aggregates, concrete, hot-mix asphalt (HMA), steel, and sealants, as well as for soil modification and pavement markings. This report summarizes the materials used in 2024 as reported from the Department's databases, along with specific reporting on the use of reclaimed asphalt shingles (RAS) and reclaimed asphalt pavement (RAP), efforts to reduce the carbon footprint, and efforts to achieve cost savings by using recycled materials, as required by Illinois Public Act 097-0314.

The recycled materials tracked by IDOT are summarized into four major groups: aggregate, HMA, concrete, and others. Aggregate includes recycled concrete material (RCM), and reclaimed asphalt pavement (RAP) used as aggregate instead of natural aggregates used as granular fill or as a replacement for natural aggregates in HMA. The HMA group includes slags used as friction aggregate, crumb rubber, RAP, and RAS. The concrete group includes fly ash, ground granulated blast furnace slag, and micro silica used to replace or supplement the cement and provide specific properties to the final concrete product. The "other" category group includes by-product lime used for soil modification, glass beads used for pavement-marking retroreflectivity, and steel used for reinforcement in concrete.

In 2019 IDOT began the process of updating its material management system from the Materials Integrated System for Test Information and Communication (MISTIC) to the Construction and Materials Management System (CMMS). As is the nature of any major computer programing update, the process has been deliberate and challenging. Since this report provides a historical recording of recycled material data, it is important to note that the data provided since the 2023 report included a combination of the old MISTIC system data and new CMMS data. The MISTIC system will eventually be phased out as the multi-year projects that were initiated in the MISTIC system conclude. It is projected that by 2026 MISTIC data will no longer be included in the IDOT reporting. In June of 2022 IDOT began full implementation of CMMS on newly let projects. Once the system was fully implemented, several issues were identified, and the system was continually improved by our CMMS program managers. Training and educational efforts continue for IDOT staff to address any ongoing data entry errors or delayed reporting concerns. Once the improvements have been implemented and staff fully trained and all entry errors corrected, IDOT will run additional reports for the recycled material data reported in 2023 and 2024. The revised data will be analyzed and provided in the Illinois Highway Materials Sustainability Efforts 2025. The new data will provide a clearer picture of the Department's use of recycled materials.

In currently available 2024 data from CMMS and MISTIC, reclaimed and recycled materials totaling 838,761 tons were reported. This represents a decrease of 288,112 tons or a 25.6% decrease from 2023 reported quantities of 1,126,872 tons. Funding levels and the portfolio of project types are the major factors influencing recycling levels. According to the "Proposed Highway Improvement Program FY 2024" report, on November 15, 2021, the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law, was signed into law. This new five-year funding authorization bill provides an approximately 20% increase in federal formula funds and an estimated 12% increase over existing formula funds. This funding, along with additional funding from the Rebuild Illinois capital program passed in June 2019, will help to make significant progress in addressing our road and bridge needs in Illinois. The IIJA and the Rebuild Illinois capital program have significantly increased the size of IDOT's highway program.

The FY 2024 Annual Highway Improvement Program remains significantly more extensive than previous years, providing $4.63 billion of the $27.03 billion included for highways in the Fiscal Year 2024-2029

Proposed Highway Improvement Program. Also included are projects totaling $620 million in appropriations from previous fiscal years scheduled to be implemented in 2024. As a result, the FY 2024 Annual Highway Improvement Program totals $5.25 billion. This allows the department to continue to move assertively towards meeting Transportation Asset Management Plan goals and fixing our state's infrastructure.

On a tons-per-mile basis, the reported quantity of recycled materials used in 2024 decreased from 2023. In 2023, there were 1,252.22 tons/mile, compared to 938.48 tons/mile in 2024, a 25.1% decrease. The 25.6% decrease in recycled quantities and a slight, 0.7% decrease in miles constructed included in the program (900 miles in 2023 and 894 miles in 2024) compared to 2023 resulted in a reported decrease in tons/mile observed in 2024. The dollar values of the recycled materials reported in 2024 resulted in a total value of recycled materials at $60,724,472 in 2024, representing an increase of 7.5% from $56,466,182 in 2023. Construction and maintenance material costs continue to rise in some areas.

The amount of RAS used in 2024 was 6,771 tons, a decrease of 10.5% from the 2023 use of 7,569 tons. The RAS use by year, since 2014 is provided and demonstrates the usage trends over time.

The tonnage of HMA reported in 2024 was 2,321,859.9 tons. This is a slight increase of 0.9% from 2,300,700.48 tons in 2023 at the time of the last report. Due to the change in reporting and implementation of CMMS, data reporting concerns have been identified for HMA. For example, one unique detail of the materials management system is that it allows the user to identify inventories, and once built, finalize and approve the material quantity in the CMMS system. This new finalization and approval step impacts the reported quantities of recycled materials used, including the tonnage of HMA. In addition, the new CMMS system reporting timeframes do not complement the reporting deadlines for this report. To test the delayed quantity entry theory, a new data retrieval report was recently generated for 2023 HMA tonnage to identify the difference in reported quantities. The HMA quantities for 2023 reported from CMMS and MISTIC on August 11, 2025, were 4,061,634.75 tons of HMA used by IDOT. This is an increase of 76.5% from 2,300,700.48 tons of HMA reported in the Illinois Highway Materials Sustainability Report 2023. It would be safe to assume that the recycled quantities reported in 2023 were underrepresented for HMA related materials. Improvements were made to the details within the reporting of HMA related materials to address some of the data entry issues, but delays continue to be a concern.

The amount of reclaimed asphalt pavement (RAP) used for HMA increased from 322,825 tons in 2023 to 403,262 tons in 2024, based on the values reported from CMMS and MISTIC. The significant increase in RAP tonnage is likely due to the improvements made to the reporting details for mix designs in CMMS. IDOT will continue to run reports after CMMS entries are completed to verify the final and more accurate HMA tonnage used for 2024.

A greater discrepancy in recycled materials was observed in the Portland Cement Concrete related recycled materials in 2024. Reviewing the 2024 CMMS reports, many reporting errors and lack of mix details were observed for PCC related recycled materials. Work is underway to correct the reporting errors but will not be completed in time to impact this report. In a year with more bridges included in the program, concrete related recycled materials would typically trend upwards.

Improvements continued to be implemented to the CMMS system, and we continue to strive to better represent the recycled materials used by IDOT for future reports.

