<u>Brevard County Board of County Commissioners / City of Palm Bay Coalition for Implementation of Photocatalytic Pavement Treatments – Project Narrative</u>

Section 1: Overall Project Summary and Approach

<u>A. Description of Greenhouse Gases (GHG) Reduction Measures</u>

The Brevard County Board of County Commissioners (BOCC), the governing agency for Brevard County Florida, is proposing to form a Coalition with the City of Palm Bay, Florida (City) – a municipality located within Brevard County. The purpose of this Coalition is to deliver our Climate Pollution Reduction project to the citizens through the opportunities presented by the Environmental Protection Agency's (EPA's) Climate Pollution Reduction Grant (CPRG) Implementation Phase funding.

The Coalition is looking to expand and improve on an existing pavement preservation program currently being carried out by local funding sources. The road network consists of 1,145 centerline miles (BOCC) and 839 centerline miles (City). The Coalition actively manages the road network by resurfacing, reconstruction, and pavement preservation. Pavement preservation treatments, such as rejuvenators, extend the life cycle of roads, resulting in carbon avoidance. With the help of CPRG funding, this Coalition seeks to implement an expanded program that will utilize a new GHG reduction-based technology that uses a nano-particulate photoreactive catalyst material called titanium dioxide to create a photocatalytic reaction enabling treated pavements to capture and permanently sequester (in the form of decomposition) mobile source air pollution. This technology will enable this project to meet CPRG goals, specifically by targeting and reducing carbon dioxide and nitrogen oxides. An example of the proposed treatment process can be seen in the below image taken during treatment of roadways in Raleigh, North Carolina.

Picture 1: Photocatalytic pavement treatment in Raleigh, NC

This single measure program is phased annually from 2025 to 2029 and will take advantage of the easily scalable nature of the photocatalytic pavement application across a sizable percentage of the Coalition. The Coalition anticipates treating cumulatively 1,282 centerline miles over the five-year program (500 miles BOCC/782 miles City) of which at least 40% is included in the Low-Income Disadvantage Community (LIDAC) areas as identified using the Climate & Economic Justice Screening Tool (CEJST). This accounts for over 64% of the Coalition's total 1,984 combined centerline miles of pavement. *(See Figures 1 and 2 below)*

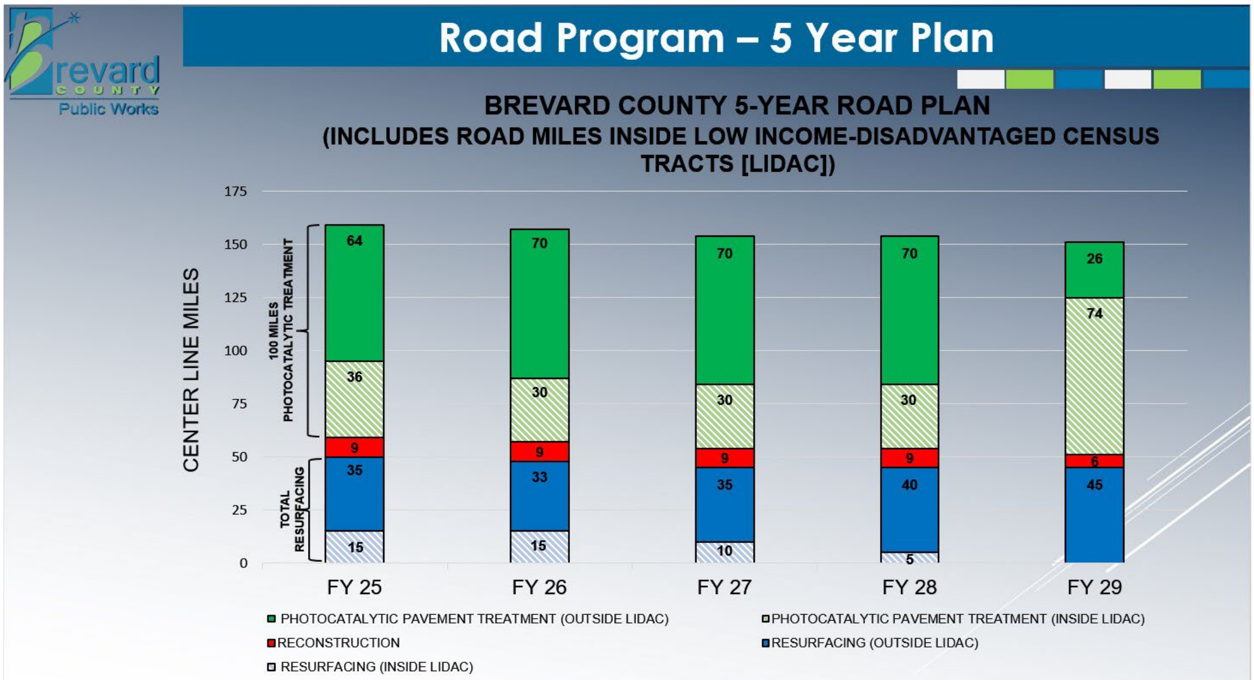


Figure 1 – Brevard County's Proposed 5-year plan for Photocatalytic Treatment

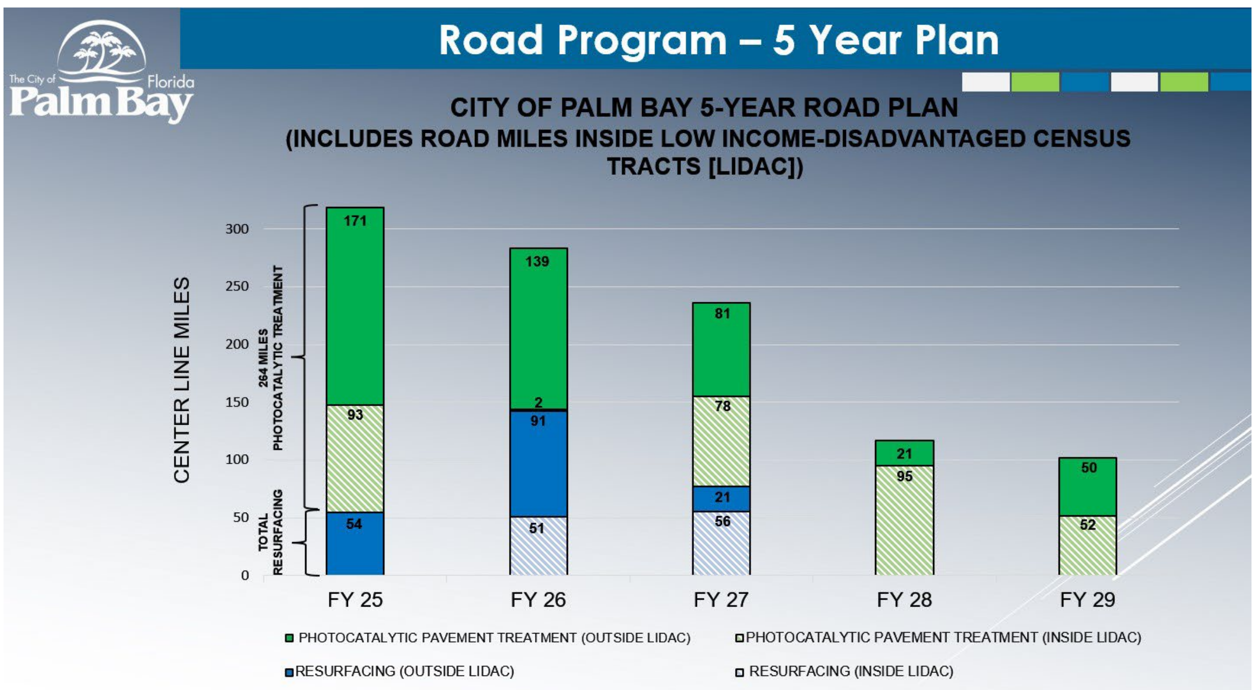


Figure 2 – City of Palm Bay's Proposed 5-year plan for Photocatalytic Treatment

This technology has significant co-benefits such as the mitigation of the Urban Heat Island effect, the decomposition of road area microplastic particles, as well as the original technology's asphalt binder extension benefit (already accounted for as part of the Coalition's existing preservation programs). Mobile source air pollution is identified as a primary driver of GHG inventories within the East Central Florida

Regional Planning Council Priority Climate Action Plan (ECFRPC PCAP) (Attachment East Central Florida Regional Planning Council PCAP_BOCC-Palm Bay, page 26). The Coalition has chosen a single priority measure (Attachment East Central Florida Regional Planning Council PCAP_BOCC-Palm Bay – East Central Florida Regional Planning Council PCAP, page 39) due to the cost effectiveness of the implementation and the long-lasting benefit for the citizens of Brevard County.

The Coalition is pursuing an EPA CPRG Implementation Grant for the purpose of targeting a high priority measure as part of the ECFRPC PCAP, specifically transportation emissions. In the Brevard County jurisdiction, transportation emissions account for 41% of all regionwide emissions inventory totaling 19,222,173 CO2e *(See Figure 3 – Communitywide Regional Emissions Inventory and Figure 4 – Baseline and Projected Emissions by Sector)* as referenced in the ECFRPC PCAP (Attachment East Central Florida Regional Planning Council PCAP_BOCC-Palm Bay, page 26 and 28).

