Post-Consumer Recycled Plastics in New York City Roadways
Literature Review

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ABSTRACT

This literature review examines the potential incorporation of post-consumer recycled plastics (PCRPs) into New York City's (NYC) capital infrastructure projects, specifically roadway asphalt. It first analyzes the policy, regulatory, and institutional frameworks that govern solid waste management, recycling, and roadway construction and materials, and then reviews current scientific evidence on technical feasibility, environmental risks, and long-term performance and viability. This two-part approach establishes the conditions under which PCRPs could enter NYC's capital infrastructure systems and evaluates whether current research supports that possibility.

While suggestive, the scientific literature has yet to demonstrate performance or environmental advantages for PCRP-modified asphalt, raising concerns about microplastics, leaching, emissions, and potential impacts on the recyclability of the asphalt pavement. Research also highlights constraints related to feedstock quantity and quality, as well as the current capacity of solid waste management systems and plant operations. Based on these findings, the review concludes that the use of recycled plastic-modified asphalt should remain limited to controlled pilots and further research until long-term field data, environmental safeguards, and clear performance standards are established to determine whether it is a viable option for NYC.

INTRODUCTION

New York City's commitment to waste reduction and resource recovery demands new strategies to integrate post-consumer municipal solid waste into a circular economy framework. Within this effort, post-consumer recycled plastics (PCRPs) present a central challenge. Plastics are produced in high volumes, they are difficult to recycle at scale, and have limited uses beyond their initial purpose. As the City and DSNY prepare to implement their draft 2026–2036 Solid Waste Management Plan (2026 SWMP), the Department of Sanitation (DSNY), along with the Department of Design and Construction (NYCDDC) and the Department of Transportation (NYCDOT), have identified the need to evaluate whether PCRPs can be incorporated into future NYC capital infrastructure projects, specifically roadway asphalt.

Other jurisdictions, agencies, and researchers have explored the potential of using recycled plastics in pavement. These efforts seek to address two primary issues. First, there is an ongoing search for alternative asphalt modifiers that might lower costs or enhance performance, and second, there is a need to find material outlets for low-value plastics. Despite growing interest, large-scale adoption has not occurred for various reasons. These reasons are explored in the *2023 National Academies' Consensus Study Report on Recycled Plastics in Infrastructure* (NAS), which included a NYCDOT pilot project in Staten Island, as one of three case studies (NYCDOT Pilot Project). This report provides the most comprehensive technical assessment available on the subject and serves as a foundational reference for NYC and other jurisdictions considering the use of post-consumer plastics in pavement systems. Commissioned by Congress through the Save Our Seas 2.0 Act, the study was directed by the U.S. Environmental Protection Agency (EPA) and U.S. Department of Transportation (USDOT) to evaluate the current state of practice, identify barriers to adoption, and clarify the conditions under which the use of PCRPs may be viable in infrastructure applications.[1] Although there are ongoing research and pilot programs in this field, these studies are long-term efforts and the NAS did not find any hard evidence that PCRP-modified asphalt improves pavement life, structural performance, or environmental outcomes. Instead, it highlights significant gaps in long-term field data and environmental assessments, especially regarding microplastics and the recyclability of recycled asphalt pavement (RAP).

This literature review supports DSNY, NYCDOT and NYCDDC in assessing whether and how PCRPs could be incorporated into NYC's roadway infrastructure. It synthesizes technical research, case studies, policy documents, and regulatory requirements to clarify what is known, what remains uncertain, and what would be required for any future pilot or implementation efforts. The goal is not to advocate for or against adoption, but rather to provide a clear and grounded understanding of the technical, environmental, and institutional landscape that surrounds this practice. To do so, the research is guided by the following initial questions:

1. What policy, regulatory, and institutional conditions shape the feasibility of incorporating PCRPs into NYC's roadway infrastructure, and what barriers or opportunities do they create for implementation within the next SWMP 10-year cycle?

2. What does existing research show about the overall feasibility of incorporating PCRPs into roadway infrastructure in terms of performance, long-term viability, environmental considerations, etc., and how can these findings inform NYC's approach to pilot testing and potential implementation?

By grounding these questions in the existing body of research, this literature review seeks to provide the foundation for developing a policy and implementation framework aligned with the circular economy goals of the 2026–2036 SWMP cycle.

METHODOLOGY

The literature review was conducted from October 2025 through November 2025 and focused on two areas. First, the team reviewed policies, regulations, and legislation that shape solid waste management, recycling, and the use of roadway materials in NYC. Second, the team examined the scientific research that evaluates the technical, environmental, and long-term considerations associated with incorporating PCRPs into asphalt. The NAS report served as a central reference point, and additional documents were identified through targeted searches based on themes that emerged from the project scope and the NAS report.

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[1] United States Congress. *Save Our Seas 2.0 Act.* Public Law 116-224, 18 Dec. 2020. Congress.gov, https://www.congress.gov/116/plaws/publ224/PLAW-116publ224.pdf

Alongside the document review, the team conducted stakeholder engagement to understand the agency's perspectives and practical considerations. This included routine meetings with the project clients at DSNY, NYCDDC and NYCDOT to understand their role in roadway materials and standards. The team also reached out to practitioners involved in other pilots referenced in the NAS report to gain a deeper understanding of their experiences and challenges. These engagements were used to complement the literature review and to clarify institutional, operational, and technical considerations relevant to assessing the potential introduction of post-consumer recycled plastics into NYC roadway asphalt.

POLICY LANDSCAPE

To properly evaluate the adoption of PCRPs in NYC capital roadway infrastructure, it is necessary to understand the policy and regulatory framework that governs these fields. This section assesses the relevant federal, state, and local policies and regulations that govern solid waste management, recycling, material use in infrastructure, and environmental considerations. However, the plan to implement PCRPs into infrastructure, and more specifically, asphalt, follows a broader model known as "Circular Economy". Thus, to truly understand the problem at hand, we must first grasp the underlying concept by defining the term and providing the context in which it is implemented in NYC.