While reporting tons of recycled materials is important, it does not represent the environmental benefit of using them. This report estimates the savings in the equivalent carbon dioxide (CO_2EQ) emissions of recycled materials used by IDOT. Using fly ash, recycled asphalt pavement and recycled concrete resulted in the most

significant environmental benefits by replacing energy-intensive cement and virgin aggregate. IDOT's recycling efforts were estimated to reduce CO_2EQ emissions by 93,036 tons in 2023 and decreased to 48,160 in 2024 based on the data currently available. The drop in steel slag from 482,580 tons in 2023 to only 85 tons in 2024 and the drastic decrease in reported fly ash used in 2024 contributed to the largest decreases in CO_2EQ savings. Fly ash dropped from 64,281 tons used in 2023 to 18,362 tons used in 2024 or a drop in reported fly ash used of 71.4%. Since fly ash has a large CO_2EQ factor, this significant drop affected our reported savings in the equivalent carbon dioxide emissions. These values will be updated in the 2025 report, once more accurate data is available.

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CHAPTER 1: INTRODUCTION

This report is part of a series of annual reports published since 2010 to document the recycling and sustainability efforts of the Illinois Department of Transportation (IDOT). This report also meets the reporting requirements of Illinois Public Act 097-0314 (Illinois General Assembly 2012).

Various past reports by IDOT and the Illinois Center for Transportation (ICT) provide excellent background information on reclaimed and recycled materials used in highway construction (Brownlee 2011, 2012; Brownlee & Burgdorfer, 2011; Griffiths & Krstulovich, 2002; IDOT, 2013; Lippert & Brownlee, 2012; Lippert et al. 2014, 2015, 2016, 2017; Rowden, 2013; Morse 2018-2022, Senger 2023).

In 2012, Illinois Public Act 097-0314 called on IDOT to report annually on efforts to reduce its carbon footprint and achieve cost savings using recycled materials in asphalt paving projects (IDOT, 2013; Lippert & Brownlee, 2012; Rowden, 2013; Morse 2018-2022, Senger 2023). The act also required IDOT to allow reclaimed asphalt shingles (RAS) in all hot-mix asphalt (HMA) mixes only if such use does not negatively impact pavement life-cycle cost.

Illinois has many years of experience using various reclaimed materials in highway construction. These tend to be materials that reduce the use of virgin materials such as aggregate, cement, or asphalt. Fly ash and ground granulated blast furnace slag (GGBFS) have been added to concrete in Illinois for over 50 years. These additions reduce the amount of cement (a carbon-intensive material) required while lending other desirable properties to concrete. Reclaimed asphalt pavement (RAP) has been widely used since the early 1980's.

Other materials, such as RAS, have a much shorter history of use. Until 2011, IDOT was conducting experimental projects using RAS in HMA. With the passage of Public Act 097-0314, specifications were developed and adopted to allow the use of RAS on all IDOT projects as a contractor option (Lippert & Brownlee, 2012). As with adopting any new specification or policy, issues and areas of improvement were identified, and changes implemented. Earlier versions of this report documented the resulting changes and improvements.

This report is structured with each chapter covering various aspects of using reclaimed and recycled materials. Chapter 2 presents IDOT's overall use of reclaimed and recycled materials in highway construction projects. Chapter 3 covers IDOT's efforts using RAS in HMA paving. Chapter 4 presents a life-cycle assessment based on available information that portrays the environmental benefits of recycling various materials. Chapter 5 provides an overview of research projects that will provide long-term improvements to the life cycle of pavements using recycled materials.

CHAPTER 2: USE OF RECLAIMED AND RECYCLED MATERIALS IN ILLINOIS HIGHWAY CONSTRUCTION IN 2024

2.1 REPORTING HISTORY

The first recycling report was published in 2002 to answer various inquiries on recycling (Griffiths & Krstulovich, 2002). After that first effort to report on recycled materials, a follow-up report was not produced until construction information was available in 2010 (Brownlee & Burgdorfer, 2011). Reporting of recycled material use has since been on an annual basis (Brownlee, 2011, 2012; Lippert et al., 2014; Rowden, 2013). The 2012 report on the use of recycled materials provided the most in-depth overview of how each material is derived and used in highway construction (Rowden, 2013). The 2013-2021 reports provided benchmark performance measures on recycled material use per mile rather than total quantity (Lippert et al. 2014, 2015, 2016, 2017; Morse 2018-2022, Senger 2023).

This report uses the new Construction and Materials Management System (CMMS). CMMS requires the development of new reporting and sorting functions. The CMMS reports are in continual development and will need to be refined and improved for future reports. The information from the old material management system, MISTIC, and CMMS is combined to report the quantities of each recycled material. Beginning with the 2016 sustainability report, the RAS data collection methodology was modified from a contractor survey on use to reliance on data contained in MISTIC (Lippert et al., 2017) and CMMS reporting of RAS began in 2022.

2.2 RECLAIMED AND RECYCLED MATERIALS ADDED OR DELETED IN 2024

IDOT's list of reclaimed and recycled materials was reviewed while preparing this report. No new materials were added, and no old materials were deleted during the 2024 reporting year.

2.3 MATERIALS RECLAIMED AND RECYCLED IN 2024

2.3.1 Determining Recycle Quantities

The quantities presented in this report pertain to the materials for which the amount of recycled material can be soundly documented through existing records. Items such as steel reinforcement and glass beads are composed of 100% recycled materials, through how those materials are manufactured, and thus are straightforward to report. Many additional tons of recycled materials are used, but tracking the quantities is impractical. For example, recycled steel is used in large steel shapes for bridge construction; however, the amount of recycled material varies in each steel heat or batch. Information on the recycled content of such items is not available in the database and, therefore, not reported.

While CMMS and MISTIC reports are the sources of material quantities for most of the reported materials, there is an exception—namely, glass beads. The reported quantity for glass beads is based on quantities accepted in Illinois. Some local agencies that take part in statewide purchase agreements use this quantity.

Previous versions of this report determined RAS quantities via a contractor survey. This data collection method was done because MISTIC reporting of RAS quantities needed to be developed and shown to be reliable. Improvements in MISTIC and CMMS documentation and reporting have progressed to the point that there is no longer a need to survey contractors for RAS quantities.

2.3.2 Economic Values of Recycled Materials

Economic values for the various materials were updated to provide a reasonable comparison from year to year. For 2024 pricing, a statewide average was determined from supplier- and contractor-provided information. The aggregate pricing was gathered from data in the "U.S. Geological Survey, Mineral Commodity Summaries, January 2025". For items with reported price indexes, such as asphalt binder and steel, the monthly IDOT index was averaged for the year (IDOT 2024b).

The RAP in the HMA price is a calculated value because it is typically not available through the typical supplier- and contractor-provided information. HMA Producers generally mill and use RAP back in their HMA as opposed to milling and selling it to other HMA Producers. CBM worked with the Illinois Asphalt Pavement Association to develop the following calculation.