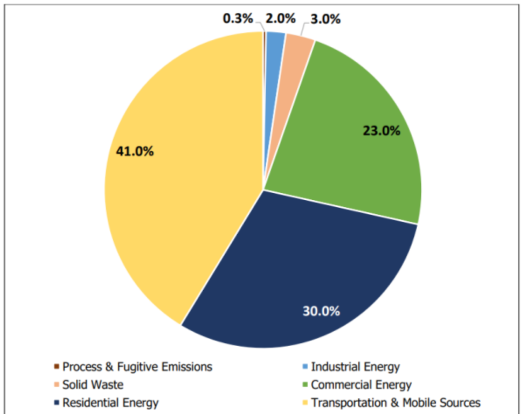


Figure 3 – Communitywide Regional Emissions Inventory

East Central Florida's 2019 regional emissions were estimated at 46,968,766 Metric Tons Carbon Dioxide Equivalent (CO_2e). Based on the above growth rates and emissions intensity factors, 2030 emissions are projected to be 52,546,550 Metric Tons CO_2e. The following table displays the primary[14] 2019 baseline and 2030 projected emissions.

Table 5: Baseline and Business-as-Usual emissions comparison

Sector	Source	Baseline Emissions (MT CO_2e)	2030 BAU Emissions (MT CO_2e)	Percent Change (%)
Residential Energy[15]	Electricity	13,614,601	16,215,081	19%
	Natural Gas	615,152	740,480	20%
Commercial Energy[1515]	Electricity	7,459,391	7,685,763	3%
	Natural Gas	3,363,758	3,877,293	15%
Industrial Energy[1515]	Electricity	803,415	796,855	-1%
	Natural Gas	292,276	326,972	12%
Transportation	On-road	19,160,670	20,873,247	9%

Figure 4 – Baseline and Projected Emissions by Sector

This application supports Goal 1, "Tackle the Climate Crisis;" Objective 1.1, "Reduce Emissions that Cause Climate Change" of EPA's Strategic Plan described in Section I.C. of the CPRG NOFO (Notice of Funding Opportunity). Furthermore, the associated ESCRPC PCAP prioritizes high impact actions and goals and lists Vehicle Miles Traveled (VMT) Reduction *(See Figure 5 – Transportation Sector VMT by Fuel Source)* with potential near term net reductions of 1,681,895 MT CO2e and lists implementing agencies, Counties and *Municipalities (See Figure 6 – High Impact Actions and Carbon Reduction Goals)*.

On-road transportation (Passenger vehicle and transit)	Gasoline	33,329,031,223	VMT	13,908,992
	Diesel	3,555,686,820	VMT	5,251,678
Rail	Diesel	5,970,447	Gal.	61,503
			Transportation total	19,222,173

Figure 5 – Transportation Sector VMT by Fuel Source

High Impact Action and Goal Summary (Priority Measure)	Potential Near Term Net Reduction (MT CO_2e)	Implementing Agency or Agencies	Geographic Scope
Region-wide Grid Decarbonization Pathway	1,586,127	Local, Regional, Utility Providers	east central Florida region
Vehicle Miles Traveled Reduction (Gasoline - 12%, Diesel - 6%)	1,681,895	Air Pollution Control Agencies, Transportation agencies, Counties, Municipalities	east central Florida region
Electric Vehicle (EV) Adoption (4.5% Annual Growth)	3,160,237	Counties, Municipalities Local, Regional	east central Florida region

Figure 6 – High Impact Actions and Carbon Reduction Goals

The prioritization of the transportation sector comes in the form of equivalent VMT reductions. The VMT reduction strategies listed in 3.4.1.2 (Vehicle miles traveled (VMT) reduction as a high impact action) is specifically identified to "Encourage emerging technologies and innovative practices to reduce emissions" (PCAP page 39) with the realization that innovation is both a keystone aspect of the EPA's CPRG application and a necessary ingredient to achieve the bold goals of the ECFRPC PCAP. The PCAP was left intentionally ambiguous to allow eligible entities covered by the plan to incorporate potential new technologies in a way that are scalable, durable, targeted, cost effective, transformational, and meets the Justice40 Initiative goals set forth by the CPRG application guidelines. The Coalition believes it to be in the best interest of its constituents and the greater good of the ECFRPC group to utilize the EPA CPRG funding to enable the use of technology that is currently becoming more prevalent but on a smaller scale. The alignment of the EPA CPRG and this Coalition's common goals has led to the pursuit of solutions that fall outside the more traditional VMT reductions (i.e., ridesharing, transit, electric vehicle (EV) conversion etc.). Our strategy can be readily implemented without modification of consumer behavior, high capital costs, enlarged land use, potential for dis-benefits, long lead times for GHG reductions and a narrower benefit to Low-Income and Disadvantaged Communities. The CPRG offers an avenue that enables the Coalition the opportunity to make the broadest positive impact across several additional co-benefits that extend beyond traditional priority measures.

In alignment with the EPA guidelines, it is the intent of the Coalition to closely follow the further guidance listed in the CPRG NOFO and expect to:

- Stimulate transformation toward a decarbonized economy (more specifically the transportation sector) and demonstrate approaches that are replicable to unlock opportunities for even greater emissions reductions (in addition to significant co-benefits such as urban heat, decomposition of microplastics and forever chemicals).
- Deliver benefits (that do not result in negative impacts) to low-income and disadvantaged communities, such as Criteria Air Pollutant (CAP) and Hazardous Air Pollutant (HAP) reductions, equitable economic growth, and improved quality of life outcomes.
- Support measures for which dedicated funding or financing from other sources (e.g., under other provisions of the 2022 Inflation Reduction Act (IRA), the 2021 Bipartisan Infrastructure Law (BIL),

the 2021 American Rescue Plan Act (ARP), and the 2021 Creating Helpful Incentives to Produce Semiconductors and Science Act (CHIPS)) is unavailable or that leverage other sources of public and private funding to the fullest extent possible prior to seeking CPRG funding.

- Achieve GHG emission reductions that are long-lasting and certain.
- Incorporate high labor standards, emphasize job quality, and support equitable workforce development; and,
- Ensure accountability by providing clear assumptions, metrics, timelines, authorities, and budget details.

Coalition High Impact Priority Measure - Understanding the Science behind photocatalysis:

Nanoparticle titanium dioxide (TiO2) is a powerful solar reactive ore capable of resolving and detoxicating most compounds, such as pollutants, via mineralization as the catalyst particles receive energy from the Sun. Mineralization is the process that turns a pollutant such as CO2 or NOx into a solid mineral, such as carbonate or nitrate, respectively. It is a chemical reaction that occurs when certain compounds get exposed to sunlight and oxygen. In chemistry, the process is referred to as reduction by oxidation or "redox". The process is generally slow unless a catalyst material is also present. One such catalyst is TiO2. When TiO2 is used to accelerate mineralization, it is called photocatalysis or photocatalytic oxidation (PCO). [1] The biggest advantage of this method of pollutant species capture, conversion, and sequestration is that CO2 and NOx cannot escape back to the atmosphere as it turns to a solid. In the case of CO2 and NOx mineralization, the resultant carbonate and nitrate are naturally consumed by vegetation as part of photosynthesis, so uptake is completed via biological storage. As a result, PCO offers a durable carbon capture and storage solution for the Transportation Sector looking to offset their emissions. Once solar energized, TiO2 releases electrons into the surrounding area that combine with oxygen and humidity (H2O) in the air to create the superoxide anion (HO2-). Simultaneously, the catalyst replaces its lost electrons by attracting electrons from ambient humidity, and hence returns to its original state or is not exhausted. *(See Figure 7 – Photocatalysis Cycle)*

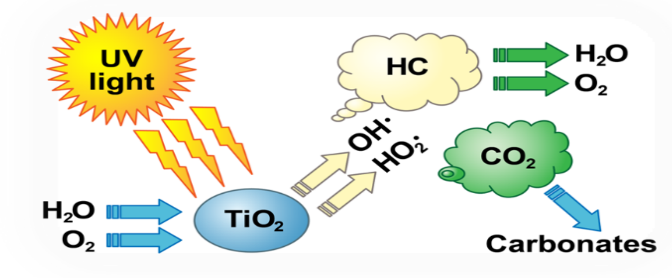
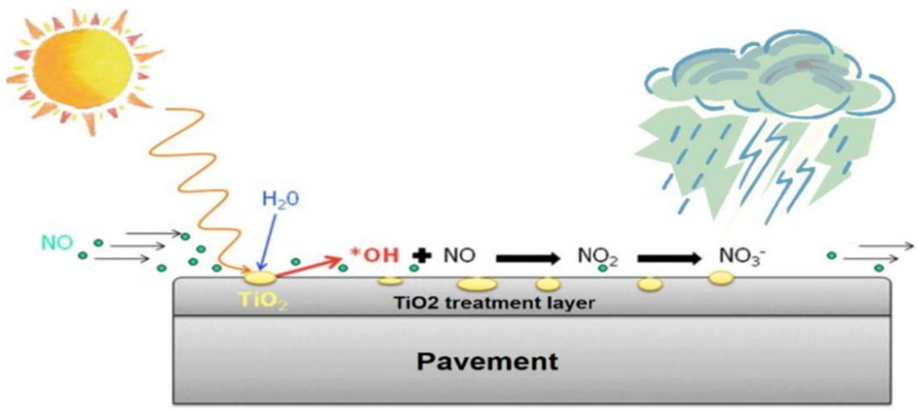


Figure 7: Photocatalysis Cycle 1

The moist air that has lost electrons is transformed into a hydroxyl radical (-OH). The HO2- and -OH (collectively oxyradicals) produce complete oxidative decomposition of nearfield pollutants. For NOx and CO2, the presence of the oxyradicals converts toxic (to humans) nitrite gas (NO2) into a harmless nitrate

[1] Brinkmann M, et al., Acute Toxicity of the Tire Rubber-Derived Chemical 6PPD-quinone to Four Fishes of Commercial, Cultural, and Ecological Importance, *Environmental Science & Technology Letters*, March 2022.



salt[2] and similarly CO2 into a harmless carbonate,[3] both are simple "plant foods", hence removing the airborne environmental threats. *(See Figure 8 – Photocatalysis Cycle in Pavement Treatment)*

Figure 8: Photocatalysis Cycle in Pavement Treatment
Source: Texas A&M Transportation Institute (TTI)

Plants insatiably consume both carbon and nitrogen as critical drivers of photosynthesis. Nitrogen is the primary constituent of chlorophyll. The sunlight then breaks down assimilated carbon into glucose to promote plant growth. What is important is the resultant of photosynthesis in establishing PCO as permanent CO2 and NO2 sequestration by perennial vegetation. The only external result of photosynthesis in plants is oxygen. As plants age, the nitrogen rich chlorophyll naturally decomposes into needed amino acids, which are metabolized.[4] Perennials hence exhaust nitrogen and sequester carbon for decades and even centuries. So, vehicle exhaust CO2 is first photochemically mineralized; assimilated by vegetation; becomes sugar and the photochemically mineralized NO2 becomes protein under PCO.

