ALDOT Trial and Implementation of Reduced Temperature Asphalt Mixtures: Workplan

# Overall Project Summary and Approach

1. **Description of GHG Reduction Measures**

As identified in the Alabama Priority Climate Action Plan (PCAP), the Industry Sector was responsible for 24% of the state’s total GHG emissions released in 2021.[[1]](#footnote-2) Approximately 50% of these industry emissions are from the combustion of fossil fuels, which have slightly increased over the years and are a hard-to-decarbonize sector.[[2]](#footnote-3) One opportunity to reduce these emissions identified by the Alabama Department of Environmental Management (ADEM) in its PCAP is through reducing the temperatures required to produce asphalt mixtures. With an annual production of approximately seven million tons of asphalt mixtures statewide, the asphalt pavement industry in Alabama contributes a substantial carbon footprint through the heat required to mix liquid asphalt binder with aggregates to make workable hot mix asphalt (HMA).[[3]](#footnote-4) These emissions are released locally near Alabama communities, with approximately 80 certified asphalt plants operating across the state and 58% of these plants in overburdened and underserved communities.[[4]](#footnote-5),[[5]](#footnote-6)

According to a National GHG Emissions Inventory conducted by the National Asphalt Pavement Association (NAPA), the average cradle-to-gate emissions intensity for asphalt mix production in the United States ranges from 50.2 to 52.1 kg CO2e per ton of mix produced.3 This translates to annual cradle-to-gate emissions ranging from 0.3514 to 0.3647 million metric tons of CO2e in Alabama. The general breakdown of cradle-to-gate emissions for asphalt mixtures includes 52% from raw material inputs, 5% from the transportation of raw materials to production facilities, and 43% from the production of asphalt mixtures.[[6]](#footnote-7) Research suggests that cradle-to-gate GHG emissions could be reduced by up to 24% by leveraging existing technologies, including measures such as reducing asphalt mixture production temperatures.6 Two strategies, warm mix technologies (WMT) and cold central plant recycling (CCPR), are the main features of this proposal to reduce temperatures needed to produce asphalt mixtures.

WMT is a family of technologies that allow for the production of asphalt mixtures at reduced temperatures. WMTs are allowed by ALDOT specifications; however, temperatures are rarely reduced due to low bid procurement structure, industry learning curve, and resistance to change. CCPR is a method that incorporates very high amounts of Recycled Asphalt Pavement (RAP), often more than 95%, with recycling additives such that heat is not required. CCPR has been demonstrated in some states but is not currently used in Alabama.[[7]](#footnote-8)

Both technologies have the potential to significantly reduce GHG emissions but are underutilized due to the low bid structure in state transportation agency procurement, which does not incentivize environmentally beneficial strategies. As defined in the Alabama PCAP, this proposal aims to address these challenges and implement WMT and CCPR to reduce GHG emissions from the combustion of fossil fuels in the hard-to-abate industry sector. This proposal is uniquely suited to meet all four outlined goals for the CPRG program. The following sections briefly discuss how the goals outlined for the CPRG general competition are achieved through the proposed measure of reducing temperatures for asphalt mixtures along with the milestones and risks and mitigation approach associated with each feature (WMT and CCPR) necessary to ensure success.

**Goal 1: Implement ambitious measures that will achieve significant GHG reductions by 2030 and beyond**

ALDOT’s plan involves conducting one CCPR pilot project annually in 2025 and 2026 to refine specifications and acceptance processes for this innovative material. The goal is to enable statewide implementation of CCPR on suitable widening, new construction, or reconstruction projects starting in 2027. In addition, ALDOT intends to plan for two CCPR projects to be open for letting each year during 2027 and 2028, with continued usage expected on appropriate projects thereafter.

Furthermore, ALDOT plans to finalize a WMT specification by 2025 based on an ongoing research project associated with WMT through the FHWA Climate Challenge grant. This specification will include lower production temperatures, leading to an increase in bid price per ton of asphalt due to the costs associated with WMT, perceived contractor risks in meeting new requirements, and increased oversight by ALDOT. As the industry transitions to a new WMT specification in 2025, it is anticipated that 35% and 45% of ALDOT’s tonnage will be produced using WMT technology with temperature reductions in 2025 and 2026, respectively. Following the two-year transition period, 60% of ALDOT’s tonnage is expected to continue to be produced using WMT technology with temperature reductions from 2027 through 2029.

The proposed timeline for adoption will lead to a significant reduction in GHG emissions. The estimated reduction is around 14% compared to the traditional HMA between 2025 and 2030. Furthermore, the estimated GHG reduction is 16% compared to the conventional HMA between 2025 and 2050. Detailed calculations supporting these estimated GHG reductions can be found in the *Technical Appendix*.

**Goal 2: Pursue measures that will achieve substantial community benefits**

Reducing the production temperatures of asphalt mixtures will also achieve substantial community benefits. WMT and CCPR significantly reduce fuel combustion, resulting in lower carbon dioxide, sulfur dioxide, nitrogen oxides, and formaldehyde emissions, depending on the type of fuel used. Plants that utilize WMT have the added advantage of significantly reducing fine particulates, PM-10.[[8]](#footnote-9) Estimates show an average percent reduction in PM-10 concentration of 80% - 92% from an average WMT mixture temperature reduction of 30°C.[[9]](#footnote-10) Furthermore, implementing CCPR could decrease emissions associated with raw material extraction and production of virgin asphalt and aggregate, as well as lead to significant cost savings.7 The added economic benefits from CCPR could enable under-resourced communities to distribute their funds further, improving the overall roadway conditions in their network. By reducing emissions from construction activities with WMT and CCPR and 58% of asphalt plants located in low-income and disadvantaged designated communities, ALDOT aims to improve air quality and create a cleaner environment for all residents of Alabama.

**Goal 3: Complement other funding sources to maximize these GHG reductions and community benefits**

This proposal builds off and complements the FHWA Climate Challenge grant that ALDOT is currently a recipient of.[[10]](#footnote-11) The goal of the FHWA Climate Challenge is to encourage state departments of transportation (DOTs) and other public sector stakeholders to explore the use of Life Cycle Assessment (LCA) and Environmental Product Declarations (EPDs) as a standard practice to inform pavement material and design selection for enhancing sustainable pavement practices and to quantify the emissions and impacts of those practices.

ALDOT was awarded $312,000 for their proposed project, which aims to quantify emissions from the production and construction of balanced mix design (BMD) asphalt mixtures with recycled materials, WMT, and recycling agents.[[11]](#footnote-12) In tangent, these grants will enable ALDOT to scale the adoption of WMT and CCPR across the state, which will help decrease GHG emissions and other pollutants in neighboring communities.