CIRCULAR ECONOMY

Circular economy is defined by the Ellen MacArthur Foundation, a key stakeholder in the global implementation of this concept, as a system in which materials never become waste and nature is regenerated, where products and materials are kept in circulation through processes such as maintenance, reuse, refurbishment, remanufacture, recycling, and composting.[2] Citing current legislation, the EPA complements this definition by introducing key objectives and implementation nuances:

> "... (circular economy) involves industrial processes and economic activities that are restorative or regenerative by design, enables resources used in such processes and activities to maintain their highest value for as long as possible, and aims for the elimination of waste through the superior design of materials, products, and systems (including business models)... A circular economy reduces material use, redesigns materials and products to be less resource-intensive, and recaptures "waste" as a resource to manufacture new materials and products."[3]

The circular economy concept serves to tackle issues such as climate change, pollution, and biodiversity loss by decoupling economic activity from the consumption of finite resources in the current linear manner of sourcing, producing, and discarding. The 2026 SWMP begins by signaling its commitment and alignment to the broad implementation of the model,[4] and while this

[2] Ellen MacArthur Foundation. *"Circular Economy Introduction: Overview."* Ellen MacArthur Foundation, 2025, https://www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
[3] United States Environmental Protection Agency. *"What Is a Circular Economy?"* U.S. EPA, 4 Sept. 2025, https://www.epa.gov/circulareconomy/what-circular-economy
[4] Lojan, Javier. *"Commissioner's Letter."* Draft 2026 Solid Waste Management Plan (SWMP26), New York City Department of Sanitation, 2025.

plan required by state law,is still on its journey towards approval, its purpose is to provide a framework for the agency's next decade of programs, strategies, and engagements related to waste reduction, reuse, recycling, and resource recovery. Notably, SWMP begins by talking about circular economy in its first paragraph, signaling its commitment to the broad implementation of the model.[5]

Further into the document, recent efforts undertaken to shift away from a linear economy towards a circular one are reviewed, including the approval of Local Law 85 of 2023, which mandated the citywide collection of curbside organics for residences, and Local Law 88 of 2023, requiring DSNY to hold community reuse and recycling events in every community board district. Accordingly, SWMP states the Agency's intention to build upon these efforts by expanding existing programs, launching new ones, and leveraging its role to coordinate with multi-sector stakeholders in an effort to continue reducing waste tonnage and increasing diversion. Through the SWMP, DSNY also aims to place itself as the hub for circular economy, expanding the network through data collection, research and adequate policymaking, and the sharing of best practices.

One of the ways DSNY looks to expand the network of circular economy is through increased collaboration with NYCDOT.[6] On its own, NYCDOT is already a strong facilitator of NYC's circular economy; using around 40% of RAP generated from road resurfacing projects as a substitute for new materials. While already producing more RAP than it can use, NYCDOT continues to develop new asphalt formulations from recycled materials, including the NYCDOT Pilot Project in Staten Island where 10,400 pounds of plastic waste were used. This NYCDOT Pilot Project is further discussed in other sections of this report. Over the next ten years, the NYCDOT is committed to identifying, testing, and utilizing various asphalt mixes that incorporate recycled materials as they become available in the industry. As a natural producer of recycled materials, DSNY is a primary stakeholder of this project. Further sections of this report address the viability of using PCRPs in asphalt mixtures as a precursor to this collaboration.

SOLID WASTE MANAGEMENT & RECYCLING

Federal Regulations & Other States

The EPA is the federal agency responsible for overseeing and standardizing solid waste management, as mandated in the Resource Conservation and Recovery Act of 1976 (RCRA). As recycling is a component of solid waste management, the EPA is also empowered to oversee this practice in the United States (US). However, the EPA's activities regarding recycling regulation are limited to general monitoring, data collection, and multi-level coordination. When it comes to plastic recycling, there is no federal legislation in place to regulate recycling.[7] In the absence of national-level regulation, the EPA issued a publication called the National Recycling Strategy (NRS) in 2021, which outlines five general objectives for recycling: improving markets, increasing

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[5] *Ibid*

[6] New York City Department of Sanitation. *Draft 2026 Solid Waste Management Plan (SWMP26).* New York City Department of Sanitation, 2025, p. 162.

[7] United States Environmental Protection Agency. *The U.S. Recycling System.* 2022, https://www.epa.gov/recyclingstrategy/us-recycling-system; United States Environmental Protection Agency. *Reduce, Reuse, Recycle.* 2022, https://www.epa.gov/recycle.

collection, reducing contamination, enhancing circularity, and standardizing measurement.[8] The NRS provides recommendations that are largely voluntary, with the agency's role in achieving them being mainly supportive. It is at the state and local levels that recycling occurs, resulting in a fragmented network of policies and initiatives with unintended consequences at the national level, even if locally effective. Some examples of these in plastic recycling include price escalation due to competition for materials, reduced revenues for material recovery facilities resulting from private collection incentives, and the elimination of regional supplies for certain types of plastic due to local initiatives (e.g., banning plastic bags).[9]

At the state level, plastic recycling initiatives have varied widely. The NAS evaluated recycling initiatives across U.S. states and found 130 Extended Producer Responsibility laws in 33 states, Container Deposit laws or Bottle Bills in 10 states, and Minimum Post-Consumer Recycled Content Mandates in 3 states (as of 2022).[10]

Solid Waste Management & Recycling in New York State

New York State (NYS) operates under a robust solid waste management and recycling framework that sets clear expectations for how municipalities must handle and reduce waste, laid out in their local SWMPs. At the head of this structure is the NYS Department of Environmental Conservation. The framework is centered around Article 27 of the Environmental Conservation Law, which establishes the state's commitment to waste reduction, material reuse, and recycling in ways that are both economically and technically feasible, while also providing support to municipalities to ensure this.[11] The Solid Waste Management Act of 1988 reinforces this by requiring every municipality to adopt source separation and recycling programs, creating the baseline recycling systems that operate statewide.[12] Beyond these requirements, the Act, as well as other State legislation, requires that municipalities and counties develop Local Solid Waste Management Plans that evaluate existing waste systems, project future waste generation, and outline strategies for reduction, reuse, and recycling.[13] The state supports this process by providing guidance, technical assistance, and oversight, as well as requiring updates every ten years to ensure alignment with statewide waste diversion and circular economy goals.[14]