The purpose of photocatalytic construction materials for our built environment are to augment and accelerate powerful natural air-purifying processes in places where the landscape has been altered for human consumption and lacks adequate greenspace. As a highly efficient photocatalyst material, TiO2[5] is a multifaceted photo responsive mineral[6] rapidly gaining increased scientific and commercial interest for near-roadway microenvironments as it advances a host of preservation and environmental benefits, including:

- Depolluting near-pavement air cleaning applications where TiO2 reacted surfaces are able to oxidize a variety of pollutants and contaminants such as those emitted by vehicles. Photocatalytic pavements remove NOx, CO2, MPP, and VOCs, reducing ozone pollution and greenhouse gas accumulations. Thereby also mitigating acid rain formation.

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[2] EPA: *Archives of Environmental Contamination and Toxicity* - Johannessen C, et al., The Tire Wear Compounds 6PPD-Quinone and 1,3-Diphenyguanidine in Urban Watershed, August 2021.

[3] *From The Ground Up, Recommendations for Building an Environmentally Just Carbon Removal Industry*, February 2023.

[4] NAPA: *The Road Forward, A Vision for Net Zero Carbon Emissions for the Asphalt Paving Industry*, www.asphaltpavement.org/climate.

[5] **soluble nitrate**: also - sodium nitrate (NO_3) is the pure form of nitric acid which is an essential plant nutrient easily assimilated by all common types of vegetation. Post absorption, nitrate is transferred to leaves and roots where it is converted into **chloroplast** (chlorophyll) for **photosynthesis** and later **amino acids** and fully metabolized.

[6] **carbonate**: also – carbon trioxide (CO_3) is a salt of carbonic acid and is an essential plant nutrient easily assimilated by all common types of vegetation. Carbonate is absorbed by vegetation via photosynthesizing or **biological carbon fixation** by all photoautotrophic plants; is converted into **carbohydrates**; and stored and utilized for energy. Perennials can store carbonate derivatives for decades and even centuries.

- Cool Pavement applications where TiO2 enhanced pavements provide a solar-reflective top boundary, which lessens pavement related radiative forcing (RF) by reducing pavement heat absorption and averting the convective re-release of solar radiation that leads to the undesired UHI impacts. Significantly lower absorption also extends the life-cycle assessment (LCA) of pavements by slowing-down pavement oxidation.[7]
- Super-Hydrophilic / Hydrophobic surfaces, which provide a rapid water desorbing (faster H2O sliding) pavement surface, making the pavements self-cleaning to remove contaminants (e.g., mold) and staining (de-soiling). The rapid water desorption protects against water intrusion to extend pavement life. Photocatalytic pavements are rain displacing / ice-build inhibiting for inclement weather-related safety improvements for roadways.[8]
- Water Purification - photocatalytic surfaces also are stormwater purifying as the combination of cooler pavements with depolluting properties are antibacterial, antiviral, and anti-plastic.
- Microplastic Decomposition is 99% efficient with TiO2.[9],[10] Dangerous airborne and aquatic plastic pollution deposition into our environment estimated to be 85% sourced from roadway tire wear (RAMPTWP), brake-pad wear (RAMPBPW), and polymer modified asphalt (RAMPPMA) degradation. One toxin, per- and polyfluoroalkyl substances (PFAS), is commonly used on tires as a protective coating, and it is an emerging cause of concern for agencies as much of the reported contaminations are coming from the roadway. *(See Figure 9 – Microplastic Reduction, Figure 10 Topical Treatments)*

	Microplastic Reduction Efficiency				
Sample	**Test (hours)**	**Pled (watts)**	**Diameter Beg**	**Diameter End**	**Volume Loss**
A	**2**	**110**	**100nm**	**37nm**	**94.8%**
B	**24**	**110**	**100nm**	**16nm**	**99.6%**

Figure 9 – Microplastic Reduction – Texas A&M Center for Infrastructure Renewal (CIR)

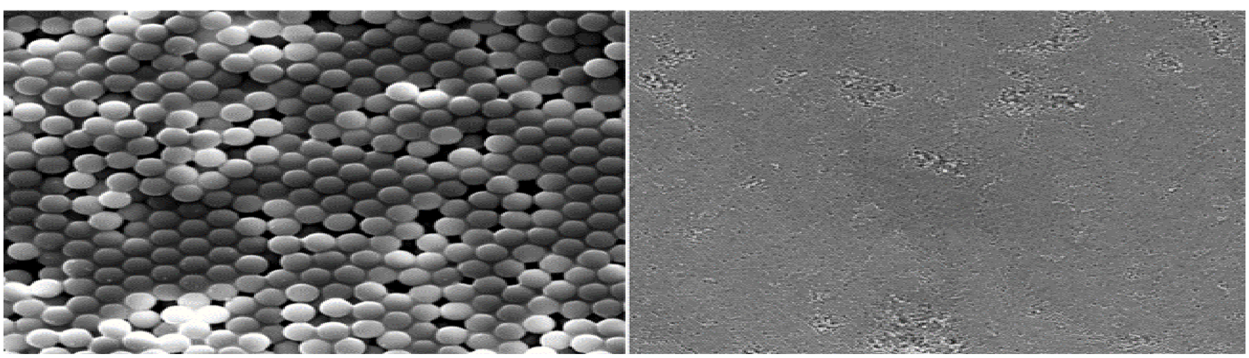


Figure 10 - Zollinger D and Philip J, Effect of TiO2 Topical Treatments on Concrete and Asphalt for On-Road Microplastic Pollution Removal, Texas A&M Transportation Institute, August 2022.

By awarding the Coalition a CPRG implementation grant, the EPA will be enabling other jurisdictions to evaluate the relative ease of transitioning from traditional pavement programs to the implementation of the new technology, thereby creating a significant reduction of GHG, Criteria and Hazardous Air Pollutants in addition to other co-benefits especially in low income and disadvantaged communities. The deployment of this technology can occur rapidly upon successful award of this grant. The application of the spray

[7] Hamilton Thorne, www.hamiltonthorne.com.
[8] WEF Institute of Technology, Inc., www.aoyama-wefit.com/en/faq/a18.html.
[9] www.optipurewater.com.
[10] **uptake** is the action of taking or making use of something that is available.

applied photocatalytic treatment occurs quickly with minimal disruption on both residential, collector and arterial roadways within the Coalition with over 40% of the grant money spent on pavements within disadvantaged communities using the Climate and Economic Justice Screening Tool (See Attachment Areas_BOCC-Palm Bay). The CO2e capture and sequestration commences immediately after the photoreactive materials have successfully penetrated the pavement and sunlight interact with the photocatalytic material, titanium dioxide (photoreactive TiO2).

As illustrated in subsequent sections of this application, the expected CO2e reductions are most accurately characterized as "direct air capture and permanent sequestration" through conversion of the mobile source pollutants from gas to solid state. Mobile source emissions like CO2 and NOx are converted through photocatalysis into carbonates and nitrates respectively. These converted solids act as plant food for near road vegetation and thus consumed permanently. This conversion is considered durable as the reaction does not consume the catalyst (TiO2) and the pavement treatment has been shown to maintain over 85% reduction efficiency for 5 years and beyond. Assumptions included in this application in Section 2.D will show an expected eventual reduction in capture efficiency beyond 5 years. However, retreatment with additional TiO2 could enable the Coalition to continue with the GHG reduction well into the 2030's and beyond with some innovative funding proposed upon completion of the CPRG period. Overall, it is expected that 1,278 miles will be treated during the 5-year period which accounts for nearly 49% of the total pavements owned by the Coalition.

Expected CO2e total reductions (GHG reductions + co-benefits) are shown in detail as part of Attachment GHGcalcs_BOCC-Palm Bay and are expected to reach 2,704,865 cumulative CO2e metric tonnes by 2030 with an overall cost efficiency of $17/tonne of CO2e. This cost efficiency makes photocatalysis a potential gamechanger in scaling solutions for the reduction of mobile source air pollution without substantial scope 1 emissions (estimated to be 258 kilograms per mile or only 330 metric tonnes across five years), high impact land use or prohibitive capital expenditure and maintenance costs. This application will achieve significant milestones as the coalition plans to deploy CPRG to every low income and disadvantaged community within the 5-year program. Additionally, since air pollution knows no boundary, pavements surrounding identified LIDAC will also be prioritized especially surrounding community green spaces, schools, and other areas of special community significance. Community outreach will be central to the program with a robust communication plan outlined in the application. Cleaner air for the communities will result in a clean air dividend that LIDAC and resident populations alike will benefit from.