Assumptions

a. 5.5% asphalt binder per ton of HMA mixture (denoted as P_{AB} in the equation below)
b. 94.5% aggregate per ton of HMA mixture (denoted as P_A in the equation below)
c. PG 64-22 asphalt binder price of $ 564.57 per ton (denoted as C_{AB} in the equation below)
d. Aggregate cost of $ 15.88 per ton (denoted as C_A in the equation below)

Example Calculation

$$RAP\ in\ HMA\ Price = (P_{AB}\ x\ C_{AB}) + (P_A\ x\ C_A)$$

$$RAP\ in\ HMA\ Price = (5.5\%\ x\ \$564.57) + (94.5\%\ x\ \$15.88) = \$46.06$$

2.3.3 Recycled and Reclaimed Material Use and Values for 2024

2.3.3.1 Data for 2024

Appendix A presents the quantities and values of 2024 recycled and reclaimed materials. In total, 838,761 tons of recycled materials were reported for 2024, a 25.6% decrease in recycled tonnage from the 1,126,872 tons reported for 2023. The value of 2024 recycled materials was $60,724,472 a 7.5% increase from $56,466,182 in 2023. In 2024, the miles of roadway improvement decreased slightly to 894 miles from 900 miles in 2023. The number of bridges constructed or rehabilitated increased from 162 in 2023 to 252 in 2024. The overall value of projects awarded in 2024 was higher at $5.25 Billion, compared with 2023 figures of $3.962 Billion. The type and scope of projects significantly influenced the number of recycled materials used. In addition, the new CMMS reporting process drastically reduced the recycled material tonnages in most of the major reporting categories. Ongoing improvements will be implemented for CMMS and reporting features for future reports will improve as a result.

2.3.3.2 Data Analysis of 2024 Use

A series of figures present a more accurate picture of IDOT's recycling effort, providing information on 2024 results and historical trends. As shown in Figure 1, the bulk of the recycled tonnage comprised three materials: RAP in HMA, recycled concrete material (RCM), and RAP as an aggregate.

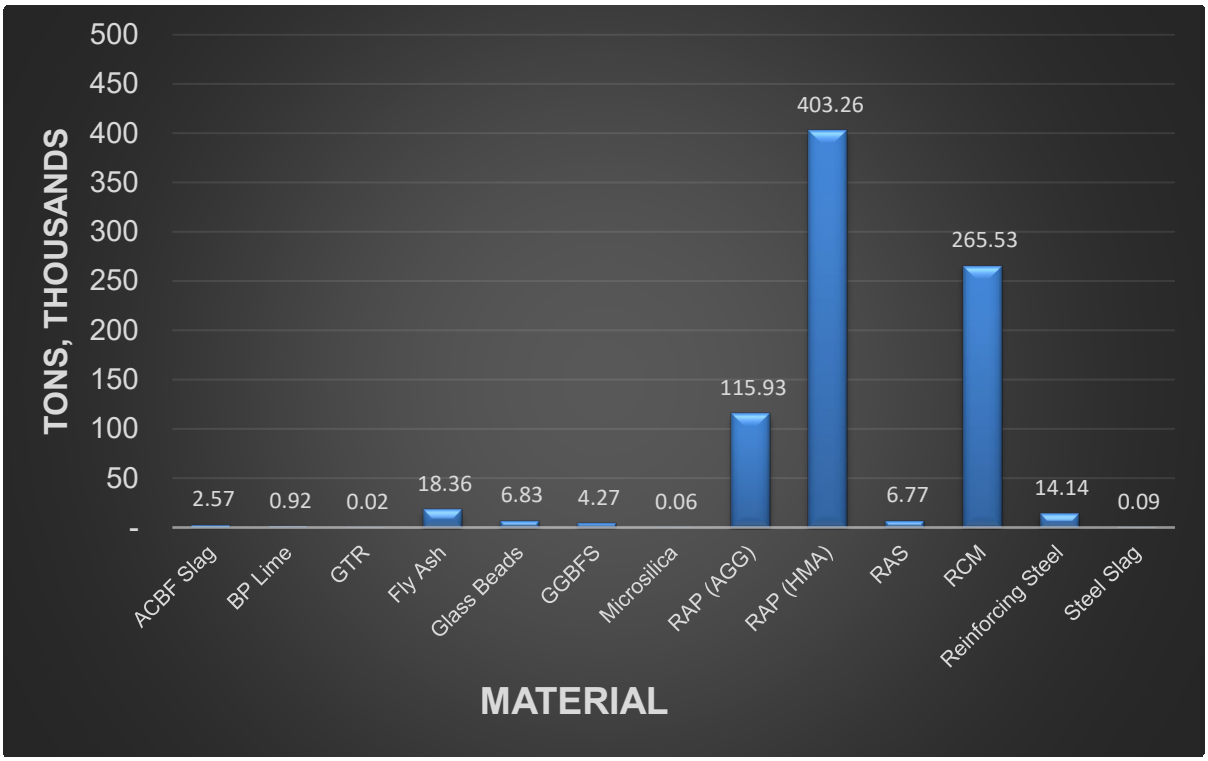

Figure 1. Reclaimed material reported for 2024.

Figure 2 breaks out quantities by related uses for HMA, aggregate, Portland Cement Concrete (PCC), and others. The other category consists of by-product lime, glass beads, and steel. The HMA category includes slags used as friction aggregate (in HMA), crumb rubber, RAP, and RAS. PCC-related materials include fly ash, ground granulated blast furnace slag (GGBFS), and micro silica, which replace cement or provide specific properties to the final concrete product. Aggregate use consists of RCM and RAP used in place of natural aggregates. From this summary, recycled materials related to HMA, and aggregate use represent most of IDOT's recycled tonnage.