**Goal 4: Pursue innovative policies and programs that are replicable and scalable across jurisdictions**

A critical output of this proposal are the specifications for the use of WMT with requirements for temperature reductions and CCPR. Leveraging the project team’s expansive network and leadership roles, a key focus of this proposal is to promote and share these specifications locally and nationally to significantly reduce the cost effectiveness of this project. Specifications will be shared with other transportation agencies through ALDOT’s participation in the Consortium of Asphalt Pavement Research and Implementation (CAPRI), FHWA Climate Challenge grant program, and AASHTO Committee on Materials and Pavements (COMP). Since most local jurisdictions in Alabama use ALDOT’s specifications, WMT and CCPR are highly scalable to cities and counties once local contractors become more comfortable with these technologies and no longer bid on the risk of the unknown. Further, the implementation of WMT and CCPR can use typical asphalt plants and equipment.[[12]](#footnote-13) To illustrate the maximum potential cost effectiveness, if the entire nation were to follow ALDOTs specification approach after a year of success demonstrated, the cost effectiveness would be as low as $17/per metric ton of CO2e (MTCO2e) reduced.

**Milestones for Implementing GHG Reduction Measures**

To ensure the proposed measure is scalable and effective, *Section 6* outlines a timeline to allow for the success of the measure outlined in this proposal. The timeline includes milestones and associated tasks that will enable ALDOT to track GHG emission reductions by assessing the tonnage produced and temperature reductions achieved. Milestones are also outlined for each feature in Table 1 below.

**Table 1: Milestones for Implementing GHG Reduction Measure**

| **Year** | **WMT** | **CCPR** | **Communication & Outreach** |
| --- | --- | --- | --- |
| **2025** | * WMT specs. published * 35% of ALDOT tonnage is produced using WMT with reduced temps. | Completion of pilot #1 with 37,514 tons of asphalt mixture produced | * 3 conference presentations * CCPR plant open house |
| **2026** | 45% of ALDOT tonnage is produced using WMT with reduced temps. | Completion of pilot #2 with 37,514 tons of asphalt mixture produced | * 3 conference presentations * CCPR plant open house * WMT 6 plant open houses * ALDOT Asphalt Technician Level 1 Course * Distribution of 2 communication pieces |
| **2027** | 60% of ALDOT tonnage is produced using WMT with reduced temps. | * CCPR specs. Published * Completion of project #1 and #2 with a total of 75,028 tons of asphalt mixture produced | * 3 conference presentations * WMT 6 plant open houses * ALDOT Asphalt Technician Level 1 Course * Distribution of 2 communication pieces |
| **2028** | 60% of ALDOT tonnage is produced using WMT with reduced temps. | Completion of project #3 and #4 with a total of 75,028 tons of asphalt mixture produced | * 3 conference presentations * WMT 6 plant open houses * ALDOT Asphalt Technician Level 1 Course * ALDOT Roadway Technician Course * Distribution of 2 communication pieces |
| **2029** | 60% of ALDOT tonnage is produced using WMT with reduced temps. | Scale CCPR | * 3 conference presentations * WMT 6 plant open houses * ALDOT Asphalt Technician Level 1 Course * ALDOT Roadway Technician Course * Distribution of 2 communication pieces |

**Risks and Mitigation Strategies**

Industry professionals and practitioners are aware of CCPR as an environmentally friendly and cost effective method for rehabilitating and reconstructing asphalt pavements. However, the level of knowledge about CCPR can vary based on experience and regional practice. There is a risk that some regions with less experience with CCPR due to regional practices or limited access to RAP may experience a learning curve. This technology requires a different production process, new equipment or modification of existing equipment, and the development of new mix designs as compared to conventional HMA. ALDOT will work with NCAT and the industry to develop training materials and documentation of best practices.

WMT is more readily adopted in the industry but is not fully utilized to maximize its benefits. The integration of new technologies within existing regulatory frameworks, industry standards, and organizational procedures poses risks of logistical challenges. To facilitate the implementation of WMT, industry associations, and government agencies should collaborate to review and update specifications, create new or revised approvals and permits, update quality assurance and control protocols, and provide enhanced training and education. Another challenge for implementing WMT is the availability of necessary supplies and potential construction delays. WMT involves the addition of organic, chemical, or water-based additives at the asphalt plant during mix production or at the job site, and if these additives are unavailable, it may cause delays in project milestones.

Additionally, when implementing new technologies like WMT and CCPR, it is not uncommon to encounter resistance to change from the industry. However, ALDOT understands that while current practices are comfortable and often risk-averse, it is necessary to take the lead in bringing about specification changes and demonstrating the effectiveness of these newer technologies. ALDOT plans to showcase the benefits of these technologies through the proposed pilots and projects and alleviate concerns regarding their performance and ease of use. By acting as an industry leader, ALDOT aims to encourage the wider adoption of WMT and CCPR, with support from industry associations in Alabama and technical assistance from the National Center for Asphalt Technology (NCAT). ALDOT also intends to create case studies and success stories to highlight the benefits of these technologies and dispel common concerns. Additionally, monitoring GHG emission reductions at each milestone will help the industry understand the environmental impact of these technologies compared to conventional HMA.

1. **Demonstration of Funding Need**

ALDOT recognizes the important role of WMT and CCPR in significantly reducing GHG emissions and enhancing environmental sustainability in asphalt pavement construction. To accelerate the adoption of these technologies, ALDOT requires funding support from the Climate Pollution Reduction Grants (CPRG) program. The CPRG program presents a timely opportunity to secure financial assistance for immediate action, aligning seamlessly with ALDOT's commitment to reducing carbon emissions and promoting sustainable infrastructure practices. Furthermore, the CPRG program specifically focuses on initiatives aimed at reducing pollution and GHG emissions, making it an ideal funding source for ALDOT's WMT and CCPR implementation efforts.

ALDOT has also diligently explored various federal and state grants to facilitate the implementation of their GHG reduction measures. Specifically, ALDOT has closely reviewed the GSA Low-Embodied Carbon Program, the FHWA Low-Carbon Transportation Materials (LCTM) Program, and the White House Bipartisan Infrastructure Law (BIL) Guidebook.[[13]](#footnote-14),[[14]](#footnote-15),[[15]](#footnote-16) While the GSA and FHWA programs offer opportunities for incentives or reimbursement for the use of construction materials with substantially lower levels of embodied GHG emissions, they have limitations that hinder funding to sufficiently support ALDOT in expediting the implementation of WMT and CCPR.

* Both the GSA program and the FHWA LCTM require a product-specific Type III environmental product declaration (EPD) at the time of bid, along with meeting a specific Global Warming Potential (GWP) limit for each material as specified by the respective agency. Following ISO standards, the current asphalt product category rules (PCRs) require twelve months of consecutive energy usage data and do not allow the allocation of the energy usage per specific asphalt mixture produced at different temperatures to produce and publish an EPD. Therefore, a plant would need to produce asphalt mixture using WMT with reduced temperatures for twelve consecutive months before the GHG reductions are realized and reflected in the GWP values reported in EPDs.
* The GSA program primarily targets federal building projects, which do not include transportation infrastructure projects such as those managed by ALDOT. Hence, the GSA program's focus and purpose do not align with ALDOT's specific funding needs for implementing WMT and CCPR in road construction projects.
* The White House BIL Guidebook provides a detailed plan for obtaining funding under the Bipartisan Infrastructure Law for a range of infrastructure projects, such as transportation, broadband, and environmental initiatives. However, a review of current open and upcoming funding opportunities does not result in any applicable programs that meet ALDOT’s needs.