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[8] United States Environmental Protection Agency**.** *National Recycling Strategy.* EPA 530-R-21-003, Office of Resource Conservation and Recovery, 2021, https://www.epa.gov/recyclingstrategy/national-recycling-strategy.
[9] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Research Needs, and the Path Toward Innovation.* The National Academies Press, 2023, p. 8.
[10] *Ibid*, p. 88–93.
[11] New York State Legislature. *Environmental Conservation Law, Article 27.* n.d., https://www.nysenate.gov/legislation/laws/ENV/27
[12] New York State Department of Environmental Conservation. *New York State Solid Waste Management Act of 1988.* 1988.
[13] New York State Legislature. *Environmental Conservation Law,* §27-0103, Article 27; New York State Department of Environmental Conservation. *6 NYCRR Part 366;* New York State Department of Environmental Conservation. *Local Solid Waste Management Plans (LSWMPs) and State Planning Requirements.* 2023. *NYC Solid Waste Management Plan 2026 – Attachment A: Local Laws Relevant to Waste Management,* New York City Department of Sanitation, https://www.nyc.gov/assets/dsny/downloads/resources/reports/solid-waste-management/2026-swmp/draft-swmp-2026-attachments.pdf
[14] *Ibid.*

These statutory mandates are put into effect through State Law 6 NYCRR sections 360–366 and 369, which define how solid waste is tracked, processed, and permitted, and outline when recovered materials can qualify as "beneficial use" (i.e., wastes that can be used as effective substitutes for commercial products or raw materials) and can cease to be solid waste.[15] This is a key consideration for evaluating whether post-consumer plastics can enter the roadway materials stream. Complementing these broad requirements are targeted state laws governing specific material types, such as the Plastic Bag Reduction, Reuse, and Recycling Law, the Returnable Container Act, and multiple Extended Producer Responsibility programs that further drive plastic diversion and recovery.[16]

Solid Waste & Recycling in New York City

NYC's solid waste regulatory landscape builds on state requirements but establishes its own set of local mandates that shape how waste is reduced, collected, and diverted within the city. The basis of NYC's recycling framework is Local Law 19 of 1989, which created the City's mandatory recycling program for residents, institutions, and businesses and set the expectation that recycling would be fully integrated into DSNY operations. Over time, the City has expanded this framework through a series of targeted local laws that strengthen access to recycling, improve diversion rates, and manage specific material streams. In 2023, the NYC City Council enacted the Zero Waste Package, a legislative package designed to advance the City's commitment to zero and sustainability. These, along with other local laws include requirements for recycling education, agency-specific recycling plans, and school recycling mandates, as well as updated diversion and reporting requirements to improve transparency.[17] Notably, Local Law 86 of 2023 establishes the City's goal of zero divertible waste for New York city by 2030.[18]

NYC has also implemented a range of local legislation that directly affects waste streams relevant to materials recovery, such as expanded organics collection, waste characterization studies, and the creation of borough-level community recycling centers. Across this landscape, NYC's policy framework works in tandem with state-level regulations, not only requiring the recycling and separation of organic materials but also creating the operational and planning conditions through which recovered materials, such as post-consumer plastics, can be captured at scale and potentially evaluated for use in infrastructure applications.

Beneficial Use Designation & Procurement Requirements

Beneficial use designations and NYC procurement requirements, which are based on a combination of state and local laws, influence how recycled materials can be incorporated into public-sector projects and broader material markets. At the federal level, the US EPA's

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[15] New York State Department of Environmental Conservation. *6 NYCRR Parts 360–366 and 369: Solid Waste Management Facilities Regulations.* 2023, https://dec.ny.gov/regulatory/regulations/adopted-parts-360-366-369-371-377-effective-july-22-2023.
[16] New York State Department of Environmental Conservation. *Plastic Bag Reduction, Reuse, and Recycling Law (6 NYCRR Part 351).* 2020*; New York State Legislature. Returnable Container Act (ECL Article 27, Title 10). 1982; New York State Legislature. Rechargeable Battery Recycling Act (ECL Article 27, Title 18). 2010.*
[17] New York State Legislature. *Local Law 34 of 2010; New York State Legislature. Local Law 41 of 2010; New York State Legislature. Local Law 40 of 2010.*
[18] New York City Council. *Local Law 86 of 2023.*

Comprehensive Procurement Guideline Program, authorized under the federal RCRA, designates products that can be manufactured with recovered materials and requires federal agencies to purchase them whenever feasible.[19] The program currently includes 61 products across eight categories, supported by EPA-recommended procurement practices designated to normalize and scale the use of recovered materials in manufacturing and construction. In NYS, this federal procurement framework aligns with their Beneficial Use Determination (BUDs) process under 6 NYCRR Parts 360–366, which defines when a material officially "ceases to be waste."[20] Of particular relevance is Part 360.12(c)(4)(i), which allows for case-specific BUDs and creates a pathway for evaluating emerging materials for potential use in roadway infrastructure.[21] This is relevant for considering the use of processed post-consumer recycled plastic additives in asphalt in the future. Together, these federal and state mechanisms not only prioritize the diversion and reuse of materials but also create the regulatory conditions necessary for innovative recycled content to move from waste streams into approved construction applications.

ROADWAY CONSTRUCTION & MATERIALS

Federal Regulations

Because plastic recycling is only the first step, we must also evaluate the policies and regulations governing roadway construction, particularly in terms of asphalt and material use. The USDOT is the primary federal agency responsible for overseeing and developing the country's transportation systems. Although it cannot directly regulate local roadways at the state and local levels, the USDOT can influence transportation projects through the Federal Highway Administration (FHWA). The FHWA is responsible for maintaining and improving the federal highway system. The FHWA often provides funding for capital infrastructure and research projects. Through this funding, USDOT can impose additional guidelines and requirements as conditions for receiving it, such as material and construction specifications. Fortunately, USDOT has a favorable outlook for the research and development of recycled materials in infrastructure projects. In 2015, the FHWA published its Recycled Materials Policy, which promotes the use of recycled materials in its infrastructure projects, so long as it does not affect performance, safety, or the environment.[22]

It is worth noting that other federal regulations or legislation may come into effect through the use of federal funds, such as the 2021 Buy America/Build America (BABA) Act. The BABA Act requires domestic manufacturing for all construction materials in federally funded infrastructure projects, including polymer additives.[23] This law is relevant because if NYC or NYSDOT uses any federal funding for a plastic-modified asphalt pilot, the recycled plastic additives must be sourced and manufactured domestically in the United States. This determines which post-