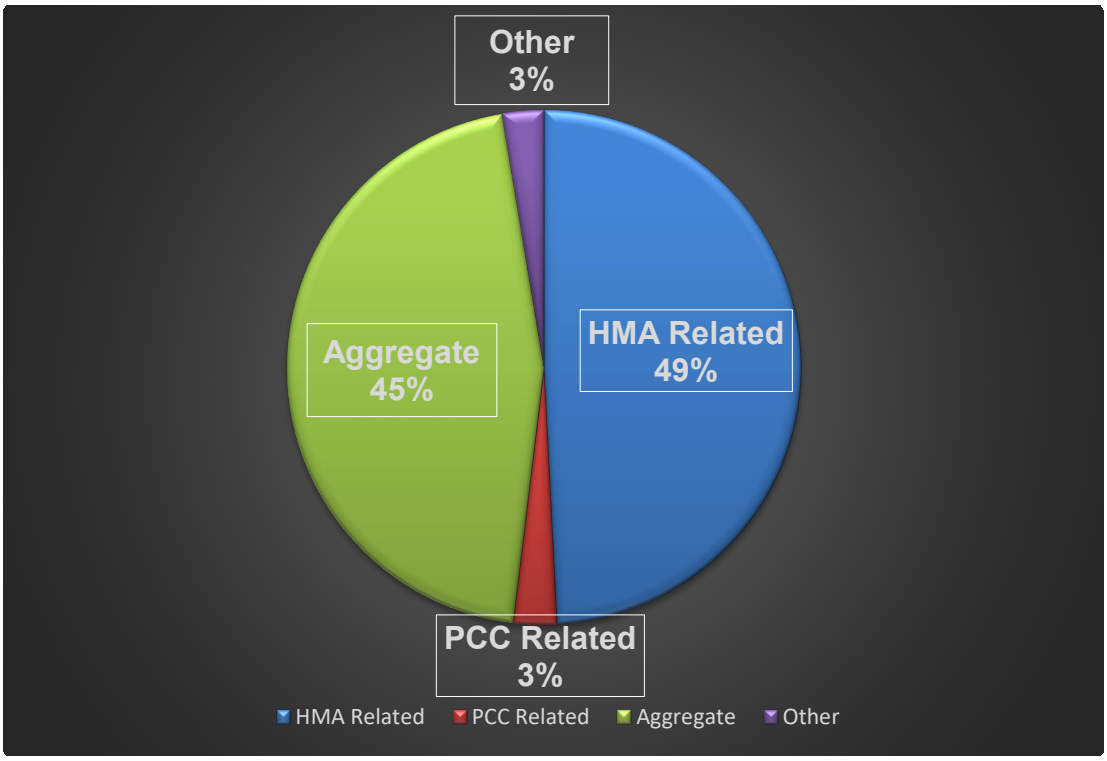

Figure 2. Reclaimed materials by related tons of use in 2024.

2.4 HISTORICAL RECYCLING TRENDS AND DATA ANALYSIS

2.4.1. Recycling Relationship to Program Budget

Recycling quantities are highly correlated to the overall budget and portfolio of project types (bridge vs. pavement resurfacing vs. reconstruction) within a budget year. In general, resurfacing projects result in RAP being both produced and used. Major reconstruction or new alignment (Greenfield) projects can use substantial amounts of recycled material. By contrast, bridge projects tend to use limited amounts of recycled material because of the short lengths involved with these types of projects. Exceptions are large structures over rivers.

Presented in Figure 3 are the total tons recycled from calendar years 2014 through 2024.

Also presented in the chart by fiscal year (FY; IDOT's FY is July 1 through June 30) are the values of projects awarded, centerline miles paved/improved, and number of bridges built/improved (IDOT 2024a). This timeframe differs from the calendar year (CY) reported for recycled tonnage. However, the values tend to align roughly on a CY basis because of the delay between the award of contracts and the use of materials in the project. For this report, it was considered reasonable to use all data as if they had been from the same time by CY.

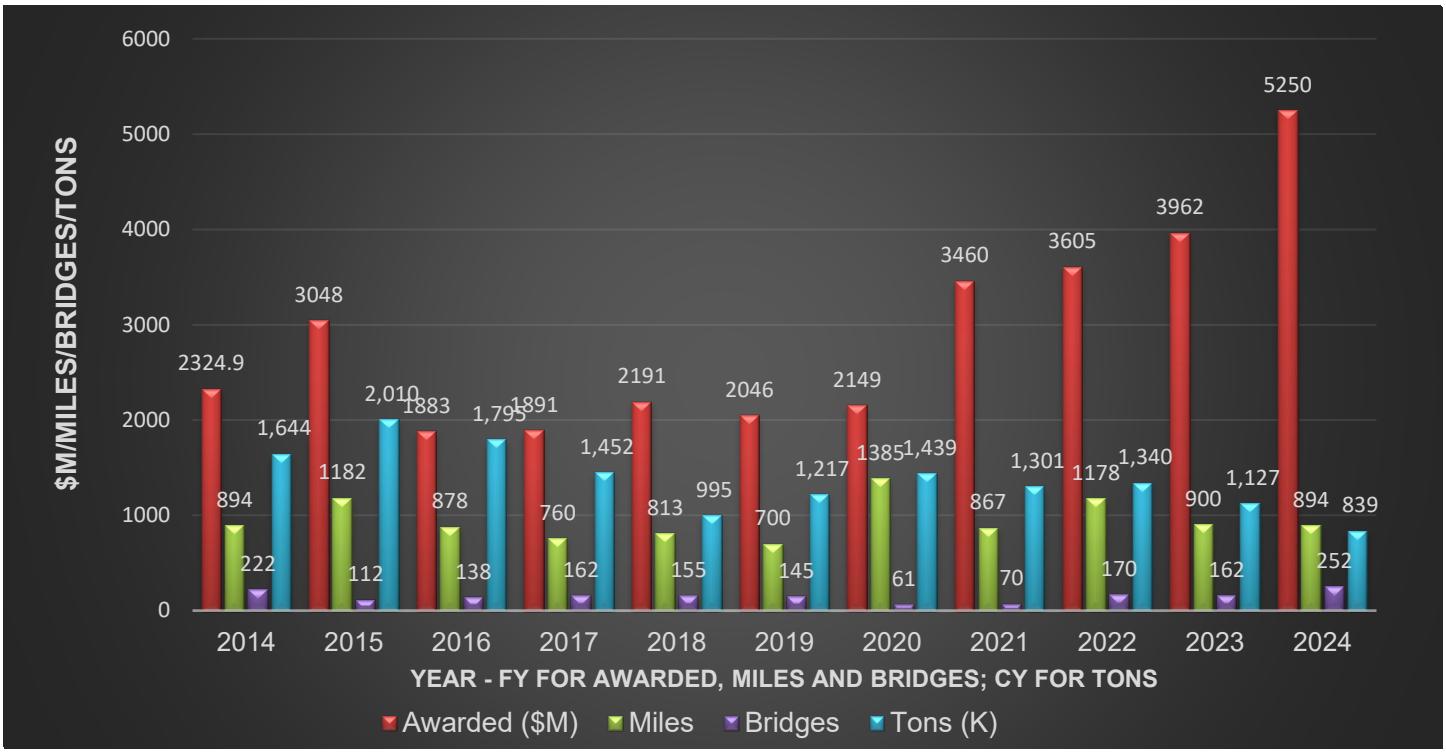

Figure 3. Annual projects awarded (FY), miles improved (FY), bridges built/improved (FY), and recycled tons (CY).