There are minimal risks associated with the completion of the program. The Coalition is well poised to deliver this project as demonstrated by a low unemployment rate of 3.3% as of January 2024). This rate is lower than the national average of 3.9%. In addition, it is anticipated there will be no shortages of raw materials, contractor capacity, and delays in procurement. Each year's milestones account for only 85 production days according to average contractor production.

GHG reduction efficiency methodology is outlined in Attachment Techappx_BOCC-Palm Bay. Vital to maximizing reduction efficiency is the proper delivery of TiO2 to the surface of the retrofitted pavement. The appropriate parts per million have been thoroughly studied and tested over 7 plus years. The Coalition lead will coordinate the third-party oversight to verify the GHG reduction quantities according to best available science. Great care will be taken to implement a thorough quality assurance/quality control plan that will minimize the chance of lower reduction efficiency caused by improper application rates or inadequate TiO2 loading in the photocatalytic emulsion.

Discovered in Japan in the 1970's, titanium dioxide is a known photocatalyst that has long been studied for its "self-cleaning" properties. The CPRG Implementation Phase will be treating existing infrastructure with a penetrating TiO2 application rather than the vastly more expensive strategy of building new infrastructure embedded full depth with TiO2. The speed of treating existing pavements also ensures that the scope 1 emissions impact remains minute compared with other measures suggested in the ECFRPC PCAP and hence was the overwhelming choice for this grant application by the Coalition. The specific application selected by this Coalition was discovered while using a carbon avoidance pavement preservation treatment for life extension on asphalt pavements. Photocatalytic pavement preservation treatment products will meet the Buy America Build America guidelines and will also meet requirements for Environmental Product Declarations while only incorporating materials properly vetted with a valid and current Safety Data Sheet.

The Coalition has received broad support from their elected officials with a letter of intent included in this application (See Attachment Brevard County_LOI_BOCC-Palm Bay and Attachment Palm Bay_LOI_BOCC-Palm Bay) and the signed MOA committed by the July 1st date. Multiple public meetings have already been held with more planned public and LIDAC engagement (Section 4.B) outlining the technical aspects of the priority measure selected by the Coalition. Both communities have made significant progress on the current carbon avoidance measures relating to the asphalt rejuvenation program that has to date resulted in the life extension of 462 centerline miles of pavement (154 centerline miles BOCC and 308 centerline miles for the City) in the last four years. Expanding the existing carbon avoidance programs by incorporating TiO2 into the preservation program, the Coalition expects to see significant GHG reductions and additional realized co-benefits outlined in the application.

B. Demonstration of Funding Need

The Coalition looks to achieve the goals set out by the CPRG while also meeting the EPA's stated intent to bring a "transformational" program that will make a significant positive environmental impact for the Citizens of Brevard County. The Coalition will not otherwise be able to do so without CPRG this application. BOCC and the City have separately pursued the pavement preservation program successfully and are benefitting from the Carbon Avoidance benefits, as well as the increased resilience of treated roadways. However, neither municipality has the budgetary means to implement this program in full, as the costs are higher than strict preservation.

Across the spectrum of GHG reductions, common acceptance of the important role carbon capture and sequestration will play is not matching the availability of funding dedicated to these types of technologies. It is likely this is due to the misperception that carbon capture is still a relatively unproven, future strategies for durable carbon reduction. Other carbon capture technologies such as Direct Air Capture facilities require significant capital expenditures, are land and energy intensive and do not meet the LIDAC goals as easily. Locating such facilities within LIDAC areas brings further challenges as this type of industrial facility is not appropriate in residential areas and brings significant detrimental impacts such as noise and aesthetics.

Other priority measures identified in the PCAP and that are likely to be funded as part of the CPRG across the Country do correlate to other Federal and State grants. Various solar, electrification, carbon avoidance, zero emission incentives can be potentially funded through alternative grant programs that are well established. As of the application date, no other Federal programs have offered as clear a path as CPRG to fund a novel technology harnessing the power of the sun to decompose mobile source emissions as effectively as photocatalysis.

C. Transformative Impact

Photocatalysis holds significant promise as a multi-pronged strategy to tackle one of the most difficult sectors of society to decarbonize - transportation. Not only do the majority of GHG emissions now come from transportation (as identified and quantified in the attached ECFRPC PCAP), but inequity has also long existed as disadvantaged communities grapple with significant infrastructure projects bisecting whole neighborhoods such as interstates or overpasses creating generational scars across predominantly low-income communities. While removal of such equity barriers is economically infeasible for most municipalities, monumental progress could be made if the source of such environmental inequality could be transformed into a sink. And not just CO2 emissions, but a host of environmental pollutants would be reduced significantly. CO2, NOx, urban heat, road area microplastic particles and even “forever chemicals” like PFAS could all be mitigated with one application with the by-products being harmless components absorbed by near road vegetation.

Such an outcome is the potential of harnessing the passive energy of the sun to generate a photocatalytic, retrofitted surface with durable capture and sequestration built into the pavement. This pioneering process has been repeatedly proven by generally accepted science across a broad compilation of studies (included in the Technical Appendix) by nationally and internationally recognized academic organizations. The replicable and scalable nature of such technology only requires a high-profile vote of confidence that would result from the success of a CPRG Implementation Phase award to show other communities around the Country what is possible.

Furthermore, the Coalition envisions a future where market forces pick up the slack as the carbon credit markets mature into the primary funding source capable of becoming a force multiplier for public sector investment into photocatalytic pavement treatments. A future where all disadvantaged communities have carbon negative surface infrastructure could be only a decade away with relative ease and minimal capital investment. Such a future will only occur with bold action to incentivize other public agencies to think outside the box of more generally accepted yet narrower opportunities such as electrification and zero emission only strategies. Multiple solutions are required in the interim until such a time as zero emission transportation can be made a reality. Even then, studies show unintended consequences resulting from EV adoption, such as significantly higher tire and brake wear create other environmental disasters previously underrepresented. Toxic additives used in tire production such as PFAS threaten to blunt the positive environmental benefit of reducing or eliminating tailpipe emissions. *(See Figure 11 – TiO2 PFAS Decomposition)*

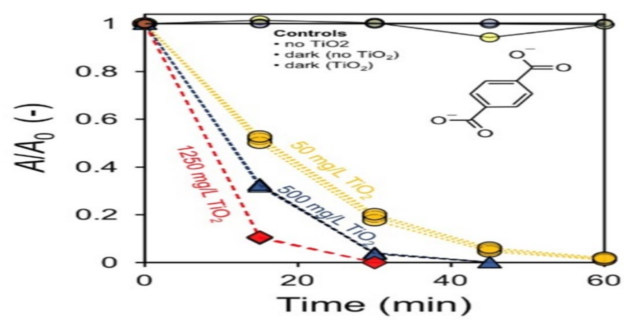


Figure 11: TiO2 Perfluoroalkyl & Polyfluoroalkyl (PFAS) Decomposition
Source: Center for Applied Geoscience

Photocatalysis can accomplish both by nonselective means capable of durably and permanently decomposing the most detrimental of byproducts coming from one of the Nation’s most valuable fixed assets, our transportation system. This system is the most vital cog in the Country’s economy in addition to the backbone for our national defense and the lifeblood of American society for over 100 years. Environmental challenges resulting from the transportation sector are among the hardest to abate as continued growth of vehicular emissions is the result of economic activity desired by every state in the Union. Accelerating the development of a scalable solution to such abatement measures is identified throughout the EPA’s CPRG guidelines. Further investments into photocatalysis drives private sector capital to be deployed through market adoption of verified carbon credits generated by photocatalysis. Such credits could become the primary driver of nearly perpetual progress shown from 2030 until 2050 and beyond.

Section 2: Impact of GHG Reduction Measures

The Coalition expects significant and compounding near term and long term cumulative GHG reductions at a significantly lower comparative CO2e/Metric tonne cost to other GHG reduction measures commonly used today. That is due to several factors (further documented in greater detail throughout the technical appendix). Utilizing photocatalytic pavement preservation treatments on roads throughout the LIDAC and non-LIDAC (adjacent roadways to LIDAC or roadways near facilities of community significance such as parks, schools, health care facilities, long term care facilities, youth sports facilities etc.) will provide an immediate and lasting impact relating to the primary GHG reductions in addition to the environmental and human health co-benefits included in this application. The reasonableness and quality of assumptions included in the technical appendix are high and come from a myriad of completed and ongoing research and testing of photocatalytic solutions. Using the best available science and a robust performance measures plan, the Coalition expects to deliver annual GHG, CAP and HAP reductions as illustrated in Attachment Techappx_BOCC-Palm Bay.

Priority one is the accurate estimation and subsequent annual measurements of GHG emissions reductions in the form of CO2. The estimation scenario utilizes the best available science and measurement standards in addition to the available data compiled from the coalition's internal pavement data. The baseline measurement for this approach is a centerline mile which in this scenario is estimated to be a roadway one mile long by twenty-two feet wide. In some cases, roadway measurements will be different which could result in fluctuations in the estimated photocatalytic pavement area treated. Another variable that is unknown at the time of application, but which will affect the measurements vs. estimates is the average annual daily traffic (AADT) count of the treated roads. This variable input effects the measured GHG reductions during the implementation phase should the Coalition receive CPRG award. More accurate measurements will be reported annually as required by the CPRG NOFO.