[19] United States Environmental Protection Agency. *Comprehensive Procurement Guidelines (CPG) for Recovered Materials.* 2024, https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program; *Resource Conservation and Recovery Act.* 42 U.S.C. § 6901 *et seq.* (1976).
[20] New York State Department of Environmental Conservation. *Solid Waste Management Facilities: 6 NYCRR Parts 360–366 and 369.* 2023, https://dec.ny.gov/regulatory/regulations/adopted-parts-360-366-369-371-377-effective-july-22-2023
[21] New York State Department of Environmental Conservation. *6 NYCRR Part 360.12: Beneficial Use Determinations.* 2023, https://www.law.cornell.edu/regulations/new-york/6-NYCRR-360.12
[22] Federal Highway Administration. *Recycled Materials Policy.* 2015.
[23] Build America, Buy America Act. *Public Law* 117-58, §§ 70901–70952.

consumer recycled materials are eligible, which suppliers can participate, and whether the project is even eligible to qualify for federal infrastructure dollars.

New York State Regulations

At the state level, several regulatory, technical, and policy frameworks shape whether recycled plastics can be used in roadway infrastructure. Most directly, the New York State Department of Transportation (NYSDOT) controls material approval through its Standard Specifications and the Superpave system, governed by Materials Method (MM) 5.16.[24] MM 5.16 outlines the procedures for designing, verifying, and testing asphalt mixtures, meaning that any plastic-modified asphalt must meet the same parameters and requirements as conventional mixes.

State climate and sustainability legislation can also influence the choices of infrastructure materials. The State's Climate Leadership and Community Protection Act mandates an 85% reduction in greenhouse gas emissions from 1990 levels by 2050, creating direct pressure on state and local agencies to decarbonize asphalt production and adopt materials that reduce embodied emissions.[25] To support compliance, the State has issued Environmental Product Declaration (EPD) guidance, encouraging agencies to quantify cradle-to-gate emissions from construction materials.[26] As such, any future use of post-consumer recycled plastics in asphalt will need to comply with environmental and sustainable requirements, such as demonstrating either carbon neutrality or a net-positive reduction in greenhouse gas emissions.

New York City Local Laws & Regulations

At the local level, we can find a web of city, state, and federal agencies at play when it comes to capital infrastructure projects. The specific agencies that come into play, as well as when, will depend on the type of project and other factors, such as scale, funding source, and location. For infrastructure projects involving roads, NYCDOT handles day-to-day maintenance and roadway resurfacing. However, capital street reconstruction projects are typically designed and built through the NYCDDC, even when NYSDOT or federal funds are involved. Of course, other agencies like the NYC Department of Environmental Protections (NYCDEP), the NYC Economic Development Corporation, and even NYSDOT can be involved.[27]

Similarly, when determining the materials that can be used for roadway construction, decisions can be influenced by this complex network of agencies, whose involvement varies depending on the type, scale, and funding source of the project. When it comes to roadway specifications in roads owned by NYC, nothing can be piloted or installed without the approval of NYCDOT, as they are the local agency responsible for establishing roadway design standards and determining the acceptable materials for asphalt production. They do so through their Standard Highway

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[24] New York State Department of Transportation. *Standard Specifications: Sections 401–402.* 2022; New York State Department of Transportation. *Materials Method 5.16: Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures.* 2021.
[25] New York State Legislature. *Climate Leadership and Community Protection Act (CLCPA).* Chapter 106 of the Laws of 2019, 2019.
[26] New York State. *Buy Clean Concrete and EPD Guidance for State Agencies.* 2022.
[27] "Agency Roles on the City's Streets." *New York City Street Design Manual,* New York City Department of Transportation, 2025, https://www.nycstreetdesign.info/process/agency-roles-citys-streets.

Specifications, which contain detailed requirements for asphaltic binders, emulsified asphalt, aggregates, as well as production protocols.

Moreover, Section 3.01 of the specifications requires that all asphalt mix designs, laboratories, and bituminous plants receive explicit approval from NYCDOT and DDC's Quality Assurance and Construction Safety Bureau, including compliance with their Mix Design, Laboratory, and Plant Approval Protocol. In short, even if the NYSDOT were to approve a plastic-modified asphalt under MM 5.16, NYCDOT must separately determine that the material meets city engineering, safety, and performance standards before it can be used on municipal streets. This is because, as a general rule, state regulations establish minimum requirements, and municipalities can enact additional legislation to meet these requirements.

If a roadway project using recycled plastics is for maintenance or repair involving no substantial changes in an existing structure or facility, it will be a Type II project and exempt from full-scale City Environmental Quality Review (CEQR) review. The majority of roadway projects at NYCDOT and NYCDDC are Type II projects. Complex roadway projects, managed by NYC DDC, involving both DOT and DEP project elements that include significant stormwater improvements of various types (e.g., sewer outfalls and/or Bluebelts) will likely be Type I and subject to the full CEQR review process, for which NYCDDC would likely be the lead agency in the CEQR process. If any of these projects use recycled plastics, CEQR-required review and disclosure of the impact of recycled plastic on the environment may occur.

Of course, other NYC policy and regulatory frameworks also come into play when implementing plastic-modified asphalt. Firstly, DSNY's SWMP, which is approved by the NYSDEC (and is currently under review), establishes long-term waste diversion goals and infrastructure planning strategies that determine the availability of post-consumer recycled streams. The SWMP is complemented by several local laws, including Local Law 199-2019 (Commercial Waste Zones), which strengthens recycling requirements and safety standards for private haulers.[28] There is also Local Law 71-2011, which requires a 30% minimum of RAP usage as an additive in asphalt for repaving in NYC.[29] This not only sets a precedent for mandates on the use of recycled material in asphalt, but is also an important consideration when adding other recycled materials, as incorporating PCRPs into asphalt doesn't affect the asphalt's recyclability.

One final policy consideration at the local level is NYC's climate and procurement frameworks, which can also shape the choices of materials in capital infrastructure projects. For example, Executive Order 23 (2022) requires carbon accounting and EPD submissions for all city-funded capital infrastructure projects.