In summary, the successful implementation of WMT and CCPR requires adequate funding from the CPRG program. This funding is essential for ALDOT to invest in the necessary pilots and demonstration projects, workforce training, and incentives to support the adoption of these technologies into routine practices. By securing funding from the CPRG program, ALDOT can ensure the sustainable integration of WMT and CCPR into their asphalt pavement projects, leading to long-term environmental benefits and cost savings.

1. **Transformative Impact**

ALDOT is fully committed to implementing strategies aimed at enhancing air quality, mitigating the impacts of climate change, expanding transportation options, and employing transportation management technologies to improve the overall efficiency of the state’s transportation network. The adoption of WMT and CCPR to reduce GHG emissions from a hard-to-abate industry sector aligns with this commitment. This implementation aims to enhance efficiency and reduce carbon emissions in transportation projects, thereby fostering a cleaner environment for all Alabama residents.

Moreover, with over 58% of Alabama's asphalt plants situated in communities facing disproportionate burdens and underserved areas, the adoption of WMT and CCPR will ensure the fair distribution of environmental benefits across all communities, particularly those with environmental justice populations. This approach guarantees equitable outcomes, promoting sustainability and inclusivity in transportation infrastructure development.

Additionally, following the statewide implementation of specifications for WMT with temperature reductions in 2025 and CCPR in 2027, ALDOT plans to collaborate with NCAT and the Alabama Local Technical Assistance Program (ALTAP) to develop and provide training and education for county engineers, consultants, and contractors in Alabama. These efforts will include promotional materials and presentations at key industry conferences such as the Alabama Transportation Conference and the Construction Engineers and Materials Engineers (CEME) Conference, facilitating the quick adoption of new specifications by local agencies, consultants, and contractors across multiple jurisdictions.

ALDOT's proactive approach positions it as one of the pioneering state DOTs to implement such specifications for reducing GHG emissions. The success of these initiatives is expected to inspire other state agencies to adopt similar specifications. Furthermore, ALDOT is committed to sharing the specifications, lessons learned, and training materials nationally through its participation in regional asphalt user and producer group meetings, CAPRI, FHWA Climate Challenge, and AASHTO COMP.

In summary, ALDOT's adoption of WMT and CCPR technologies underscores its proactive approach toward achieving cleaner air quality, mitigating climate impacts, and promoting sustainable transportation practices in Alabama. Its successful implementation will lead to transformative change, inspiring other state and local transportation agencies to accelerate the adoption of these technologies for GHG emission reductions from a hard-to-abate industry sector.

# Impact of GHG Reduction Measures

1. **Magnitude of GHG Reductions from 2025 through 2030**

Using the calculations outlined in the *Technical Appendix*, it is estimated that the cumulative GHG emission reductions from 2025 to 2030 would total 66,564 metric tons of CO2e (MTCO2e), representing approximately a 14% reduction compared to if traditional HMA was used. Table 2 shows the annual estimated emission reductions between 2025 and 2030. Variation in temperature reductions will impact GHG emission reductions. Research shows that WMT temperature reductions are normally in the range of 10 to 90 degrees Celsius (50 to 194 degrees Fahrenheit).[[16]](#footnote-17) This proposal estimates a reduction of 80 degree Fahrenheit when estimating the GHG reductions for WMT.

As stated under Section 1.a., *Description of GHG Reduction Measures*, this proposal includes one pilot project for CCPR per year in 2025 and 2026. Additionally, it is also expected that 35% of ALDOT’s tonnage will utilize WMT with reduced temperatures in 2025 and increasing to 45% in 2026. Specifications will be developed and refined with incentives to scale the use of these technologies following the pilot projects. It is further anticipated that 60% of ALDOT’s tonnage will be produced using WMT technology with temperature reductions from 2027 through 2030. Since CCPR is used in lane widening, reconstruction or new construction projects, it is anticipated that 2 CCPR projects will be let per year during 2027 and 2028.

**Table 2:** **Estimated GHG Reductions from 2025 through 2030**

| **Year** | **Alabama Tonnage (Short Ton)** | **AL Total GHG Emissions (MTCO2e)** | **Pilot Tonnage (Short Ton)** | **Total GHG Emissions (MTCO2e)** | **Pilot GHG Reductions (MTCO2e)** | **% Reductions (MTCO2e)** |
| --- | --- | --- | --- | --- | --- | --- |
| 2025 | 4,400,000 | 76,673 | 1,577,514 | 27,487 | 8,145 | 11% |
| 2026 | 4,400,000 | 76,673 | 2,017,514 | 35,153 | 9,954 | 13% |
| 2027 | 4,400,000 | 76,673 | 2,715,028 | 47,307 | 12,167 | 16% |
| 2028 | 4,400,000 | 76,673 | 2,715,028 | 47,307 | 12,167 | 16% |
| 2029 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2030 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| **Total** | **26,400,00** | **460,040** | **14,305,084** | **249,254** | **66,564** | **14%** |

Using the calculations outlined in the *Technical Appendix*, it is estimated that 1 short ton of asphalt mixture produced using WMT with reduced temperatures equates to a reduction of 0.005 MTCO2e (28.1% reduction). Similarly, 1 short ton of asphalt mixture produced using CCPR equates to a reduction of 0.016 MTCO2e (92.3% reduction). Table 3 outlines the GHG emission reductions from the completion of one CCPR pilot project with 37,514 tons of asphalt mixture.

**Table 3:** **Estimated GHG Reductions from CCPR and WMT Pilot**

| **Pilot** | **Project Tonnage (Short Ton)** | **Total GHG Emissions (MTCO2e)** | **Pilot GHG Reductions (MTCO2e)** | **% Reduction (MTCO2e)** |
| --- | --- | --- | --- | --- |
| CCPR | 37,514 | 654 | 603 | 92.3% |

The durability of GHG emission reductions associated with CCPR is considered high since these reductions are attributed to reduced energy consumption and changed behavior resulting from ALDOT’s development of a CCPR specification, a critical output of this proposal. It is expected that CCPR asphalt mixtures could also lead to potential cost savings, encouraging broader use across the state where applicable (i.e., where an abundance of RAP exists and the project is specified for full-depth reconstruction, lane widening or new construction). In addition, CCPR incorporates very large amounts of RAP, which has additional benefits such as conserving raw materials and reducing GHG emissions associated with raw material extraction and transport. These additional benefits are not included in the estimated reductions above, as this proposal focuses solely on the reduction in GHG emissions resulting from eliminating the heat needed to produce asphalt mixtures. As a result, CCPR is a promising pavement rehabilitation method that can offer lasting GHG emission reductions.