2.4.2 Determination of Recycled Content

To provide a more representative performance measurement of IDOT's recycling efforts, previous reports presented the general recycle content by calendar year (Lippert et al. 2014, 2015, 2016, 2017)(Morse, 2018, 2019, 2020, 2021, 2022. 2022)(Senger, 2023). That approach is continued in this report. Figure 4 represents the results of determining the average tons of recycled material for each centerline mile of improvement since 2014. On a tons-per-mile basis, 2024 represents a 25.1% decrease in recycle quantity per mile from 2023, or 1,252.22 tons/mile in 2023, to 938.48 tons/mile in 2024.

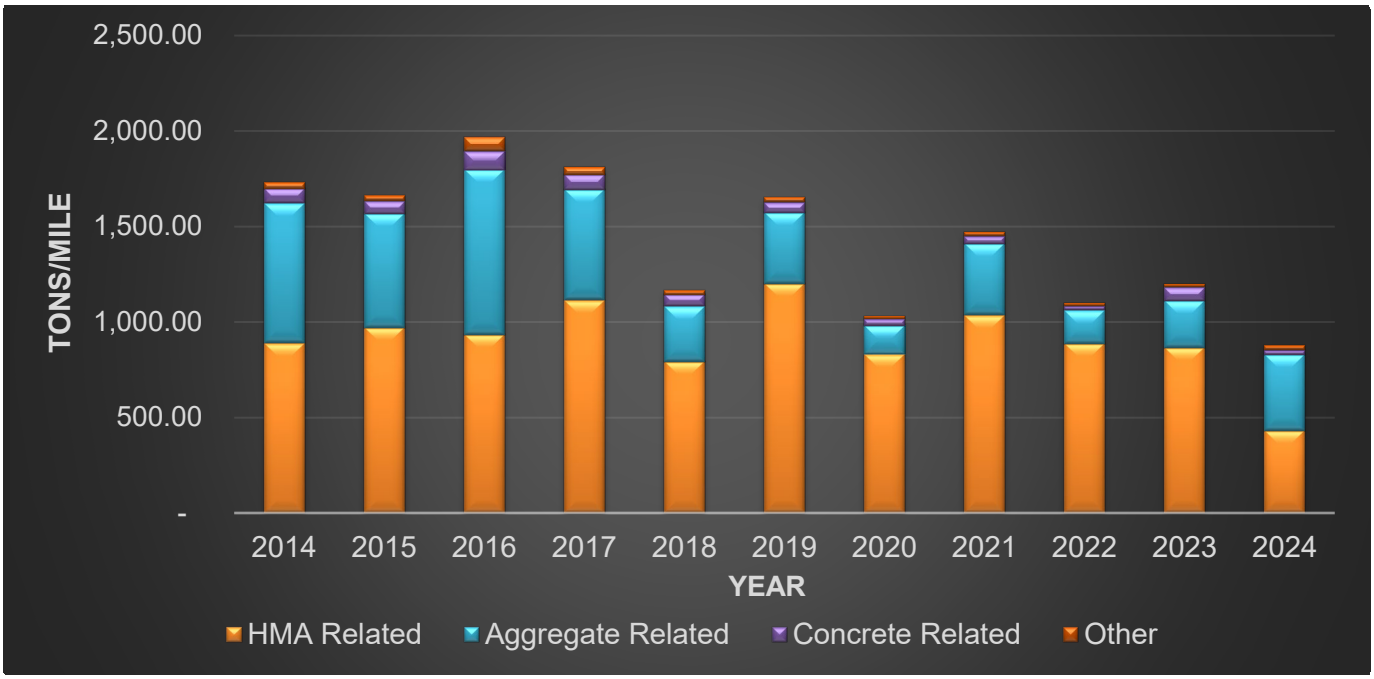

Figure 4. Historical recycle content.

2.5 REGIONAL/DISTRICT RECYCLING EFFORTS

Due to the use of RAP/RAS throughout the State and the desire for a consistent specification, a Standard Specification for Road and Bridge Construction was implemented effective January 1, 2022. The link is attached in Appendix B.

CHAPTER 3: RECLAIMED ASPHALT SHINGLES

This chapter continues reporting on the specific status and use of RAS as required by Illinois Public Act 097-0314 (Illinois General Assembly 2012). Several reports provided details of RAS adoption (IDOT, 2013; Lippert & Brownlee, 2012; Lippert et al., 2014, 2015, 2016, 2017). MISTIC data and CMMS reports were used to report 2024 RAS usage.

3.1 RAS POLICIES AND SPECIFICATIONS IN EFFECT FOR 2024

3.1.1 RAS Policy for Sources

The Central Bureau of Materials (CBM) Policy Memorandum, "Reclaimed Asphalt Shingle (RAS) Sources" (28-10.4), continues to be in effect for all RAS suppliers and was updated in 2024. The current 2024 version of the Certified Sources for Reclaimed Asphalt Shingles list contains 17 suppliers.

3.1.2 RAS Specifications

3.1.2.1 Statewide Specifications

Reclaimed Asphalt Pavement and Reclaimed Asphalt Shingles – Standard Specifications for Road and Bridge Construction, Adopted January 1, 2022, Section 1031.

3.1.2.2 Regional/District Specifications

Implementing the Standard Specification mentioned above has minimized the need for regional or district specifications.

3.2 QUANTITY OF RAS USED IN THE CALENDAR YEAR 2023

In 2024, IDOT experienced a decrease in RAS use. The total reported for 2024 was 6,771 tons compared to 7,568.6 tons in 2023. This change represents a decrease of 10.5%. The RAS usage by IDOT districts is no longer available. The lower RAS usage reported is corresponding with the significant decrease in the CMMS finalized and reported HMA tons placed throughout the state. The following Figure 5 tracks the RAS usage by year from 2014 to 2024.

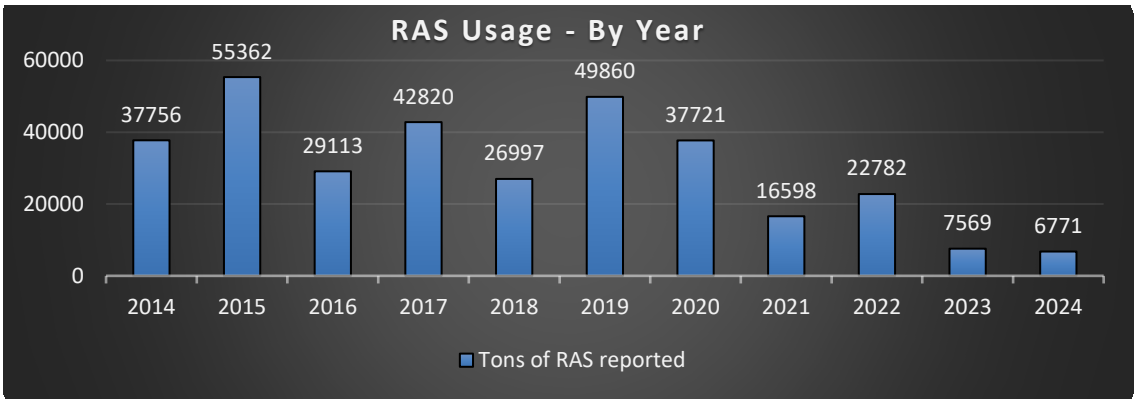

Figure 5. RAS usage by year.