Taken together, this policy and regulatory landscape demonstrates that the incorporation of PCRPs into roadway infrastructure is not simply a technical question, but one shaped by a complex multi-level regulatory network. Understanding how this network interacts is essential for identifying feasible pathways for plastic-modified infrastructure and for anticipating the coordination required to advance any future pilot or implementation.

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[28] New York City Council. *Local Law No. 199 of 2019: Commercial Waste Zones.* 201

[29] New York City Council. *Local Law No. 71 of 2011: Use of Reclaimed Asphalt Pavement.* 2011.

FINDINGS: POST-CONSUMER PLASTICS IN ASPHALT

The following section provides a comprehensive overview of the current landscape of recycled plastics in asphalt mixtures, grounding the analysis in Chapter 6 of the National Academies of Sciences, Engineering, and Medicine's *Consensus Study Report: Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities* (2023). Drawing on more than 150 sources, the NAS chapter offers the most authoritative synthesis to date on whether and under what conditions recycled plastics should be incorporated into pavement systems. Building on this foundation, the section situates the broader conversation around plastics in asphalt, examines the scientific and engineering questions that must be resolved before large-scale implementation, and delineates what current research has found. Subsequent subsections review NAS's general findings, summarize key elements of asphalt mixture design, consider lessons from alternative additives such as sulfur and rubber, and assess the state of practice through emerging case studies. Together, this structure establishes both the opportunities and the persistent uncertainties that define the feasibility of using recycled plastics in roadway infrastructure and outlines the caveats under which such implementation may be responsibly pursued.

NATIONAL ACADEMIES CONSENSUS STUDY REPORT

As previously mentioned, the foundation for this report is the National Academies' Consensus Study Report. The NAS recognizes in its findings that "[o]ne of the greatest opportunities for using recycled plastics in infrastructure may be as a component material in pavements…the science to back those claims is not there yet."[30] Despite this, at the time that it was prepared, the report found no empirical evidence that recycled-plastic modifiers extend pavement service life, improve structural performance under traffic or climatic stressors, or deliver a superior environmental life-cycle profile compared to conventional asphalt mixtures. The report's authors emphasize that every claimed benefit relies on lab-scale results that have not been validated through full life-cycle modeling or long-term field data. Accordingly, the report recommends focusing on further research and development, as well as pilot and field-testing, and setting standards, while also identifying the best use case for the proposed feedstock and strengthening the supply through policymaking.

Despite its limitations, the report identifies several areas of potential opportunity. Asphalt remains one of the few infrastructure materials capable of consuming large quantities of low-value plastics. If adopted in only 12% of national annual asphalt production, PCRP-modified mixes could theoretically absorb approximately 240,000 tons of polyethylene waste annually, offering a material outlet for waste streams that currently lack viable markets.[31] The report also notes that certain polymer types may contribute to improved rutting resistance or moisture sensitivity under controlled conditions, although these effects have not yet been demonstrated through field-scale performance monitoring.[32] In addition, the substitution of recycled polymers for virgin polymer modifiers presents a possible pathway for cost and carbon reductions, contingent on rigorous performance validation. This possibility remains theoretical until supported by long-term field

[30] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies Press, 2023, p. 101
[31] *Ibid*, p. 128-129.
[32] *Ibid*.

evidence. Current pilot studies in Missouri and Staten Island represent some of the first attempts to test these claims under real-world traffic and climatic conditions, yet their results will take several years to mature. Until those datasets are available, the performance benefits of recycled plastics cannot be generalized beyond laboratory contexts.

The NAS emphasizes that the most significant knowledge gap involves the long-term behavior of plastic-modified pavements across the entire service life. Research still needs to clarify the quality standards and consistency criteria required for recycled plastic feedstock, and must determine how the environmental and economic life-cycle performance of plastic-modified pavements compares to that of traditional mixes. These questions remain unresolved. The report also stresses that any assessment of plastic use in infrastructure demands a holistic life-cycle perspective. Evaluating only a single stage produces an incomplete understanding. A comprehensive analysis must account for the impacts of manufacturing, installation, maintenance cycles, service life, and end-of-life recyclability.[33]

ASPHALT MIXTURE DESIGN

Three types of asphalts dominate the current markets, varying in construction materials and design to provide for different load distributions.[34] Flexible pavements use multiple layers of asphalt mix, rigid pavements are constructed using cement, and composite pavements mix both approaches. Rigid pavements distribute loads over a large area of the subbase and are designed to have a high stiffness, while flexible pavements provide the opposite. No significant research is available on plastics incorporated into concrete pavements, and they are therefore not the subject of discussion herein.

Roadways are constructed using several layers of asphalt mixtures, each layer designed to provide specific, often mandated characteristics at the lowest possible cost.[35] In general, the mixes are primarily composed of aggregate materials, with a binder content ranging from 4% to 6%. A common aggregate is RAP, while others, like tire rubber, are also considered. RAP results from cold milling asphalt pavement layers for rehabilitation, and its usage provides various incentives. RAP is primarily used for its cost-cutting nature, as it reduces the amount of new asphalt binder and aggregates needed, while also being a sustainable option that reduces greenhouse gas emissions. On the other hand, binders can be purposely produced plastics, and they all closely follow the fluctuations in the crude oil market. All this to say that contractors aim to design asphalt mixtures that meet approved standards for high and long-term performance while minimizing costs by using as little asphalt as possible and as much local aggregates as possible, including the broad use of RAP.

OTHER ALTERNATIVE MATERIALS

Other endeavors to incorporate alternative materials into asphalt as both a cost-cutting and sustainable measure include sulfur and rubber.[36] While the use of sulfur as an additive to asphalt

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[33] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies Press, 2023, p. 162.
[34] *Ibid.*, p. 101.
[35] *Ibid.*, p. 103.
[36] *Ibid.*, p. 107-110.

binder did not work as well as recycled tire rubber (RTR), both endeavors provide an idea of what implementation looks like for plastic. A new additive for asphalt mixtures must first show clear life-cycle performance benefits that offset costs. In the case of sulfur, short-term economic gains were achieved in some instances; however, laboratory testing revealed performance gaps in certain circumstances. As a byproduct of oil refining, sulfur prices sharply rose in the 1980s, and interest was lost altogether. Additionally, a new additive must not pose any major environmental or health risks, which was a concern for sulfur but not RTR. Finally, a new additive must not compromise pavement circularity, as it completely disrupts the eLCA benefits. Again, sulfur failed this test as incorporating it into a RAP process requires high temperatures that would release harmful gases, negating any pavement circularity. Ultimately, further research is necessary to assess RTR's circularity capabilities.