Similarly, the durability of GHG emission reductions associated with WMT is also considered high since these reductions are attributed to reduced energy consumption resulting from lower production temperatures and changed behavior resulting from ALDOT’s change in asphalt mixture specifications, a critical output of this proposal. While WMTs are allowed in ALDOT’s specifications, few contractors currently use these technologies to reduce temperatures. With the specification changes, contractors will be required to reduce production temperatures in the future.

1. **Magnitude of GHG Reductions from 2025 through 2050**

Assuming the successful implementation and transition, 60% of ALDOT’s tonnage will continue to be produced using WMT with temperature reductions from 2030 through 2050, as stated under *Section 1.a.,* *Description of GHG Reduction Measures*. In addition, one CCPR project will be let every three years, starting in 2031, because of the specification change. Table 4 provides detailed estimates on the annual and overall GHG emission reductions that the project is expected to achieve from 2025 to 2050. According to these estimates, the total reduction in GHG emissions during this period will be 312,102 MTCO2e. This represents a 16% decrease compared to the emissions that would have been produced if conventional HMA had been used. A temperature reduction of 80 degrees Fahrenheit holds true for these calculations.

As discussed in the previous section, CCPR is a promising pavement rehabilitation method that can offer lasting GHG emission reductions with high durability. From 2030 through 2050, ALDOT will have specifications in place with experience and confidence gained from the pilot sections and demonstration projects, thereby overcoming resistance to change and increasing the durability of the GHG emission reductions. Similarly, ALDOT will have specifications updated to require contractors to reduce temperatures and allow WMT to be adopted in industry, becoming a commonly used technology. This will significantly increase the durability of the GHG emission reductions associated with WMT.

**Table 4: Estimated GHG Reductions from 2025 through 2050**

| **Year** | **Alabama Tonnage (Short Ton)** | **AL Total GHG Emissions (MTCO2eq)** | **Pilot Tonnage (Short Ton)** | **Total GHG Emissions (MTCO2eq)** | **Pilot GHG Reductions (MTCO2eq)** | **% Reductions (MTCO2eq)** |
| --- | --- | --- | --- | --- | --- | --- |
| 2025 | 4,400,000 | 76,673 | 1,577,514 | 27,487 | 8,145 | 11% |
| 2026 | 4,400,000 | 76,673 | 2,017,514 | 35,153 | 9,954 | 13% |
| 2027 | 4,400,000 | 76,673 | 2,715,028 | 47,307 | 12,167 | 16% |
| 2028 | 4,400,000 | 76,673 | 2,715,028 | 47,307 | 12,167 | 16% |
| 2029 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2030 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2031 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2032 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2033 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2034 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2035 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2036 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2037 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2038 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2039 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2040 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2041 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2042 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2043 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2044 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2045 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2046 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2047 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2048 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| 2049 | 4,400,000 | 76,673 | 2,677,514 | 46,653 | 12,669 | 17% |
| 2050 | 4,400,000 | 76,673 | 2,640,000 | 46,000 | 12,066 | 16% |
| **Total** | **114,400,000** | **1,993,508** | **67,367,682** | **1,173,823** | **312,102** | **16%** |

1. **Cost Effectiveness of GHG Reductions**

The estimated cost effectiveness of GHG reductions for WMT and CCPR combined is approximately $959 per MTCO2e reduced. As specified in the grant NOFO, this figure was derived by dividing the $63.8M requested CPRG implementation grant dollars by the total reduction of 66,564 MTCO2e for the period from 2025 through 2030.  This estimated cost-effectiveness is conservative, given the number of pilots and projects outlined in the proposal.

As a key milestone for this proposal, ALDOT will host meetings with stakeholders (i.e., government, industry, and academic partners) to refine specifications for CCPR and WMT. Standard Specifications for WMT will be published in the first quarter of 2025 and for CCPR by the second quarter of 2027. These specifications can then be used on Federal, State, and County funded projects where the technologies present advantages over conventional materials and practices.

There is high confidence that the enhanced specifications will be adopted locally and possibly even nationally through ALDOT’s leadership in various associations and committees, such as the FHWA Climate Challenge, AASHTO COMP, and CAPRI. According to the 2021 NAPA survey, approximately 1.5 million tons of HMA were produced in Alabama for other agencies.3 Combining this with the 4.4 million tons for ALDOT and assuming local agency adoption at 60% of the total tonnage utilizing WMT with reduced temperatures from 2028 through 2030, the resulting cost-effectiveness decreases to $765 per MTCO2e reduced.

Similarly, based on the 2021 NAPA survey, it is estimated that approximately 432.2 million tons of HMA were produced in the United States.3 If similar specifications are adopted nationwide and 60% of the asphalt tonnage across the United States is produced using WMT at reduced temperatures from 2028 through 2030, the cost-effectiveness of GHG reductions will decrease to $17 per MTCO2e. Detailed calculations and estimates can be found in the *Technical Appendix*.

1. **Documentation of GHG Reduction Assumptions – (see *Technical Appendix*)**

As required in the NOFO, the Technical Appendix and the GHG Calculation Spreadsheet contain the necessary information about the methodology, assumptions, and calculations used to determine the GHG emission reductions resulting from the measure of reducing production temperatures for asphalt mixtures. For this purpose, the latest available information from the IPCC Fifth Assessment Report and the EPA Emission Factors for Greenhouse Gas Inventories were used. These documents provide detailed information on the calculations used for determining the GHG emission reductions for two time periods: 2025-2030 and 2025-2050.

# Environmental Results – Outputs, Outcomes, and Performance Measures

1. **Expected Outputs and Outcomes**

Table 5 outlines the expected outputs and outcomes associated with each feature that can be used to reduce temperatures during asphalt mixture production. As seen in the table, the outcomes are directly aligned with Objective 1:1 under Goal 1, Tackle the Climate Crisis – Reduce Emissions that Cause Climate Change, of EPA’s Strategic Plan.[[17]](#footnote-18)

**Table 5: Expected Outputs and Outcomes**

|  |  |  |
| --- | --- | --- |
| **Feature** | **Outputs** | **Outcomes** |
| **WMT** | * Review and refine Standard Specifications to use WMT on State and Local Government projects by Q4 2025 * Conduct projects with ALDOT tonnage is produced using reduced temperatures and 35% WMT in 2025, 45% in 2026, and 65% WMT in 2027 through 2030 * 175 people participate in training sessions * Present at 3 conferences per year, at a minimum * Distribute 6 communication pieces * 6 plants per year host an open house during production after spec. change | * Estimated Time-bound outcomes   + 2025 through 2023     - 14% (66,564 MTCO2eq) reduction in GHG emissions     - Total of 14,305,084 tons of asphalt mixture produced   + 2025 through 2050     - 16% (312,102 MTCO2e) reduction in GHG emissions     - Total of 67,367,682 tons of asphalt mixture produced * Reduced exposure to hazardous air pollution or unhealthy ambient air quality; an estimated reduction in PM10 concentration of 80% - 92% with an average WMT mixture temperature reduction of 30°C9 * Increase knowledge of WMT and CCPR technologies and environmental impacts * Enhanced level of community engagement in conclusion of structured training projects and community outreach efforts |
| **CCPR** | * 4 CCPR projects completed before Q1 2029 * Total of 150,056 tons of asphalt mixture produced * Review and refine Standard Specifications to use CCPR on State and Local Government projects * 175 people participate in training sessions * Present at 3 conferences per year, at a minimum * Distribute 6 communication pieces * All plants that participate in a pilot project host an open house during production |