CHAPTER 4: ENVIRONMENTAL EVALUATION OF RECYCLED MATERIALS USED IN 2024

Over the years, the prime driver for using recycled materials has been the initial cost savings of reclaimed materials. Often, these materials have a low economic value due to the need to be removed or disposed of at the generation site. Often, these materials can be used to replace more costly virgin materials, provided they are produced to a consistent quality standard. The ability to replace virgin or manufactured materials with a product that otherwise would be landfilled or stockpiled as waste can also significantly reduce the environmental burden of highway materials. As such, this chapter summarizes a quantitative analysis of the use of recycled materials in terms of carbon emissions.

4.1 LIFE-CYCLE ASSESSMENT

An approach to evaluate the environmental burden of processes in life-cycle assessment (LCA) can also be applied to pavements and paving materials. Based on documented processes, this approach estimates all aspects of a material used for a given application from cradle to grave. As part of the LCA process, each step of material production is analyzed in detail to determine a standard and simple environmental burden measure. Typically, the measure used is carbon dioxide equivalents per ton of the material used, or CO_2EQ/ton.

For a simple example of aggregate production, fuel and electricity use can be assigned to each step. For virgin aggregate, the material must be mined, crushed, sized, transported to the site, placed, compacted, and used for the duration of the facility, then salvaged or wasted at the end of the facility's life. Recycled aggregates have an advantage in that they do not have the economic or environmental burden of mining, which is a significant part of the environmental savings in recycled aggregate.

This report used LCA values from the literature for both virgin materials and recycled materials used in Illinois to estimate a CO_2EQ/ton for each material recycled and the virgin material being replaced. The difference in CO_2EQ/ton between virgin and recycled material is the "savings" noted in Table 1 for each material, in kilograms equivalent of CO_2 for each ton of material recycled, for which information was available (Chen et al., 2010; EarthShift, 2013; Prusinski, 2003; Sunthonpagasit & Duffey, 2004; World et al., 2011). For 2024, the total CO_2EQ savings in tons is also presented. This estimate includes typical transportation distances for Illinois. A primary assumption is that the performance of the highway infrastructure item is equivalent for both virgin and recycled options.

Materials with low CO_2EQ, such as aggregates, have minimal savings values when recycled materials are used. By contrast, when energy-intensive materials such as lime and cement are replaced with by-products such as fly ash, by-product lime, or GGBFS, very high CO_2EQ savings can be realized.

From this simple analysis, it is estimated that a total of 48,160 tons of CO_2EQ was saved in 2024. Appendix A presents an accounting of CO_2EQ saved in 2024 for each material used. As noted previously, using total tons of recycled material alone is limited as a performance measure for recycling. The environmental burden saved by material for 2024 is presented in Figure 6. This picture is very different from the tons of material presented in Figure 1. Likewise, Figure 7 shows the distribution of CO_2EQ savings by related use, which differs significantly from the previous tonnage distribution in Figure 2.

Table 1. Estimated Environmental-Burden Savings by Use of Recycled Material

Material	Savings per Ton of Use, CO_2EQ (kg)	2024 CO_2EQ Savings (Tons)
Air-Cooled Blast Furnace Slag	13	13
By-Product Lime	920	934
Crumb Rubber	1,704	41
Fly Ash	894	18,095
Glass Beads	929	6,999
Ground Granulated Blast Furnace Slag	763	3,594
Microsilica	NA	NA
Reclaimed Asphalt Pavement Used for Aggregate	0.8	102
Reclaimed Asphalt Pavement Used For HMA	17	7,557
Reclaimed Asphalt Shingles	79	590
Recycled Concrete Material	0.8	234
Steel Reinforcement	640	9,976
Steel Slag	17	2
Wet Bottom Boiler Slag	NA	NA