Using the estimated totals as calculated in the attached GHG Calculations Appendix, the coalition expects reductions to exceed the ECFRPC targeted reduction over the initial 5-year program and when including CO2e from co-benefit calculations the 5-year total is nearly double the ECFRPC targeted reduction by 2030.

CAP and HAP reductions are estimated using the best available science as part of studies from Louisiana State University and the Texas Transportation Institute at Texas A&M and were originally focused on NOx reduction (which include both the GHG N20 and the CAPs N02) and the secondary pollutant O3 which is formed when NOx emissions mix with sunlight and O2. While more difficult to measure, the significance of impact on the environmental and human health makes these co-benefits important aspects of this approach.

Another co-benefit that plays a part in the selection of photocatalytic pavement treatments is the capability of pavements embedded with TiO2 nano particles to reflect the ultraviolet radiation from the sun which thereby decreases the thermal emissivity of the treated pavement at night. By lowering the temperature of the air around the roadways in LIDAC areas (and other areas as well), lower building energy demand generates savings in low-income areas, a common good in addition to a positive environmental result. This will be measured using the measurement of the solar reflective index (ASTM E1980-11 Standard Practice for Calculating Solar Reflectance Index of Horizontal or Low Sloped Opaque Surfaces) and to measure the risk of dis-benefit from reflection of heat making pedestrians feel hotter or suffer from more extreme heat, the use of the Wet Bulb Temperature test (ASTM E337-84 Standard Test Method for Measuring Humidity with a Psychrometer) as shown in the Technical Appendix.

Mitigating UHI results will also be measured using satellite imagery which is expected to show the reduced emissivity of thermal energy as has been observed on previous photocatalytic pavement treatment projects. *(Figure 12 – Thermal difference between TiO_2 treated pavement and non-treated pavement)*

Figure 12 – Thermal difference between TiO_2 treated pavement and non-treated pavement.

Source: City of Raleigh, NC

The Coalition's CO_2e reductions will prioritize scaling up treatment quantities by front loading treated mileage in 2025 and 2026 (as seen in Figures 1 and 2) to maximize GHG reductions over the initial five-year period. Phases one through five encompass the EPA funded program however the benefits will continue into the second timeline beyond 2030 out to 2050. Testing has shown that five years after initial application, TiO_2 can remain active and efficient at reducing CO_2e at levels of 88% initial efficiency with annual loss of capture efficiencies being low single digit. The total of such reductions in CO_2 in the 2025 to 2030 timeline are 1,525,564 tonnes cumulatively. The total CO_2 reductions in the 2025 to 2050 timeline is expected to be 7,289,871 tonnes cumulatively.

A. Magnitude of GHG Reductions from 2025 through 2030

The estimated metric tonnes of GHG reductions and the extent of the permanence of such reductions are quantified as part of the GHG reductions spreadsheet attached. Each year the coalition will target the application of photocatalytic pavement treatments on roads that are selected from the respective agencies eligible list prioritizing LIDAC and community significant sites while following a set methodology covered as part of the Performance Plan. The overall program will complete 40% of the total pavements treated in LIDAC identified areas which equates to 520 centerline miles of roads which equates to nearly 97% of all pavements within the LIDAC designated census tracts in Brevard County and the City of Palm Bay. The remaining 60% or 762 centerline miles proposed for treatment include other high priority pavements selected to accompany LIDAC selections. CO_2 reductions are estimated to be 173,641 metric tonnes after year 1, with an additional 259,866 metric tonnes added after year 2, an additional 321,642 metric tonnes after year 3, an additional 373,162 metric tonnes after year 4 and an additional 397,253 metric tonnes by year 5. Total GHG reductions estimated from 2025 to 2030 are 1,525,564 metric tonnes of CO_2. These reductions shown another way in Figure 13:

	2025	2026	2027	2028	2029	Total 2025-2030
Carbon Dioxide (CO2)						
CO2 tonnes ongoing annual	173,641	259,866	321,642	373,162	397,253	1,525,564
CO2 tonnes new added	173,641	86,224	61,776	51,520	24,090	
Median AADT	8,000	6,000	4,000	4,000	2,000	
CO2 tonnes per CLKM (1)	296	222	148	148	74	
CLKM	586	388	417	348	325	2,064
CLM	364	241	259	216	202	1,282

Figure 13 – CO2 Reduction Table

The co-benefit reductions can be quantified using best available science as CO2e reductions relating to the reduction of NOx emissions, the urban heat island effect (SRI) and the decomposition of microplastic particle pollution. CO2e reductions are estimated to be 134,229 metric tonnes after year 1, with an additional 200,883 metric tonnes added after year 2, and additional 248,638 metric tonnes after year 3, an additional 288,464 metric tonnes after year 4 and an additional 307,086 metric tonnes by year 5. Total reductions estimated from 2025 to 2030 are 1,179,301 metric tonnes of CO2e. The grand total from adding the GHG reductions in figure 13 with the CO2e reduced through co-benefits equate from 2025 to 2030 to 2,704,865 CO2e. These reductions are referenced in the GHG Reductions Spreadsheet attached and seen below in Figure 14:

	2025	2026	2027	2028	2029	Total 2025-2030
Co-Benefits (CO2e) (2)						
CO2e tonnes ongoing annual	134,229	200,883	248,638	288,464	307,086	1,179,301
CO2e tonnes new added	134,229	66,654	47,755	39,826	18,622	
Per CLM						
NOx (3)(4)(5)	267	200	133	133	67	800
Microplastics (6)(7)(8)(9)	38	29	19	19	10	114
Solar Reflectance (10)	64	48	32	32	16	192
Total	369	277	184	184	92	1,106
Total CO2 and CO2e Annual	307,871	460,749	570,280	661,626	704,339	2,704,865

Figure 14 – Total CO2 and CO2 E Annual Reductions

Efforts to quantify the decomposition.

CO2e reductions resulting from co-benefits as estimated from 2025 to 2050 are expected to be 3,866,307 metric tonnes. Upon completion of the first five-year initial result measurements a deterioration curve will allow for higher reliability estimates as far out as 2050. It is possible that within the initial five-year period, adequate growth in the private carbon markets will enable private sector carbon credits to extend the full program beyond the EPA CPRG Implementation Phase completion date of 2030. When both the GHG reductions and the estimated CO2e from identified co-benefits is combined the potential total CO2e reductions over the 2025 to 2050 timeline is 11,156,179 metric tonnes.

B. Magnitude of GHG Reductions from 2025 through 2050

Estimated metric tonnes of GHG reductions extending out to 2050 comes with lower reliability however efforts have been made to quantify the average rate of deterioration on treated roads. After applying percentage reductions as part of the GHG Reductions Spreadsheet attached, the GHG reductions that could reasonably be expected are estimated to be 7,289,871 metric tonnes.

The co-benefit reductions can be quantified using best available science as CO2e reductions relating to the reduction of NOx emissions, the urban heat island effect, and the decomposition of microplastic particle pollution.

CO2e reductions resulting from co-benefits as estimated from 2025 to 2050 are expected to be 3,866,307 metric tonnes. Upon completion of the first five-year initial result measurements a deterioration curve will allow for higher reliability estimates as far out as 2050. It is possible that within the initial five-year period, adequate growth in the private carbon markets will enable private sector carbon credits to extend the full program beyond the EPA CPRG Implementation Phase completion date of 2030. When both the GHG reductions and the estimated CO2e from identified co-benefits is combined the potential total CO2e reductions over the 2025 to 2050 timeline is 11,156,179 metric tonnes.

C. Cost Effectiveness of GHG Reductions

The coalition expects the cost effectiveness of the CPRG Implementation Phase to compare favorably to any other carbon capture/sequestration technology currently available. Input or scope 1 carbon emissions from implementation of the program will be 258KG of CO2e per centerline mile of treated pavements or only 330 metric tonnes for the five-year program. The Coalition expects to receive Environmental Product Declarations from the applicating contractor further quantifying scope 1 emissions.

2025-2030

The cost effectiveness and targeted approach of mitigating the emissions at the source (vehicular emissions occurring on each roadway) enables the coalition to scale delivery of GHG and air pollutant removal in the respective LIDAC and non-LIDAC areas. All emissions reductions are permanent through the durable conversion of the emission at time of occurrence. Furthermore, ambient CO2e reductions occur through photocatalysis throughout the daylight hours. Emission reduction efficiency is directly correlated to the parts per million application rates of each pavement. Thus, the cost effectiveness of GHG reductions from 2025 to 2030 is $45,751,163/1,525,564 = $30

2025-2050

When the cost effectiveness estimates extend out to 2050 the attractiveness of this low-cost strategy become even more evident. The cost effectiveness of GHG reductions from 2025 to 2050 is $45,751,163/7,289,871 = $10

D. Documentation of GHG Reduction Assumptions

GHG Reductions assumptions made as part of the Coalition's CPRG submission are identified and referenced throughout the Workplan and Appendices and specifically referenced in Section D. Every effort has been made to thoroughly outline the test methodologies for GHG reduction measurements and methodologies used to measure each co-benefit outcome. Using best available science and in many cases referencing recent national and international studies, the Coalition has demonstrated the ability to provide the EPA with ongoing high quality and comprehensive measurements of GHG reductions and overall CO2e impact across the initial five-year period and ultimately to 2050. (See Attachment GHGcalcs_BOCC-Palm Bay)

Specific care has been taken to provide conservative estimates for the long-range measurements of reductions and the Coalition expects accuracy of these long-term estimates to improve after successful completion of the five-year initial measurement period. Long term models will have enough data points in 2030 in regard to the known deterioration rate of the GHG reduction efficiency to forecast out to 2050. However, the Coalition has used the best available data and discounted reduction efficiency from the photocatalytic reaction that is tied to the parts per million TiO2 existing on the treated roadway long term. Multiple factors can impact this in a way that is difficult to forecast over long time periods.