PLASTICS IN ASPHALT MIXTURES

The use of plastics to modify asphalt mixtures is not a new endeavor, as testing dates back to the 1970s.[37] Such a consideration is unsurprising, as the potential to incorporate it into asphalt mixtures is very promising. If achieved, it would serve as a resource for a material that accounts for 94% of the US's roadways, spanning 2.5 million miles and requiring 363 million tons worth of resurfacing each year. These statistics overlook the alternative uses of asphalt, including driveways, airports, parking lots, port facilities, and recreational areas; the possibilities are sizable. Recently, research and development have focused on using recycled plastics, rather than purposely produced ones. To understand what plastics are suitable for this practice, we must first understand their place in asphalt mixtures. See Figure 1 for a detailed diagram of asphalt production.[38]

If plastic is to be incorporated into asphalt mixtures, it would be during the production process. Currently, there are two major methods for incorporating plastic into asphalt. In the wet process, plastics are melted directly into the hot asphalt binder, making up about 1 to 12% of it, and forming a fully blended modified binder. This requires plastics that melt easily, as well as the addition of a compatibilizer or strong mixing to prevent the plastic from separating from the binder in later stages. In the dry process, plastics are added to the heated aggregate before it meets the binder, making up between 0.2% and 6% of the aggregate. Depending on the type of plastic, it may either coat the aggregate as it melts, remain as discrete solid particles, or incinerate it altogether. This is a key uncertainty of the plastic's behavior and final result, which depends on the technique and temperature employed.

India is a significant implementer of this approach, with over 60,000 miles of roads utilizing recycled plastics as a modifier. Professor Rajagopalan Vasudevan of the Thiagarajar College of Engineering developed a variation of the dry process whereby shredded recycled plastic is added to the aggregate conveyor of an asphalt plant before the aggregate enters the dryer. While this approach likely incinerates the plastic due to the high temperatures, its simplicity earned it policy implementation throughout India. We have reached out to Prof. Vasudevan to understand his

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[37] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies Press, 2023, p. 114-118.
[38] Sourced from *Ibid.,* p. 115.

method and gather knowledge regarding long-term performance, but have not received a response as of the time of this paper.

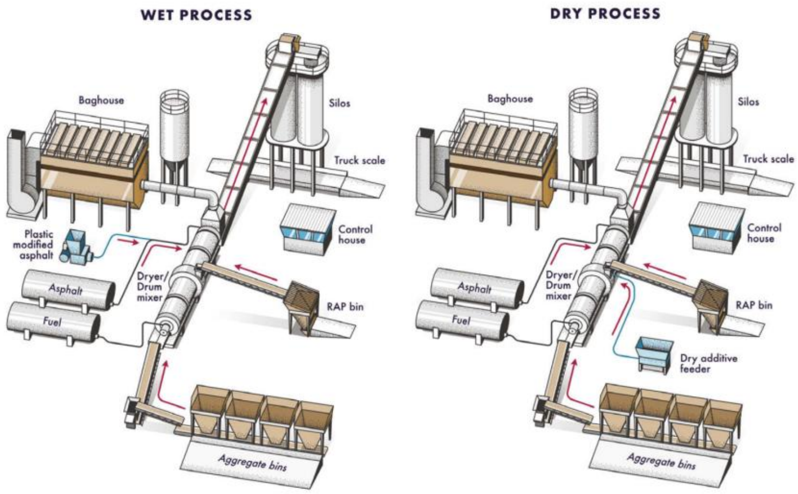

FIGURE 1

Suitable Plastic Types

Understanding the production-related nuances, current research indicates that recycled plastics incorporated into asphalt mixtures must meet specific melting points, flexibility, and thermal stability characteristics. Asphalt blends require plastics that can melt and disperse uniformly at mixing temperatures without burning, degrading, or clumping. Specifically, our review has found that a melting point of at least 15°C below the mix temperature, a melt flow index of more than 1 g/10 min at 190°C, and the avoidance of non-plastic contaminants commonly found in post-consumer feedstocks are key determinants of compatibility with roadway infrastructure.[39] Therefore, the ideal polymers are soft plastics with melting points that overlap with asphalt's production temperatures. These plastics must not only melt consistently but also enhance or at least maintain the performance properties of the binder into which they are introduced. Suitable plastic types include: linear low-density polyethylene (LLDPE), low-density polyethylene (LDPE), high-density polyethylene (HDPE), polyethylene terephthalate (PET), and polypropylene (PP), with the first three being the most researched. Ultimately, the ideal plastic type depends on achieving the appropriate physical and chemical properties while ensuring minimal contamination, sufficient material availability, and meeting the previously discussed restrictions regarding performance, economic benefits, and policy considerations.

CASE STUDIES

Missouri

[39] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Research Needs, and the Path Toward Innovation.* The National Academies Press, 2023, p. 23, 117.

The Missouri Department of Transportation (MoDOT), in partnership with the University of Missouri, operates the most technically advanced U.S. field evaluation of recycled-plastic asphalt. The NAS points to this project as one of the most significant domestic studies underway.[40] The Missouri trials focus on the dry process, incorporating polyethylene pellets blended with ground tire rubber into balanced mix design formulations that also use RAP content. The selected roadway segments had known histories of reflective cracking, allowing researchers to compare plastic-modified and control sections under matched environmental and traffic conditions.

Early results show that the plastic-modified mixes met MoDOT's performance thresholds at construction, and initial laboratory testing indicated acceptable cracking and rutting resistance relative to controls. Short-term field observations have not shown visible failures. However, long-term performance has not yet been established.

Our interview with Jen Harper, MoDOT Research Director, provided valuable insight that their biggest limitation was not engineering capacity, but their feedstock availability.[41] Missouri cannot reliably source high-purity post-consumer plastics, and MoDOT will not divert plastics that already have established end markets, as doing so would raise costs for existing buyers. Harper explained that Missouri was only able to conduct its pilot because the research team acquired plastic from a private contractor and, in some cases, received discounted or free material. Contractors also increased prices due to the risks and insurance concerns associated with the use of experimental materials. Much of the funding came from university research budgets, and federal approval was needed to cover the differential cost of the pilot sections. Harper noted that these realities make clear that plastic asphalt is feasible only under controlled test conditions, not at a scale MoDOT could adopt for routine paving.