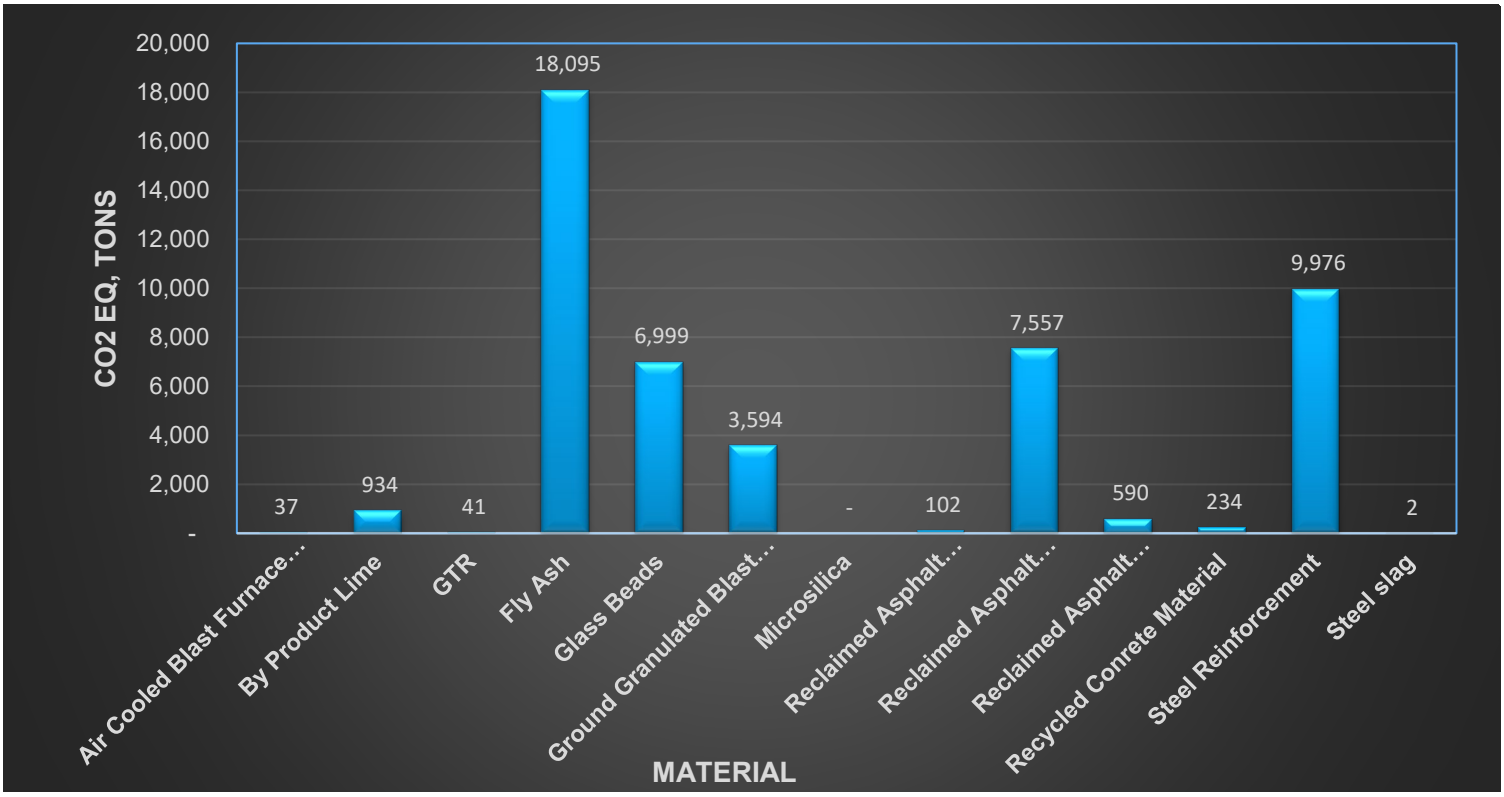

Figure 6. CO_2EQ saved by material in 2024.

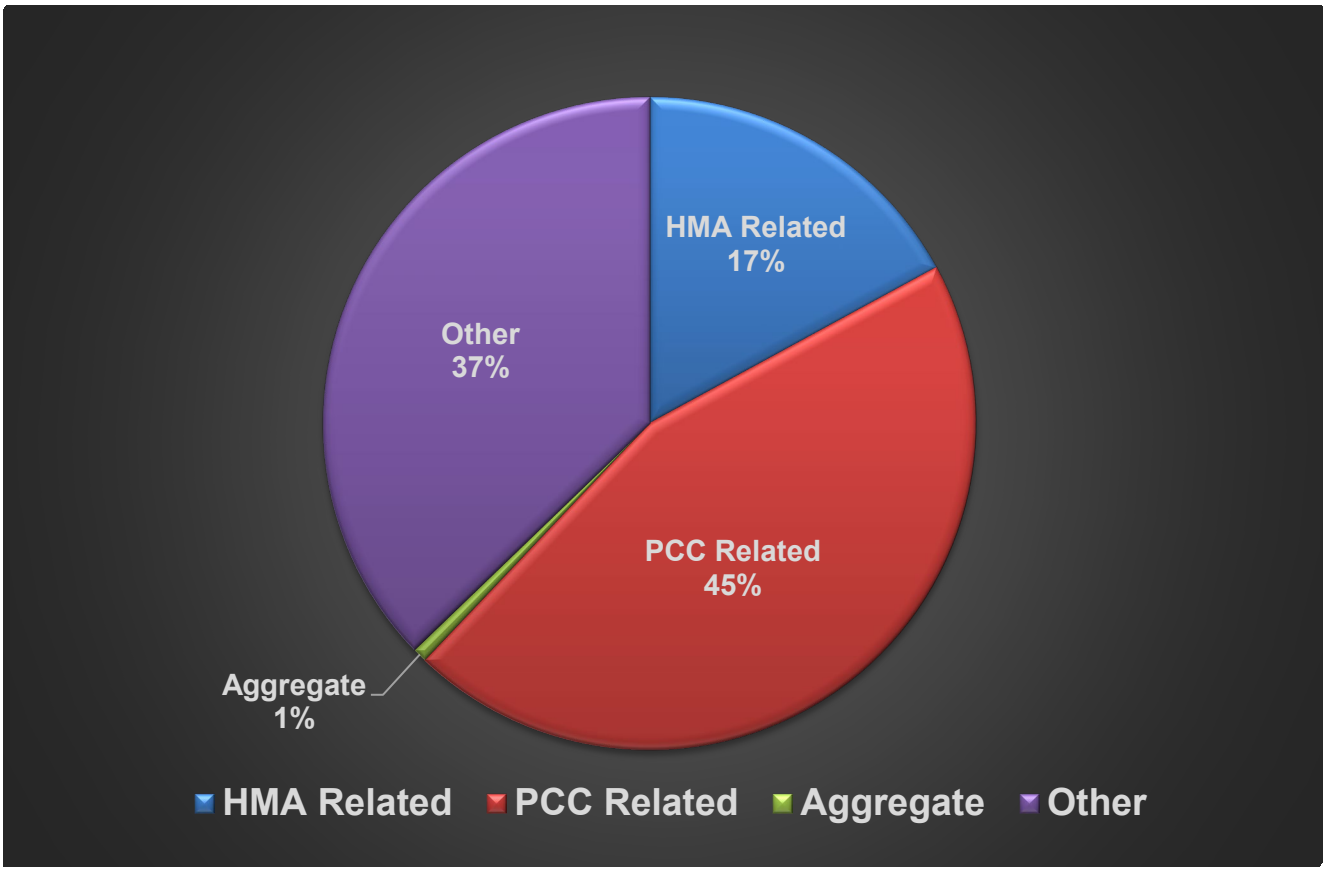

Figure 7. CO_2EQ saved by related use in 2024.

CHAPTER 5: SUSTAINABILITY-RESEARCH ACCOMPLISHMENTS AND INITIATIVES

During 2024, IDOT had seven sustainability-related studies underway with ICT. These efforts focused on the use of recycled materials. Each of these studies resulted in an interim or final report. A brief description of each effort is provided.

5.1 SUSTAINABILITY RESEARCH ACCOMPLISHMENTS DURING 2024

5.1.1 R27-216 - Optimizing the Use of Local Aggregates in Stone-matrix Asphalt (SMA)

The objective of this study is to determine whether Illinois Department of Transportation can use locally available aggregates in SMA to reduce the cost and environmental impact of its production without sacrificing resistance to pavement rutting or cracking. Reducing the cost of SMA will allow it to be used more widely in Illinois. Widespread use of SMA will result in less frequent pavement rehabilitation, fewer traffic interruptions from road construction and substantial cost savings. This project is scheduled to end in March 2026.

5.1.2 R27-239 Development of Commercial Vehicle Emission Inventory and Analysis

This project started in August 2021 and concluded in February 2024. The objectives were to create a procedure to collect and analyze data from vehicle activities, vehicle characteristics, operation, and their effect on greenhouse emissions and air toxicity. The research team assembled and analyzed three datasets and found that vehicle type, make, age, odometer mileage, fuel type, engine brand (manufacturer), and the year the engine was built are all important factors for truck emissions. Additionally, the team used the US EPA's MOVES model to estimate the commercial vehicle daily emissions by pollutant across the state. Finally, the team investigated the feasibility of adopting e-truck for long-haul operation on interstates and national highways. The project report can be found here.