Due to this fact as show on the GHG Reduction Spreadsheet, additional timeframes have been added to enable the discounting of emission reduction efficiency over time until enough data points exist from the first five years to increase modeling accuracy. For instance, from 2031 to 2035 photocatalytic reduction efficiency has been reduced by 30% and from 2036 to 2050 photocatalytic reduction efficiency has been decreased another 50%. These conservative estimates represent the best available long-term modeling for a technology that is relatively new. As such this represents the most probably risk of all submission assumptions. All reduction estimates in the GHG Reduction Spreadsheet have included footnotes showing the source of data used in building the GHG emission reduction estimates and additional co-benefit reduction estimates. All criteria and hazardous pollution reduction estimates are based on data from the UN IPCC Fifth Assessment.

Section 3: Environmental Results – Outputs, Outcomes, and Performance Measures

A. Expected Outputs and Outcomes

The Coalition has identified the expected outputs and outcomes for the singularly focused GHG reduction measure, photocatalytic pavement treatments. Such outputs and outcomes are listed below:

Outputs

The Coalition expects to generate outputs from the GHG reduction measure through photocatalysis. The resultant outputs from the reduction activity equates to the same output resulting from photosynthesis, oxygen. This output is generated instantly as emissions come in contact with the excited electron energy field responsible for capturing and sequestering GHG emissions (CO2) and various CAPs and HAPs. Natural, non-selective photocatalytic oxidation is "accelerated photosynthesis". Mineralization (nitrate/carbonate) is considered permanent sequestration (i.e., removal) and therefore is not traditionally considered an output.

Outcomes

The coalition expects to have annual measurable outcomes utilizing third party testing and reporting through the lead applicant, Brevard County. Field sampling, lab testing and field monitoring will be conducted on an annual basis across the treated pavements as outlined in the technical appendix.

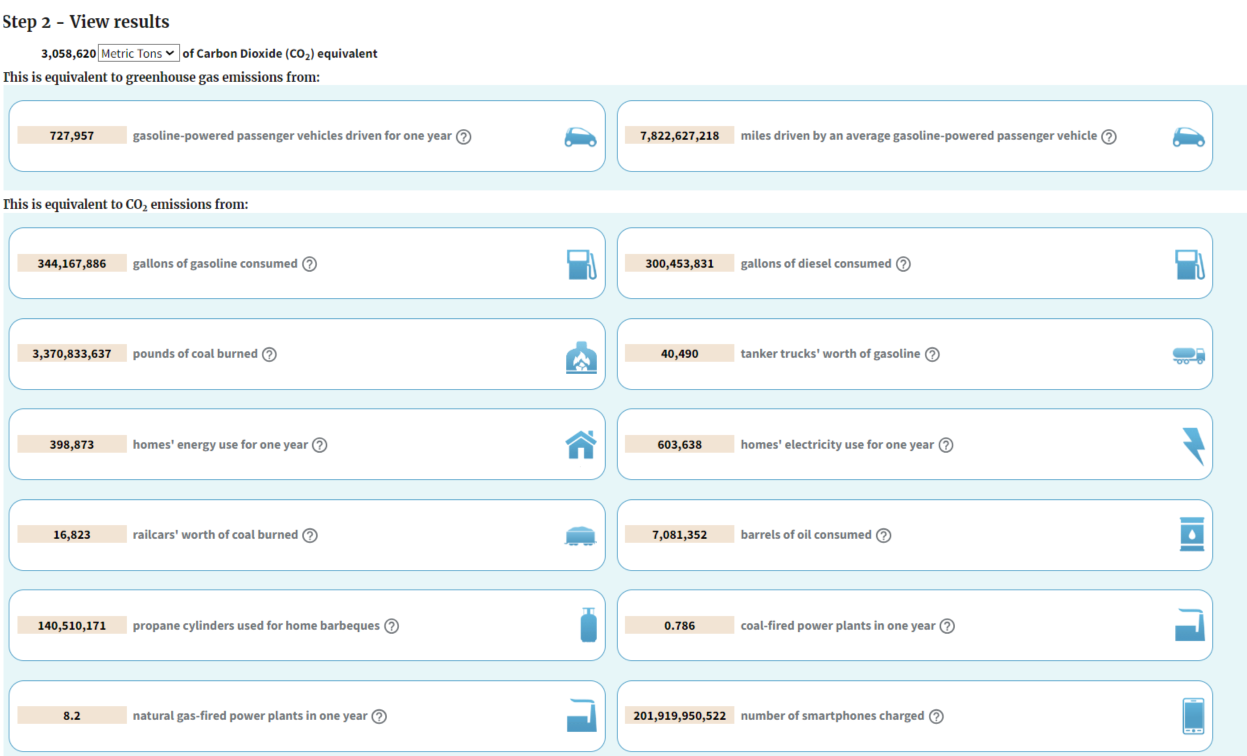
Measurable outcomes specific to LIDAC are expected to show significant GHG reductions annually in addition to co-benefit outcomes that stretch across a multitude of specific environmental and human health areas. LIDAC designated census tracts are prone to experience greater exposure to extreme heat and both criteria and hazardous air pollutants due to the lack of vegetation, proximity to high traffic roadways and more recently lower adoption of zero emission vehicles. This CPRG Implementation Phase application is well suited to successfully address these issues as part of the co-benefits that accompany the use of photocatalytic pavement treatments.

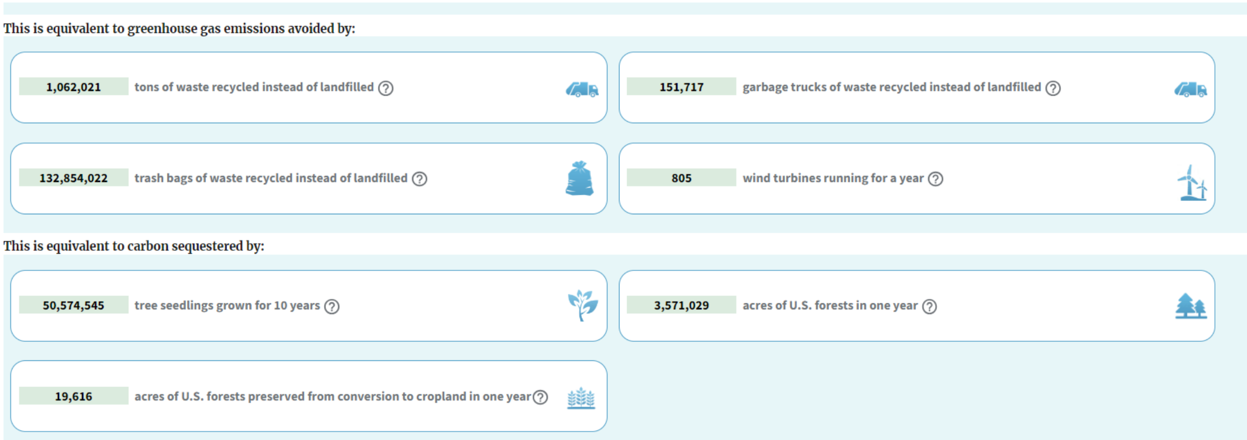
Overall, the Coalition's proposed photocatalytic program will treat nearly all of the roads within the LIDAC designated census tracts. This accounts for 782 centerline miles of roadway and is expected to generate 610,222 metric tonnes of GHG reductions over the 2025 to 2030 timeframe. Additional co-benefit results in CO2e reductions of approximately 471,723 metric tonnes over the same timeframe. These reductions include emissions that are primary contributors to health problems facing LIDAC specifically. Health benefits accruing from reductions of NOx emissions, less exposure to extreme heat through the mitigation of the UHI and the decomposition of microplastic particles creates a substantial benefit to these communities and the environment of Brevard County as a whole. This will be magnified once the entire scale of the proposed program is considered as the total centerline miles reaches 1,282.

Furthermore, with sensitive environmental areas in the targeted treatment areas such as the Indian River Lagoon, these co-benefits extend beyond human health. While quantification is currently difficult, the Coalition expects a program with a large scale such as proposed to be a unique opportunity to further study and develop measurement of the decomposition efficiency expected through Photocatalysis of microplastics and other dangerous “forever chemicals” such as PFAS.

GHG emission reductions are the primary target of the proposed program. However, there are several direct co-pollutant emission reductions including NOx, decomposition of microplastic particle pollution from tire and brake wear. urban heat island reductions (quantified as CO2e reductions derived from reduction of building energy demand). These outcomes are further described with accompanying estimated reductions as part of the technical appendix and GHG reduction calculator. Another tool used to illustrate the expected outcomes is the EPA’s Greenhouse Gas Equivalencies Calculator. When inserting the estimated five-year total CO2e reductions expected outcome, the GHG Equivalencies Calculator shows the high impact of the proposed program by converting reductions to equivalent measures such as number of vehicles removed, equivalent reduction of VMT or acres of U.S. forests in one year. The illustration is included below. Of particular interest is the five-year impact on the miles driven by an average gasoline powered passenger vehicle which shows 7,822,627,218. This is a significant five-year reduction which ties directly to the ECFRPC high impact priority and achieves 4.2% equivalent VMT reduction without any other identified high impact priority measures.