Environmental testing in Missouri is also incomplete. Harper stated that limited screening did not show evidence of leaching or microplastic release, but emphasized that these evaluations were shallow and cannot substitute for multi-year environmental research. Most importantly, Harper emphasized that MoDOT is not moving towards long-term implementation, given unresolved questions about long-term environmental effects. Harper's overall assessment was cautious but supportive of continued research. She stated that plastic asphalt "is not proven enough for implementation," but she encouraged further pilots as long as stable feedstock, controlled testing, and multi-year evaluation are in place. For NYC, the Missouri case study offers several key lessons. Successful pilots depend on high-purity, consistent feedstock, something Missouri has struggled to secure. Environmental assessments must be a priority and extend beyond initial screening, involving multi-year monitoring of microplastics, leachate, and the recyclability of RAP.

Staten Island

The Staten Island recycled-plastic asphalt pilot represents NYC's first controlled evaluation of a PCRP additive, using a proprietary mixture dubbed "MR8" from Scottish engineering company MacRebur. They describe MR8 as a polymer blend intended to extend the liquid asphalt binder in

[40] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies Press, 2023, p. 122-123
[41] Harper, Jen, Research Director at Missouri Department of Transportation. Personal interview. 12 Nov. 2025.

standard mixes while reducing fossil-fuel content and providing verified carbon savings.[42] The complete mixture details are patented by MacRebur and thus unknown. Also, the NAS notes that the purported benefits remain unverified without long-term field data and full life-cycle assessment.[43]

For this project, the Staten Island pilot should be viewed as a proof of concept rather than a model ready for broader adoption. The pilot confirms that a dry-process plastic additive can be introduced into NYC's asphalt production system and applied to local streets without disrupting plant operations or causing immediate surface distress. It does not show that plastic-modified pavements last longer, reduce overall costs, or improve environmental outcomes. Moreover, there is a gap in research regarding the long-term environmental impact on introducing PCRP into roadway infrastructure. Moving beyond the pilot stage would require long-term performance data that confirms plastic-modified mixes align with the city's goals related to the circular economy and material recovery. Until these research gaps are addressed, the Staten Island pilot provides valuable operational insights, but cannot answer long-term performance and environmental questions at this time.

FEASIBILITY CONSIDERATIONS

Environmental Considerations

Environmental considerations form the basis for evaluating whether PCRPs should remain in pilot programs or be integrated into broader infrastructure use. Before assessing suitability, it is essential to understand the environmental impacts that these materials may create, including the release of microplastics, chemical transport, air emissions, and recyclability.

Microplastics now circulate across air, water, and soil as a persistent background pollutant. They are small plastic fragments less than five millimeters in size that originate from both the breakdown of larger plastic items and the intentional manufacture of pellets or microbeads. These particles can carry persistent organic pollutants and heavy metals, which can be released once ingested or when environmental conditions shift.[44] The risk is when microplastics have been detected in drinking water, seafood, salt, and urban air, and they accumulate in human lungs, placentas, and blood, with likely links to inflammation, oxidative stress, and endocrine disruption.[45]

Pavement surfaces constantly shed material due to traffic abrasion, which grinds the surface into progressively smaller fragments.[46] If plastic modifiers alter the physical structure of the pavement surface, they may affect the rate, size distribution, or chemical composition of the particles produced through wear. The NAS identifies microplastic generation as one of the three principal environmental concerns associated with plastic-modified asphalt, alongside the release of toxic

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[42] MacRebur. *Copy of NYCDOT Trial Road Report: Rice Avenue and Royal Oak Road, Staten Island, New York*. 30 Aug. 2022.
[43] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies ofPress, 2023, p. 85-132
[44] Strothers, Joel, Environmental Engineer at AECOM. Personal interview. 29 Oct. 2025
[45] Strothers, Joel, Environmental Engineer at AECOM. Personal interview. 29 Oct. 2025
[46] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies Press, 2023, p. 129

components during production and the potential generation of chlorine-based gases when PVC-contaminated plastic is used.[47] This uncertainty is particularly significant in a city with dense stormwater catchments and combined sewer overflows that can transport these particles directly into surrounding waterways. However, existing studies are insufficient, and no environmental thresholds exist for determining the acceptable level of microplastic release.

The NAS also warns that introducing plastics into asphalt could threaten the circularity of reclaimed asphalt pavement, which is currently the most recycled material in the United States. If plastic additives inhibit RAP recyclability, the report characterizes this outcome as a "game-ending consequence." [48]

These concerns exist within the broader challenge of plastics recovery. The NAS emphasizes that only a small fraction of plastic waste is recycled globally, while most plastics are landfilled, incinerated, or released into the environment. It identifies the need for reformulating plastics for reuse and improving collection systems, but also emphasizes that infrastructure applications remain in the preliminary stage and have not yet demonstrated reliable environmental or technical performance.[49] Due to these unresolved risks, the findings demonstrate that environmental questions surrounding plastic-modified pavements remain technically unresolved and are highly dependent on polymer chemistry, mix design, and end-of-life recyclability. Field data is needed on microplastic release, chemical burdens, and RAP recyclability before any specification changes can be responsibly evaluated.

Performance and Economic Considerations

The report highlights evidence that the addition of recycled plastics to asphalt mixtures increases binder stiffness, which is likely beneficial for countering a common asphalt failure known as rutting. Also, some laboratory tests have found that the wet process yields mixtures with comparable performance to regular asphalt.[50] However, there is no long-term data that certifies performance gains in any direction.

Regarding costs, the research suggests that while the wet process may have economic advantages when recycled plastic substitutes traditional, virgin polymer modifiers, these cost advantages may be negated by the need for a stabilization agent and/or modifications to provide for continuous agitation of the mixture to prevent separation.[51] However, as a replacement for traditional asphalt binders, the report also suggests that the economic gains of using recycled plastics may be overstated due to a misunderstanding of standard asphalt mixture volumetrics used to determine binder content. More research is needed to determine the theoretical cost-benefits that implementation could have.