5.1.3 R27-248: Investigation of Dolomite Aggregate Long-Term Cementation and Its Potential Advantage for Building Roads

The objective of the proposed research is to systematically study the effects of chemical, mineralogical, and physical properties of dolomitic aggregate fines on the long-term performances of both unbound and chemically stabilized aggregate base/subbase materials. After different conditioning periods, the characterization tests will be conducted to identify changes in the phase compositions and mineralogy contributing to cementation and strength gain. This project is scheduled to end in December 2025.

5.1.4 R27-250 - Using Advanced Binder Rheological Parameters to Predict Cracking Potential of Hot-Mix Asphalt Mixtures with Modified Binders

This project has two objectives. First, it evaluates the potential of advanced binder rheological parameters to predict HMA cracking potential. Second, it evaluates the potential to blend softener-modified binders with a Styrene-butadiene-styrene (SB) polymer. The project began in August 2022 and is scheduled to end in September 2025.

5.1.5 R27-268 Quarry By-product Fines for Otta Seal Surfacing of Local Roads

The main objective is to utilize quarry by-product (QB) fines as aggregates in Otta seals. QB are more uniformly graded, available locally, and can be of marginal quality, which makes them ideal for Otta seals. This project will examine the use of quarry by-product fines, a leftover material from crushed rock extraction found in abundance in Illinois, as aggregates in Otta seals. Researchers will review design parameters as well as conduct lab testing to prepare mechanistic-based design and construction guidelines for Otta seals with quarry by-product aggregates. This project is scheduled to conclude in August 2026.

5.1.6 R27-271 Development of a Project-Scale Air Quality Screening Tool

This project's goal is to estimate air pollution levels associated with transportation projects through various pollutants such as carbon monoxide, ozone, particulate matter and greenhouse gases. Researchers will develop an analysis tool for IDOT to estimate project-specific air pollution levels. Development of the analysis tool will allow IDOT and its partners to better estimate and improve transportation-related emissions. This project is scheduled to conclude in February 2027.

5.1.7 R27-273 ITAG (Illinois TrAnsit GHG): a User-Friendly Tool to Estimate and Compare Greenhouse Gas Emissions from Transit Operations in Illinois

The State of Illinois aims to lower its greenhouse gas emissions by 46% by 2030 in accordance with the Climate and Equitable Jobs Act. One way to reduce these emissions is to focus on public transit vehicles, which primarily run on fossil fuels. Researchers will develop a user-friendly tool to help Illinois transit agencies estimate current GHG emissions from transit operations as well as potential savings of transitioning to alternative fuel fleets. The tool will also examine the carbon footprint from transit operations and compare them across Illinois agencies. This project is scheduled to conclude in August 2027.

CHAPTER 6: CONCLUSIONS

The goal of this report is to provide a single-source document for 2024 sustainability efforts in highway materials that serve to meet the reporting requirement of Illinois Public Act 097-0314. In summary, the 2024 efforts in recycling resulted in the following:

- In 2024, recycled materials used in highway projects totaled 838,761 tons, with a value of $60,724,472. The tonnage decreased from 2023, and the monetary value increased. Due to challenges related to the transition to the Department's new materials database, these quantities are considered preliminary and actual quantities used are likely higher. Updated 2024 quantities will be included in the 2025 report.

- The usage of reclaimed asphalt shingles (RAS) in 2024 was 6,771 tons compared to 7,568.6 tons in 2023. This change represents a decrease of 10.5%.

- It is estimated, using the life-cycle assessment (LCA), that carbon dioxide–equivalent emissions were reduced by 48,160 tons in 2024. Fly Ash and Steel Reinforcement accounted for the most significant contribution by reducing over 28,071 tons combined.

- In 2024, the department had seven active or ongoing material sustainability research projects. These research projects will result in at least seven publications in interim/final reports and white papers.

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APPENDIX A: RECYCLED AND RECLAIMED MATERIALS: QUANTITIES USED AND EQUIVALENT VALUES, 2024

Material	Unit Equivalent Value	Quantity[1] Tons	Total Equivalent Value to Department	CO_2 Equivalent Savings Tons[6]
Air-cooled blast furnace slag	$8.23	2,571	$21,159	37
By-product lime	$13.00	921	$11,973	934
Crumb rubber[2]	$400.00	43,792	$8,758	41
Fly ash	$85.00	18,362	$1,560,770	18,095
Glass beads[3]	$996.00	6,834	$6,806,963	6,999
Ground granulated blast furnace slag	$145.00	3,594	$619,585	3,594
Microsilica	$540.00	59	$31,860	NA
Reclaimed asphalt pavement used for Aggregate	$8.60	115,932	$997,015	102
Reclaimed asphalt pavement used for HMA	$49.28	403,262	$18,574,248	7,557
Reclaimed asphalt shingles	$24.08	6,771	$163,046	590
Recycled concrete material	$7.60	265,528	$2,018,013	234
Steel reinforcement[4]	$2,115.15	14,140	$29,909,212	9,976
Steel slag	$22.00	85	$1,870	2
Wet-bottom boiler slag[5]	NA	NA	NA	NA
Totals	**—**	**838,761**	**$60,724,472**	**48,160**

[1] Quantities were calculated from amounts assigned to projects in the calendar year 2024. Before the summation of values, metric values were converted to English values using factors in Appendix B of the *Standard Specifications for Road and Bridge Construction.*
[2] Crumb rubber: This material quantity was calculated as 5% of the hot-poured joint sealant used in 2024.
[3] Glass bead units are based on tested and approved quantities and not projects assigned through CMMS and MISTIC.
[4] Steel reinforcement: For this report, the IDOT monthly steel index was averaged for 2024 and used to represent the value of just the steel contained in these products. This approach does not include the epoxy coating value in the calculation of the material being recycled, which is a more accurate representation.
[5] Wet-bottom boiler slag: No records were found in CMMS or MISTIC that indicated WBBS was used for any IDOT projects in 2024.
[6] Based on typical haul distances for Illinois and industrial averages between virgin material and recycled/reclaimed material found in the literature.

APPENDIX B: RECLAIMED ASPHALT PAVEMENT AND RECLAIMED ASPHALT SHINGLES - STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, ADOPTED JANUARY 1, 2022, SECTION 1031

https://public.powerdms.com/IDOT/documents/1945348/Standard%20Specifications%20for%20Road%20and%20Bridge%20Construction%202022