(See Figure 15 – Greenhouse Gas Equivalencies Calculator and table 3, page 28 in attached PCAP)





See Figure 15 – Greenhouse Gas Equivalencies Calculator

Source: EPA Greenhouse Gas Equivalencies Calculator

B. Performance Measures and Plan

The Coalition proposed performance measures utilize the best available science culminating in multiple academic research studies across decades of long-term study of photocatalytic applications. All proposed performance measures include a corresponding ASTM methodology and third-party collection and a list of the procedures proposed is included below:

Testing Schedule, Measurement & Reporting

The same methodologies used in the Photocatalytic Pavement Program Model for the Coalition [See Technical Appendix] will be repeated during year one of the project and hence will follow the same rigorous, systematic, and objective procedures under the Science-Based Targets protocol using the *best available science* from direct product testing by independent research universities and commercial laboratories.

The principal investigators expected to be the Texas A&M Transportation Institute (TTI) and the Purdue University Lyles School of Engineering (Purdue).

The following direct product tests performed on field core samples taken from pavements completed in year one:

ISO 22197-3 – *Test Method for Air-Purification Performance of Semiconducting Photocatalytic Materials*	Texas A&M University and/or Purdue University	$200,000
ASTM E1980-11 – *Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Surfaces*	Texas A&M University and/or Purdue University	$150,000
ASTM E1253 – *Infrared Organic Spectrometry*	Texas A&M University and/or Purdue University	$100,000
Proprietary Carbon Dioxide Removal	Purdue University	$350,000

ISO 10678 – *Determination of Photocatalytic Activity or the Standard ("Self-Cleaning") Photocatalytic Test*	Purdue University	$100,000
Xray Florescence (field cores) to measure TiO2 load	Texas A&M University; Purdue University; Commercial Lab	$100,000
	2025-2030 Total	$1,000,000

In subsequent years and annually through year five, field core samples collected from all streets cumulatively completed since inception and evaluated for titanium dioxide (TiO2) load in the upper six (6) millimeters of the pavement using Xray florescence (XRF). The measurements from the year one results (Table) under the standardized testing protocols will be used to develop a coefficient of determination (index), a common statistical strategy used to streamline well-established scientific testing. A final report will be submitted as required in 2030 upon completion of the program.

Data collected reported to the EPA annually.

GHG, CAP/HAP emissions, UHI performance measures and plan – the mechanism to track, measure and report progress toward achieving the expected outputs and outcomes are as follows:

1. Test application – verified by field inspection to confirm proper application rate of the photocatalytic pavement treatment.
2. No sooner than 30 days after application, cores taken of a representative sample of the total phase pavements at a recommended rate of the total pavement treated annually for lab verification testing.
    a. Verification of Solar Reflectance Index E1980-11
    b. Verification of TiO2 PPM, XRF Analyzer
    c. Indexed values of each representative field sample
    d. Field core sample taken for lab testing.
3. Testing of field cores, verification of CO2 and NO reduction efficiency taken at yearly interval (JIS)
4. Wet Bulb Temperature testing in the field by third party to verify UHI Cool Pavement results.
5. Microplastics reduction quantification study – further analysis of other "forever chemical" decomposition efficiency through photocatalysis.

C. Authorities, Implementation Timeline, and Milestones

The implementation of the proposed measure is based on CPRG award in October of 2024 with an estimated 60–90-day procurement and pre-commencement timeline. All procurement will follow the applicable EPA Procurement Guidelines with Brevard County's authority to contract with a contractor for the application of the photocatalytic pavement treatment. The attached timeline highlights the speed at which this program is expected to commence which also enables rapid outcomes to accrue to the benefit of Brevard County citizens. (See Attachment Timeline_BOCC-Palm Bay)

Section 4: Low-Income and Disadvantaged Communities

A. Community Benefits

The Coalition expects significant community benefits as the outcome of the EPA CPRG Implementation Phase award. Following the Justice40 Initiative, the photocatalytic pavement strategy enables the coalition to reach the 40% target inside LIDAC areas within each jurisdiction. This strategy will maximize the balance of GHG reductions with EPA priority co-benefits such as CAP/HAP reductions, extreme heat resilience through UHI mitigation, reduction of microplastic particles and potentially decomposition of "forever chemicals" such as PFAS.

LIDAC census tracts within the coalition jurisdictions of Brevard County and the City will receive an estimated 100% coverage utilizing the photocatalysis pavement treatments. In addition to targeting climate change through carbon capture and sequestration of CO_2, the reduction in harmful emissions such as NO_x (and precursor primary pollutants to O_3), the protection of the disadvantaged and vulnerable in Brevard County and the City has the potential to leave a last legacy for decades to come.

Cleaner and cooler communities will have secondary benefits as well such as healthier residents, lower extreme heat event risks, lowered building energy demand, cleaner stormwater (with lower amount of road associated microplastic particles). The entire community will benefit as mobile source air pollution knows no boundary. Lower GHG emissions and cleaner air benefits will extend well beyond LIDAC and encourage further investments aimed at maintaining the significant outcomes achieved during the initial five-year period from 2025 to 2030. The Coalition believes that as the carbon credit market matures, private investment will be spurred to continue the photocatalytic pavement treatments by generating income through carbon credits which can then be used to repeat photocatalytic treatments beyond the initial five-year funded CPRG measure. Extending photocatalytic capabilities across the coalition jurisdictions the estimated CO_2e reductions can be significantly increased as more TiO_2 is delivered to pavements which have slowly experienced degraded performance beyond 2030 (gradual decline in GHG reduction efficiency is expected as treatments age and is outlined in the Technical Appendix).

Avoided disbenefits are evident when compared to other identified PCAP priority measures which require greater land use, higher cost, required consumer behavior changes (such as EV adoption as part of charging infrastructure etc.) less equitable benefits due to geographic location of the priority measure (i.e., physical plant location), higher per metric tonne CO_2e costs and less transformative potential to the MSA and beyond. The use of the identified strategy also carries a low disruption to the affected communities due to the expected high production rates and minimal and temporary interruption of use on treated pavements. Community engagement as listed below will help drive education and support of the proposed program and generate a positive sense of common purpose among all residents and visitors of the coalition jurisdictions.

A list of CEJST Census tract IDs is included. (See Attachment Areas_BOCC-Palm Bay) The Coalition's target for the photocatalytic pavement treatment approach is 97% of the roads designated as disadvantaged within each jurisdiction following the Performance Plan and following the methodology and best engineering practices outlined within the application.

The Coalition will be following the Performance Plan using the data within the Technical Appendix to assess, quantify and report annually the quantitative analysis of the associated community benefits, co-pollutant (CAP and HAP) emission reductions and extreme heat resilience benefit through mitigation of UHI. Best available science will be utilized through accredited coalition participants such as Purdue University and Texas Transportation Institute in addition to other technical team members.

B. Community Engagement

Brevard County and the City will build their community outreach for the Climate Pollution Reduction Grant Implementation Program upon the existing outreach being performed for roadway pavement maintenance. Both the City and Brevard County have been utilizing roadway rejuvenation as a method for lengthening the life of freshly paved roadways and to reduce the pollution that arises from constructing a roadway from scratch. These programs have been utilizing the internet to provide information to affected citizens, and providing notice of upcoming road treatments via door hangs and informational fliers left at homes and businesses.

For this grant, these practices will continue. The public at large will be invited to review the information regarding the project, to include the science at work and the reasoning behind the treatment process. There will be links and contact information to allow citizens to voice concerns and provide feedback. Brevard County will dedicate staff to community outreach regarding the program, to ensure that all affected communities are made aware of not just the timeline for project work, but the benefits that will come from the utilization of the treatment process. This outreach will be a combination of in-person through canvassing and door hangs, and online with explanation videos posted in highly visible sections of the Brevard County and City of Palm Bay websites.

Additionally, all contracts for both the City and County are approved by publicly elected officials (A City Council member for Palm Bay and a Board of County Commissioners member for Brevard County). These meetings are open to the public and advertised with a publicly available agenda for a minimum of a week before. All citizens are welcome to come and offer input into the awarding process for both grant agreements and contract awards. Likewise, they are able to offer input on currently in process programs.

Project managers for both Brevard County and the City of Palm Bay will work to ensure that a minimum of 40% of areas designated as disadvantaged will receive the benefits of this program and will ensure that these communities are made fully aware of the benefits of this road treatment both for their economic security (ensuring safe and stable roadways) but also for the benefits to their environment (reductions in pollutants such as carbon and microplastics).

Section 5: Job Quality

The Coalition's proposed activities under this funding opportunity do not lend themselves to the Job Quality criterion of this funding notice. The Coalition will be contracting with an outside agency to provide the roadway treatments described in the preceding sections of this grant narrative. However, due to the nature of the process – each year's projected treatments should take no more than three months and must be done during the dry season of Florida's weather pattern – the jobs created by this grant will not be permanent and will not meet the criteria of family-sustaining.

However, the Coalition is dedicated to ensuring that the chosen contractor show:

- A clear commitment to paying the median area income for all workers.
- Include family-sustaining benefits and retirement contributions for all full-time staff.
- Allow for use of workers that belong to labor organizations and other worker's rights groups.
- Follow health and safety plans that are developed in conjunction with workers, including anti-harassment for workers and management, OSHA training to minimize workplace hazards, and supplemental health and safety training as needed.

Section 6: Programmatic Capability and Past Performance

A. Past Performance

Brevard County has a long history of successfully obtaining and executing grants from Federal, State, and Local levels. BOCC is administering over 70 active grants worth over $170,000,000 of improvements and aid to the citizens of Brevard County. The below listed grants are currently being worked on by Brevard County.