1. **Performance Measures and Plan**

This proposal focuses on developing specifications for WMT and CCPR and monitoring the GHG reductions in pilot projects used to refine those specifications. It is anticipated that every construction project faces its own set of challenges, which may potentially cause delays, so the performance measures of this proposed project will be tracked against the timeline given in Table 6. Standard specifications for WMT will be published in the first quarter of 2025 and for CCPR by the second quarter of 2027, making them available for use on State and Local Government projects. The amount of GHG reductions achieved in the pilot projects used to develop these specifications can be estimated based on the actual project tonnage and temperature reductions through the aforementioned methodologies.

Contractors will report their WMT and CCPR asphalt tonnages as part of ALDOT Construction Personnel oversight throughout the construction process. Asphalt tonnages will be reported monthly for each project for contractor payment purposes, ensuring that GHG emissions are accounted for in each Semi-annual Report associated with this application, as shown in Table 6. Tonnages will also be confirmed once projects conclude by ALDOT personnel in the project closeout phase.

**Table 6: Detailed Implementation Timeline**

A screenshot of a spreadsheet

Description automatically generated

1. **Authorities, Implementation Timeline, and Milestones**

The implementing agency for this application is the Alabama Department of Transportation. ALDOT’s Authority to Implement can be found in Alabama Code 39-2-1 and 39-2-2, which state that the Alabama Department of Transportation has the authority to specify, advertise, and let and award highway projects for construction in the State of Alabama. ALDOT will utilize their existing project management framework to handle the organizational structure for carrying out many aspects of the workplan, thereby optimizing efficiency and saving on the overall cost of the application since the work will be done by state employees. Table 7 breaks out the various personnel involved in implementing this proposal and defines responsibilities for each.

**Table 7: Authorities To Implement Timeline and Milestones**

| **Authorities** | **Core Responsibilities** |
| --- | --- |
| ALDOT Personnel | * Area and Materials Personnel will scope project locations in accordance with CPRG guidelines to ensure overall success and maximize GHG reductions * Materials and Construction Personnel will develop specifications for WMT and CCPR * Design Personnel will create plans for each project * Office Engineers will oversee the bidding and awarding process for each project * Construction Personnel will inspect and monitor each project from beginning to end * Media Relations Personnel will follow ALDOT’s Public Involvement Plan for Statewide Transportation Planning and coordinate with local news outlets and social media to guarantee participation in all public involvement meetings to ensure the welfare of the areas of the state where construction activities will occur * Materials Personnel will monitor GHG emissions, organize the Semi-annual Report, as indicated in Table 6, and be responsible for the overall implementation of the application |
| National Center for Asphalt Technology (NCAT) | * Assisting in the development and refinement of WMT and CCPR specifications * Aiding in the monitoring of GHG emissions * Developing the Semi-annual Report shown in Table 6: Detailed Implementation Timeline * Assisting in training that may be required for adaptation to WMT and CCPR technologies |
| Alabama Asphalt Paving Association (AAPA) & Alabama Road Builders Association (ARBA) | * Providing the Contractors performing construction projects with additional expertise and experience to ensure the quality of workmanship |
| Alabama Community College System (ACCS) | * Attending all community involvement meetings * Offering courses near project areas to help local residents obtain roadway construction skills that would enable them to access highly valued career opportunities * Coordinating with AAPA and ARBA concerning courses relevant to the development of a skilled roadway construction workforce |
| Contractors | * Bidding and constructing roadway projects using the new WMT and CCPR specifications |

1. **Low-Income and Disadvantaged Communities**
2. **Community Benefits**

The construction projects for this proposed study will be selected to maximize both carbon reduction and equity impacts. This will ensure that the CPRG program not only reduces GHG emissions but also considers and addresses equity concerns, aiming to improve air quality for all residents of Alabama. Across the state of Alabama, ALDOT has approximately 80 approved asphalt plants. According to the Climate and Economic Justice Screening tool, 46 plants (58%) are in overburdened and underserved communities.5 Table 8 outlines the percentage of ALDOT-approved HMA plants in each region.

**Table 8: Locations of ALDOT-Approved Asphalt Plants**

| **ALDOT Approved Asphalt Plant Location** | **% in EJ Communities** |
| --- | --- |
| North Region Guntersville Area | 40% |
| North Region Tuscumbia Area | 40% |
| East Central Birmingham Area | 44% |
| East Central Alexander City Area | 46% |
| West Central Region Tuscaloosa | 50% |
| West Central Region Fayette Area | 50% |
| Southwest Region Grove Hill Area | 75% |
| Southeast Region Troy Area | 100% |
| Southeast Region Montgomery Area | 100% |

ALDOT's adoption of WMT and CCPR will provide direct benefits to low-income and disadvantaged communities. These benefits include:

* *Improved Air Quality.* Asphalt plants burn fuel, such as natural gas and recycled fuel oil, which account for approximately 80% of the energy used. The use of WMT and CCPR will reduce fuel and eliminate burner fuel usage, respectively. This results in lower or no burner combustion emissions such as carbon dioxide, sulfur dioxide, nitrogen oxides, and formaldehyde emissions. The amounts reduced are dependent on the type of fuel used. Plants that utilize WMT have also demonstrated significant reductions in fine particulates, PM-10.8 Furthermore, the implementation of CCPR could lead to a decrease in emissions associated with raw material extraction and production of virgin asphalt and aggregate.7 By decreasing emissions from construction activities through the use of WMT and CCPR, ALDOT aims to improve air quality and create a cleaner environment for all residents of Alabama.
* *Climate Mitigation.* ALDOT's efforts to reduce carbon emissions align with broader climate mitigation goals, contributing to a decrease in the state's carbon footprint and helping to mitigate the impacts of climate change.
* *Enhanced Transportation Options.* The adoption of WMT and CCPR improves the highway network in urban and rural areas of Alabama, leading to enhanced accessibility, connectivity, and mobility for residents statewide.
* *Efficient Network Operations.* The use of WMT and CCPR can result in better compaction and a strong foundation, enhancing pavement performance and reducing delays.

1. **Community Engagement**

ALDOT will follow their Public Involvement Plan for Statewide Transportation Planning to actively engage with local communities near all project sites.[[18]](#footnote-19) To facilitate this engagement, ALDOT has five Regional Public Information Officers responsible for community engagement statewide. These officers will ensure that various local media outlets are notified and utilize social media platforms to maximize public involvement, gather feedback, and deliver lasting benefits to the communities.

This inclusive approach aims to foster a comprehensive understanding of community needs and concerns regarding construction-related carbon reduction efforts. In addition, ALDOT intends to partner with AAPA in their community engagement efforts. This partnership will involve interactions with citizens, community leaders, and stakeholders to promote collaboration and raise awareness of the benefits of implementing these technologies within the community. As part of these efforts, ALDOT will partner with AAPA to conduct annual regional open houses at asphalt plants for the duration of the project. Furthermore, ACCS will be actively involved in all community engagement events to inform residents about the skills development opportunities that could be beneficial for pursuing careers in roadway construction on such projects. All community engagement efforts will be reported in the Semi-annual Report throughout the project duration.

1. **Job Quality**

Contractors in Alabama are held to high job quality standards since most roadway construction in the state is tied to federal funding. As a result, everyone involved must abide by all the appropriate OSHA standards. Contractors, at a minimum, are required to develop safety programs, provide safety training, regularly conduct safety inspections, and maintain accurate records of all training and incidents. An added benefit of this project is that there are lower emissions from WMT and CCPR that contractors may be exposed to during paving[[19]](#footnote-20). The Alabama Department of Labor will be consulted throughout the length of the proposed project to ensure all parties are performing up to all aspects of applicable laws and regulations. In addition to ensuring a safe work environment for current employees, the services provided by ACCS will be advertised at all community involvement meetings to encourage more future construction workers. ACCS can help create a skilled workforce where the WMT and CCPR pilot projects occur. Construction positions associated with the completion of these projects are higher-paying jobs and allow the worker access to a career in the construction industry, which currently has a definite need for new workers.

1. **Programmatic Capability and Past Performance**

The Alabama Department of Transportation (ALDOT) is spearheading this application with the support of other prominent organizations in the state. These organizations include the National Center for Asphalt Technology (NCAT) at Auburn University, the Alabama Asphalt Pavement Association (AAPA), Construction Partners, Inc. (CPI), and The Alabama Community College System (ACCS).

NCAT is renowned for its research and implementation of asphalt technology and will provide technical assistance related to WMT and CCPR. They will also provide training to ALDOT and contractor personnel on the new specifications. AAPA will work with its member companies to implement the new specifications for WMT and CCPR and help in public engagement efforts. ACCS will assist in developing a skilled workforce where the WMT and CCPR trial projects are taking place by offering courses near project areas to equip residents with the necessary skills required to access highly valued career opportunities in the roadway construction field. The following sections provide information about the partners in this application.

1. **Past Performance**

Below is a list of federally funded assistance grants that have been performed within the last three years.

**Project 1: FHWA Climate Challenge**

* **Assistance Agreement Number:** N/A
* **Assistance Listing Number:** N/A
* **Brief Description of agreement:** FHWA provided ALDOT with funds to construct asphalt test sections and measure GHG emissions from the construction process. <https://www.fhwa.dot.gov/infrastructure/climatechallenge/>
* **Contact**:

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Pavement Design & Performance Team Leader

Federal Highway Administration

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**Project 2: Accelerated Implementation and Deployment of Pavement Technologies Program**

* **Assistance Agreement Number:** N/A
* **Assistance Listing Number:** N/A
* **Brief Description of agreement:** FHWA provided ALDOT with funds to construct asphalt test sections and test the materials used according to the balanced mix design framework, for the purpose of Validating BMD test criteria. <https://www.pooledfund.org/Details/Study/705>
* **Contact:**

LaToya N. Johnson, P.E.

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1. **Reporting Requirements**

For each of the past performances listed above in S*ection 6a*, below is additional details on the history of meeting the reporting requirements under each agreement.

**Project 1: FHWA Climate Challenge:**

* Quarterly updates are required, as well as participation in update webinars and meetings
* ALDOT has provided all necessary updates and participated in update meetings
* Progress on this project was delayed due to construction delays; this was communicated to all stakeholders

**Project 2: Accelerated Implementation and Deployment of Pavement Technologies Program:**

* We have provided updates to FHWA and all stakeholders as information is available
* Due to the complexity of the study, finding a suitable project was difficult, so we have experienced considerable delays; this was communicated to all stakeholders in a timely manner
* Construction on the validation sections is planned for the next month, so no results are available yet, but they will be communicated as soon as they are

1. **Staff Expertise**

ALDOT is a state agency with the primary responsibility of statewide transportation through all modes of travel. ALDOT employs approximately 4,000 people and utilizes federal, state, and local funds. Its mission is to provide a safe, efficient, and environmentally sound transportation system for all customers. The Department is organized into five geographic regions, with a Central Office in Montgomery. The Central Office is organized into the Office of the Transportation Director and the Office of the Chief Engineer. The five Region Engineers report to the Director and Deputy Director of Operations. The organization of the various bureaus and offices are designed to report to the Director and the Deputy Directors, Chief Engineer, or the Assistant Chief Engineers. The Department has several boards and committees that operate either within a bureau or as a cooperative effort among several bureaus and/or regions. More information about ALDOT is available at <https://www.dot.state.al.us>.

* **George Connor (ALDOT**) – Deputy Director for Operations, part of ALDOT’s Executive Leadership Team

**Project Role: Oversite of Operations/Construction**

* + 32 years of experience with ALDOT
  + Oversees ALDOT’s Bureau of Materials &Tests, Construction Bureau, and Maintenance Bureau
  + Chairman of the AASHTO Committee on Maintenance
  + Licensed Professional Engineer in the State of Alabama
* **Clay McBrien (ALDOT)** – Assistant Chief Engineer for Policy and Planning, part of ALDOT’s Executive Leadership Team

**Project Role: Oversite of Funding**

* + 32 years of experience with ALDOT
  + Oversees ALDOT’s Research & Development Bureau, Local Transportation Bureau, and Office Engineer
  + ALDOT’s Contact for FHWA’s Every Day Counts initiative
  + Licensed Professional Engineer in the State of Alabama
* **Scott George (ALDOT)** – State Materials and Tests Engineer, In ALDOT’s Bureau of Materials & Tests

**Project Role: Oversite of Materials**

* + Bureau Chief of the Materials & Tests Bureau
  + 35 Years of experience with ALDOT
  + Licensed Professional Engineer in the State of Alabama
* **John Jennings (ALDOT)** – State Materials Engineer in ALDOT’s Bureau of Materials & Tests

**Project Role: EPA and ADEM Point of Contact**

* + 14 Years of experience with ALDOT
  + Oversees all pavement designs on the Alabama National Highway System
  + Has written specifications for and managed various special projects
  + Licensed Professional Engineer in the State of Alabama
* **Zane Hartzog (ALDOT**) – State Bituminous Engineer in ALDOT’s Bureau of Materials and Tests