- Ellis Road Widening from US 192 to Interchange – Florida Department of Transportation (FDOT) Agreement No. G0M20 ($4,922,452)
  The Catalog of State Financial Assistance (CSFA) No. is 55-008 (County Incentive Grant Program). The project widened a 1-mile stretch of Ellis Road from US192 to the Interchange. The project included Planning and Construction. The contact at FDOT is Loreen C Bobo.
- St. Johns Parkway Widening Design – FDOT Agreement No. AR-235 ($2,960,329)
  The Catalog of Federal Domestic Assistance (CFDA) No. is 20.205 (Highway Planning and Construction). This was a planning study to widen the St. Johns Heritage Parkway along Ellis Road to end west of Wickham Road. The Florida Department of Transportation contact is Loreen C Bobo
- St. John's Heritage Parkway – FDOT Agreement No. GH1H21 ($1,000,000)
  The CFDA No. is 20.205 (Highway Planning and Construction). This was a corridor planning study to evaluate future corridors for an extension to the existing St. Johns Heritage Parkway. This project included travel demand forecasting, land suitability mapping, environmental analysis, and public involvement. The contact for Florida Department of Transportation is Loreen C Bobo.
- John Rodes Blvd Sidewalk Construction – FDOT Agreement No. GS109 ($495,157)
  The CFDA No. is 20.205 (Highway Planning and Construction). This was a grant to design and construct an 8 Ft wide concrete sidewalk on John Rodes Blvd from Eau Gallie Blvd to Aurora Road. The project included reconstruction of curb ramps, pedestrian crossing, and drainage updates. The Contact for Florida Department of Transportation is Loreen C Bobo.
- Brevard County Advanced Traffic Management System – FDOT Agreement No. G2L30 ($300,000). The CFDA No. is 20.205 (Highway Planning and Construction). This project is to incorporate and grow an Intelligent Transportation System for Brevard County. The project included installation of fiber optic and wireless communication systems, CCTV systems, and adaptive signal controls. The Contact for the Florida Department of Transportation is Jack Adkins.

B. Reporting Requirements

- Ellis Road Widening from US 192 to Interchange – FDOT Agreement No. G0M20 ($4,922,452)
  This grant was awarded in FY17. The project ended in FY22, and the final invoice and report were submitted in September 2022. All reports were filed by the due dates, and there were no significant program delays.
- St. Johns Parkway Widening Design – FDOT Agreement No. AR-235 ($2,960,329)
  This project was awarded in FY19. The final pay application and report were processed in FY21. All milestones were met, and there was minimal disturbance due to COVID-19.
- St. John's Heritage Parkway – FDOT Agreement No. GH1H21 ($1,000,000)
  This project was awarded in FY 19. The final pay application processed in 2021. All reports were filed on time, and all milestones were met. The only delays on this project were faced toward the end, due to the emergence of COVID 19.
- John Rodes Blvd Sidewalk Construction – FDOT Agreement No. GS109 ($495,157)
  This project was awarded in FY 20. The final pay application processed in 2022. All reports were filed on time, and all milestones were met. The only delays on this project were faced toward the end, due to the emergence of COVID 19.
- Brevard County Advanced Traffic Management System – FDOT Agreement No. G2L30 ($300,000). This project was awarded in October of FY24. The project is currently in progress. All milestones have been met, and all required reporting has been submitted on time.

C. Staff Expertise

The staff at Brevard County and the City have extensive experience in both obtaining and successfully completing grants. The Coalition is headed by Marc Bernath, the Director of Public Works. The Proposed project will be helmed by Susan Jackson, the Assistant Director of Public Works, and the Manager of the Road & Bridge Program for the County. They will direct a Brevard County staff that has over 153 combined years of experience with Public Works Projects, both in oversight and implementation. (See Attachment Brevard County Bio Sketches_BOCC-Palm Bay)

The Brevard County team will serve as the lead agency for the project, and will handle all subawards, invoicing, reporting, reimbursement requests, closeout of grant. Monitoring for Brevard County roadways will also be carried out by County staff.

The City of Palm Bay team, led by Public Works Director Valentino Perez, will be instrumental in the successful completion of this grant program. Oversight and monitoring of City owned roadways will be performed by a Palm Bay staff that has over 78 years of combined experience with Public Works projects. (See Attachment Palm Bay Bio Sketches_BOCC-Palm Bay)

The entirety of both the BOCC and the City will be available through this proposed coalition to help ensure the successful completion of this Climate Pollution Reduction Grant. Work has already begun to obtain a Memorandum of Agreement for submission by the July 1, 2023, deadline. (See Attachment Brevard County_LOI_BOCC-Palm Bay and Attachment Palm Bay_LOI_BOCC-Palm Bay)

Section 7: Budget

A. Budget Detail

The Coalition proposes to subaward the funds received through Sole-Source procurement to Pavement Technology, Inc (PTI). This company is currently under contract with both BOCC and the City. They are the only licensed contractor in the State of Florida that can provide the A.R.A.-1 Ti and Ti Intro Application. (See Attachment Sole Source Letter_BOCC-Palm Bay).

The Coalition chose Pavement Technology Inc. due to its history and reliability. PTI was founded in 1972 and has been operating in Florida since 1985. PTI regularly receives multi-year contracts from public entities and is committed to the long-term success of the proposed photocatalytic program should the Coalition be selected.

Pavement Technology Inc. developed, researched, and patented this technology (Sole Source Justification Letter Attachment 8) and has been working with local agencies, Departments of Transportation, and the Federal Highway Administration on the use of photocatalytic pavement treatments for GHG reduction and focusing on the co-benefits as well. Additionally, while Texas A&M and Purdue University were instrumental in helping to develop and validate testing to create methodology for this novel strategy for carbon capture and sequestration, other academic studies included in this submission have also shown that the effects of TiO_2 are substantial and serve as further evidence that the science behind photocatalysis is generally accepted worldwide. Private entities have also successfully incorporated photocatalytic TiO_2 in numerous forms on different platforms to achieve similar results using protected intellectual property.

The totality of the projected costs for this grant funding will be contractual. The Coalition does not seek to use time spent monitoring and administering this subaward as a recorded match. Therefore, the Budget Narrative will be wholly the costs of the project to include procurement of treatment supplies, mobilization, and demobilization of treatment teams annually, the treatment itself, and testing and monitoring performed each year to ensure the project is meeting its goals. (See Attachment Budgetcalcs_BOCC-Palm Bay and Attachment Budget_BOCC-Palm Bay)

B. Expenditure of Awarded Funds

Brevard County will be the primary applicant for this grant opportunity. The County has a long history of successfully completing grant awarded programs and will utilize all of its existing financial policies and controls to ensure that funds are spent in accordance with Federal, State, and Local laws and policies.

BOCC, upon award of funds, will enter into an Interlocal Agreement with the City. This agreement will indicate that all contracts for this grant will be procured by Brevard County Central Services, and the bidding and award process will follow the internal controls developed by staff. Once awarded, the winning bidder will submit invoices for roadways in both Brevard County and Palm Bay to program staff at the County, who will process the invoices and issue payment through Brevard County Finance. Programmatic reporting will also be carried out by Brevard County staff, with assistance from Palm Bay staff.

C. Reasonableness of Costs

The Coalition's proposal for the EPA's Climate Pollution Reduction Grant – Implementation phase represent an innovative and unique approach to address much needed climate change mitigation over the next five years. The Coalition plans to accomplish these important reductions by utilizing an advanced pavement treating technology that utilizes photocatalysis.

This comprehensive approach will enable the Coalition to make a significant and sustainable difference, particularly in Low-Income Disadvantaged Communities, where the effects of climate change are often felt most acutely. By prioritizing these communities, the Coalition seeks to address environmental justice concerns and ensure equitable access to the benefits of climate pollution reduction efforts.

Moreover, the reasonableness of the proposed budget justifies the award of this grant. The costs for the Coalition's proposed program is a differentiating factor in large part due to the low per unit CO2e cost expected by using the photocatalytic pavement treatment technology. Harnessing the passive power of the sun to create a high efficiency and durable carbon sink out of the previous contributing cause of the mobile source air pollution is a significant achievement.

The Coalition expects that successful deployment and completion of the five-year grant period will provide other transportation system stakeholders the data required to deploy similar approaches on their road networks. The reasonableness of costs of this program could ultimately be quantified as $4 per metric tonne of CO2e by 2050 should the Coalition's assumptions be accurate.

This calculation is achieved by taking the contract costs divided by the amount of total CO2e removed. The estimate of cost effectiveness from GHG reductions 2025 to 2030 is approximately $30/ metric tonne of CO2 reductions which dips to around $6/ metric tonne of CO2e by 2050. When including expected co-benefits the cost per tonne of CO2e could reach as low as $4/metric tonne.

In addition to the primary objective of greenhouse gas emissions reduction, our proposal emphasizes the significant co-benefits that accompany the implementation of this innovative pavement treatment technology. As detailed in the workplan and technical appendix, the Coalition approach offers multifaceted advantages beyond GHG mitigation. These include the reduction of CAPs and HAPs, contributing to improved air quality and public health outcomes. Furthermore, this strategy addresses the mitigation of Urban Heat Island (UHI) effects, enhancing the resilience of urban environments to extreme heat events and associated health risks. Additionally, our pavement treatment technology facilitates the decomposition of microplastics and other 'forever chemicals,' thereby safeguarding ecosystems and water quality. These co-benefits underscore the holistic nature of the Coalition approach, highlighting the potential for synergistic solutions that address multiple environmental challenges simultaneously.