**Project Role: Specifications Writing and Project Manager**

* + 10 years of Experience with ALDOT
  + ALDOT’s contact for FHWA Climate Challenge Grant and FHWA AIDT Grant
  + Has written specifications for and managed various special projects
  + Licensed Professional Engineer in the State of Alabama
* **Allison Green (ALDOT)** – Public Information Manager in ALDOT’s Media and Community Relations Bureau

**Project Role: Community Engagement**

* + 9 years of experience with ALDOT
  + ALDOT’s Drive Safe Alabama Coordinator
  + More than 20 years of experience in communications, public relations, and marketing
  + Serves as a news media spokesperson for other ALDOT initiatives

NCAT was established in 1986 as a partnership between Auburn University and the National Asphalt Pavement Association (NAPA) Research and Education Foundation to provide practical research and development to meet the needs of maintaining America's highway infrastructure. NCAT was created to ensure this industry's ability to provide pavements that are durable, sustainable, quiet, safe, and economical. NCAT works with state highway agencies, the Federal Highway Administration (FHWA), and the highway construction industry to develop and evaluate new products, design technologies, and construction methods that quickly lead to pavement improvements. NCAT’s mission is to provide innovative, relevant, and implementable research, technology development, and education that advances safe, durable, and sustainable asphalt pavements. NCAT's research center and Test Track make it one of the world's leading institutions for asphalt pavement research and an important source of information for those tasked with maintaining our nation's infrastructure. NCAT is fully equipped with the latest laboratory and field-testing equipment for pavement engineering and forensic analysis, materials testing, field testing, and asphalt research. More information about NCAT is available at [ncat.us](https://eng.auburn.edu/research/centers/ncat/).

* **Nam Tran** – Associate Director and Research Professor at NCAT

**Project Role:** Dr. Tran will serve as a WMT Subject Matter Expert. He will be responsible for developing specifications, gathering WMT production data and acceptance testing results, and reporting on the progress of WMT implementation.

* + 18 years of experience, with about 14 years conducting applied research at NCAT
  + Expertise in asphalt and renewable materials, including WMT, pavement design, specification development, and deployment and implementation of new technologies
  + Licensed Professional Engineer in the State of Arkansas
* **Ben Bowers** – Assistant Professor at Auburn University

**Project Role:** Dr. Bowers is responsible for developing specifications, collecting production data and acceptance testing results, and reporting the progress of CCPR trials and implementation as a CCPR Subject Matter Expert.

* + 12 years of experience conducting research and implementing findings in geotechnical and flexible pavement
  + An expert in CCPR, sustainability and resilience of asphalt pavements
  + Licensed Professional Engineer in the State of Virginia

**Suri Gatiganti** – Assistant Research Professor at NCAT

**Project Role:** Dr. Gatiganti will collect production data, monitor construction activities, and report on GHG emission reductions as an LCA Subject Matter Expert.

* + 8 years of experience conducting research in sustainability and asphalt materials
  + An expert in life cycle assessment, environmental product declaration, and data collection related to emissions and energy usage.
* **Travis Walbeck** – Training Manager at NCAT

**Project Role:** Mr. Walbeck will serve as a Training Coordinator and will be responsible for developing training materials and leading training for ALDOT and contractor personnel on the new specifications and acceptance testing.

* + 23 years of experience as a civil engineer working in the private, public, and educational sectors
  + An Expert in training, community outreach, and workforce development

Other key personnel that have volunteered to support this project include Houston Blackwood, the Alabama Community College System Innovation Center Workforce Director; Mel Monk the Executive Director of the Alabama Asphalt Pavement Association; and Dr. Heather Dylla and Laurel McCarthy with Construction Partners, Inc., a member of the Alabama Asphalt Pavement Association through Wiregrass Construction Company. Letters of support from these organizations are included in the Appendix, along with resumes for those who play a critical role in training, workforce development, and community outreach.

# Budget

1. **Budget Details**

ALDOT will use EPA Grant Funds for three activities: Cold Central Plant Recycled Asphalt Mix, Warm Mix Asphalt with Reduced Temperature Requirement and Technical Assistance from The National Center for Asphalt Technology (NCAT). Details of the budget for these three activities have been outlined below and in the *Budget Narrative*.

1. **Cold Central Plant Recycled Asphalt Mix**

ALDOT will identify and let CCPR projects through ALDOT’s standard project scoping and letting process. ALDOT will use CPRG funds for all costs associated with these projects. Since these projects have not yet been identified or let, the exact cost is unknown. Therefore, costs have been estimated using information from Alabama Asphalt Pavement Association, Virginia Asphalt Pavement Association, and NCAT. Project cost was estimated at approximately $3M and increased using the average inflation rate for the last 5 years from BLS.gov to estimate future cost increases. The budget for CCPR trials and pilot projects is provided in Table 9 below.

**Table 9: CCPR Trials and Pilot Projects**

| **Year** | **Project** | **Cost** |
| --- | --- | --- |
| 2025 | Trial 1 | $   3,037,901 |
| 2026 | Trial 2 | $   3,153,949 |
| 2027 | Project 1 | $   3,274,430 |
| 2027 | Project 2 | $   3,274,430 |
| 2028 | Project 3 | $   3,399,513 |
| 2028 | Project 4 | $   3,399,513 |
|  | **Total CCPR** | **$ 19,539,736** |

1. **Warm Mix Technology with Reduced Temperature Requirement**

ALDOT will scope and let WMT projects with reduced temperature requirements through their standard scoping and letting process. The reduced temperature requirement will incur extra costs and risks over typical paving operations. Examples of extra costs include costs associated with developing a specification, monitoring the use of the specification, finding projects suitable for reduced temperature, accounting for CPRG funds, and reporting all these activities. For the contractor, examples of increased cost could include adding warm mix technologies to existing asphalt plants, purchasing warm mix additives, the risk associated with a specification that will penalize the contractor for production above the temperature limit, and inability to simultaneously produce mix at typical hot mix temperatures. ALDOT anticipates these costs and risks will be reduced over time as both ALDOT and contractors become accustomed to using the new specifications. Therefore, ALDOT will increase the percentage of projects each year that use a reduced temperature requirement while reducing the cost offset paid into each project that uses the reduced temperature requirement. ALDOT lets projects with a total of approximately 4.4 million tons of asphalt mixture per year. A breakdown of proposed tonnage for each year is in Table 10 below.

**Table 10: WMT Cost Offset**

| **Year** | **Cost Offset per Ton** | **ALDOT's Annual Tonnage** | **% of Annual Tonnage with Reduced Temperature Requirement** | **Total Cost** |
| --- | --- | --- | --- | --- |
| 2025 | $ 5.00 | 4,400,000 | 35% | $ 7,700,000 |
| 2026 | $ 4.50 | 4,400,000 | 45% | $ 8,910,000 |
| 2027 | $ 4.00 | 4,400,000 | 60% | $ 10,560,000 |
| 2028 | $ 3.50 | 4,400,000 | 60% | $ 9,240,000 |
| 2029 | $ 2.80 | 4,400,000 | 60% | $ 7,392,000 |
|  |  |  | **WMA TOTAL** | **$ 43,802,000** |

This cost offset funds will be managed by ALDOT’s Administrative section by placing the CPRG grant funds into an account representing the CRPG as a project. Those funds will then be dispersed to individual projects based on the number of tons of mix on that specific project with a reduced temperature requirement.

1. **Technical Assistance from The National Center for Asphalt Technology (NCAT)**

NCAT and ALDOT have partnered on several projects including FHWA’s Climate Challenge project. Assistance from NCAT will be critical to ALDOT in implementing these two technologies for developing specification, monitoring projects, and generating reports. ALDOT is requesting $100,000 per year for five years, totaling $500,000 for this assistance from NCAT. ALDOT currently has a contract with NCAT for offering certification classes. NCAT will add relevant material to these classes with information about CCPR and WMA with reduced temperature requirements.

1. **Expenditure of Awarded Funds**

ALDOT’s Executive Leadership Team in the Administrative Bureau will oversee the expenditure of all CPRG Funds. The Funds associated with the CCPR projects will be dispersed through ALDOT’s typical project letting process, which is competitively bid. Funds for Technical assistance from the National Center for Asphalt Technology (NCAT) will be paid to NCAT through ALDOT and Auburn University’s usual process of billing on a per hour of assistance basis. Technical assistance funds will be managed by ALDOT’s Administrative Bureau or ALDOT’s Research and Development Bureau. CPRG funds to be used for warm mix asphalt cost offsets will be managed by ALDOT’s Administrative Bureau by placing the funds in an account that represents the CPRG grant as a project. Funds will then be dispersed to competitively bid construction projects based on the number of tons of asphalt mixture produced meeting the lower temperature requirement. ALDOT’s Construction program contracts the production of approximately 4.4 million tons of asphalt pavements annually. It will not be outside of ALDOT’s routine work to find projects where these processes can be used.

1. **Reasonableness of Costs**

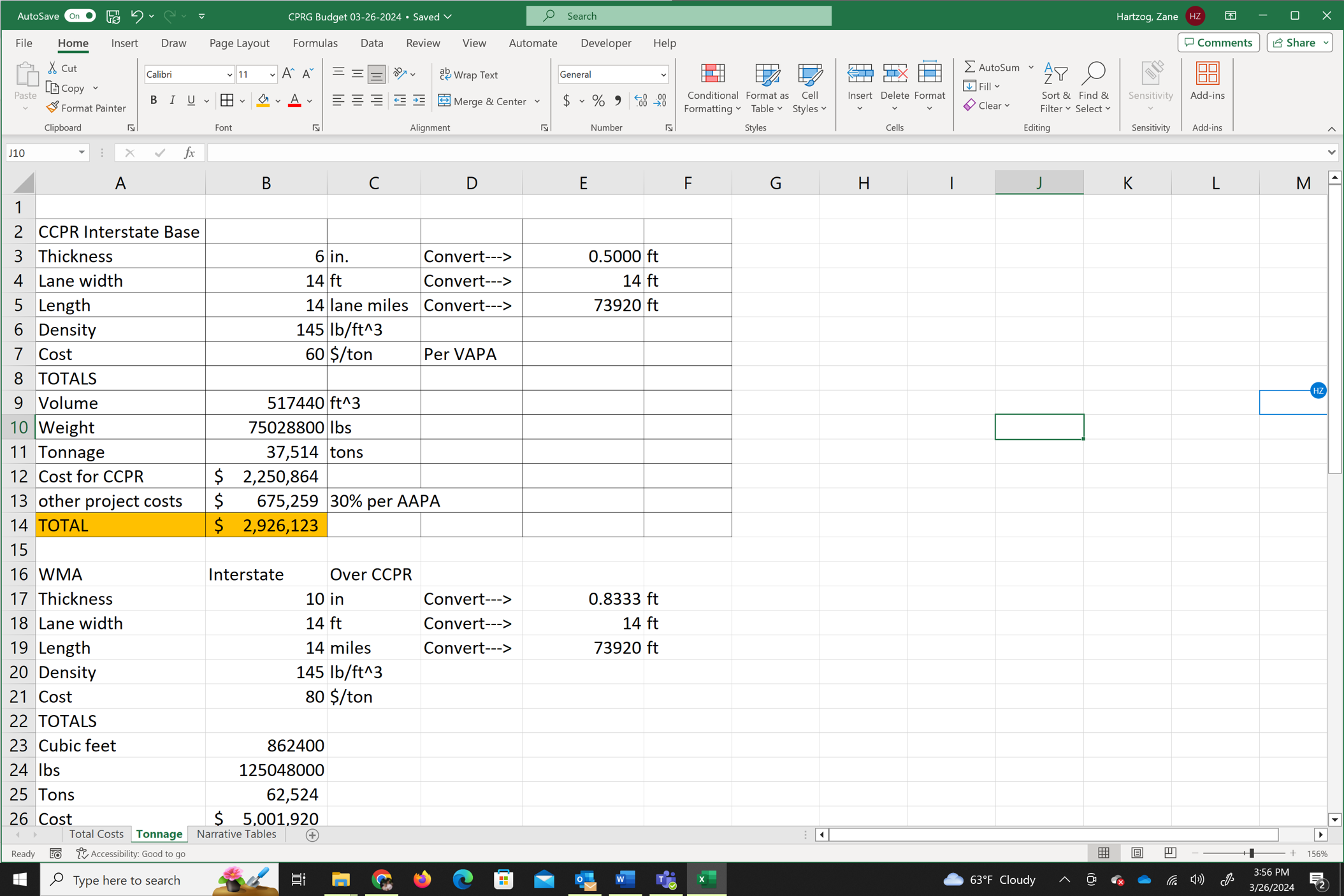
Costs for these projects were calculated based on information from several organizations, including ALDOT, NCAT, Alabama Asphalt Pavement Association, and Virginia Asphalt Pavement Association.

The cost for one CCPR construction project was estimated in Table 11 as follows:

* Project volume = Thickness x Width x Length
* Project Tonnage = Volume x density / 2000 lb/ton
* Cost per ton of CCPR material = $60 per ton, according to Virginia Asphalt Paving Association
* Density of CCPR = 145 lb/ft3

Other Project costs are estimated to account for an additional cost of 30% over the project tonnage per Alabama Asphalt Pavement Association

**Table 11: Estimated Cost for One CCPR Construction Project**



The Total Cost is rounded to $3M and then increased by 3.82% per year to account for future inflation. 3.82% was calculated by averaging inflation in the last 5 years using data from BLS.gov.

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