ANALYSIS: FEASIBILITY IN NYC

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[47] National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*. National Academies Press, p. 119
[48] *Ibid.*, p. 129
[49] *Ibid.*, p. 177-178
[50] *Ibid.*, p. 118-119
[51] *Ibid.*

AVAILABLE PCRP FEEDSTOCK

A key feasibility question for any implementation is whether the plastics collected and processed through the recycling system align with the polymer types that research identifies as most suitable for PCRP-modified binder. Indeed, this is a key hurdle for the Missouri pilot study, to the point of them having to purchase plastics from elsewhere in order to carry out the study. In a DSNY-led implementation for NYC, these concerns are somewhat mitigated but, in any case, feedstock is a dual faceted issue affected by what's received as suitable product, and what is desirable for the specific asphalt mixture. Even still, there is the issue of competing with other more established and economically sensible alternatives to recycling. All things considered, the final outcome will be determined by lab and pilot testing.

In a general availability sense, Dr.William Buttlar,[52] founding director of the Missouri Center for Transportation Innovation, has told us that color is not chemically relevant for asphalt modification; instead, procurement should prioritize the cheapest, softest, and most abundant plastics in the City's waste stream. Once DSNY collects municipal recyclables, they are sent to the Sunset Park Material Recovery Facility, which is privately operated by Sims Municipal Recycling. Because Sims handles the sorting, processing, and baling of PCRP, early engagement with the company is essential. Kara Napolitano, the facility's Education Director, echoed many of the considerations outlined in this report. It is also important to recognize that contamination levels, resin types, and the market value of PCRP bales fluctuate significantly based on DSNY's collection practices and broader waste-generation patterns.[53]

NYC's Waste Characterization Study shows that the municipal recycling stream contains meaningful volumes of these polymers.[54] The categories most conducive to asphalt applications include #2 HDPE colored bottles (57.9% capture rate), #2 HDPE natural bottles (54.7% capture rate), and #4 LDPE bottles, though #4 is grouped together with #3-#7 & Unlabeled Bottles (35.8% capture rate). Notably, DSNY does not sort its plastics by strict resin type. To refine estimates of available material in DSNY feedstock, the project team would need to examine their waste processors' bale specifications in detail, including contamination levels, bale compositions, and market-ready quantities. While NYC's waste stream clearly contains the right polymers for binder development, ensuring consistent feedstock quality and dependable supply remains a key constraint.

Among the plastics present in DSNY municipal solid waste feedstock, LLDPE, LDPE, and HDPE are the most suitable for asphalt modification due to their compatibility and successful demonstration in field trials. Logically, increasing volumes of these plastics would need to be prioritized should the City look to implement PCPW in roadway infrastructure.

R&D/PILOT/IMPLEMENTATION CONSIDERATIONS

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[52] Buttlar, William. Founding Director of the Missouri Center for Transportation Innovation. *Personal interview.* 11 Nov. 2025.

[53] Napolitano, Kara. Education Director for the Sunset Park Material Recovery Facility. *Personal interview.* 21 Nov. 2025.

[54] New York City Department of Sanitation. *2023 NYC Waste Characterization Study.* Mar. 2024 (published), https://www.nyc.gov/assets/dsny/downloads/resources/reports/waste-characterization-studies/2023/wcs-2023.pdf

As outlined earlier in this report, the use of RAP in new asphalt mixtures for repavement is a form of recycling. Utilization of RAP also reduces the prevalence of virgin plastic additives, lowers GHGs, and lowers costs of asphalt production. Currently, NYCDOT collects RAP to produce new asphalt at its Hamilton and Harper plants, resulting in a surplus of asphalt that exceeds its needs. The national average of RAP in asphalt mixes is around 21%, and the NYCDOT is above average at approximately 41% utilization; the remaining material is made available to private industry and community developments at no charge. Therefore, incorporating PCRP into the roadway binder in NYC will require targeted research and development to ensure compatibility with current RAP usage. That is, additional research is required within the NYC context to ensure that plastic additives will not inhibit the usage of higher percentages of RAP in the future, and whether using plastic would affect the overall recyclability of asphalt. Current research suggests that this may be successfully addressed in two ways: (1) using a softer plastic to account for RAP's stiffening effect,[55] or (2) lower the binder's Performance Grade (PG) to maintain necessary flexibility.[56]

Infrastructure owners, such as public infrastructure owners including NYC, routinely raise several concerns when evaluating the adoption of new pavement materials, and these issues should be taken into consideration as NYC explores the use of PCRP-modified asphalt.[57] Concerns about high material and installation costs are typically raised, but because landfill fees can be relatively high, waste processors may prefer to divert plastics at a lower cost.[58] This could involve paying the City to take certain post-consumer plastics instead of landfilling them, leading to an at-cost binder.

Concerns about long-term performance are another common consideration for infrastructure owners. Plastic-modified asphalt is still an emerging field, underscoring the importance of a structured, multi-year pilot program in NYC, which will allow engineers to observe its performance over time and directly compare it to traditional binders. The accumulation of city-specific performance data will be a key factor in advancing new materials from pilot status to broader adoption. The more localized the data, the more relevant it will be for local projects as well as for governmental and community advocacy. Additionally, microplastics and PFAS will require careful monitoring throughout the material testing and deployment process. MoDOT's program funded environmental and performance studies, including microplastic analyses, ultimately finding no net increase in microplastic generation from plastic-modified pavements.[59] Conducting environmental monitoring as part of the pilot phase would help provide the degree of certainty and transparency that agencies (and NY residents) will require when critiquing

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55 La Macchia, Joseph Nicolas, et al. "Experimental Evaluation of High RAP Bituminous Mixtures Modified with Recycled Waste Plastics." Construction and Building Materials, vol. 506, 17 Dec. 2025, p. 144896, www.sciencedirect.com/science/article/pii/S0950061825050482

56 Buttlar, William, Founding Director of the Missouri Center for Transportation Innovation, personal interview. 11, Nov. 2025

57 National Academies of Sciences, Engineering, and Medicine. *Recycled Plastics in Infrastructure: Current Practices, Research Needs, and the Path Toward Innovation.* The National Academies Press, 2023, p. 3.

58 Buttlar, William Founding Director of the Missouri Center for Transportation Innovation, personal interview. 11, Nov. 2025

59 Duan, Yufei, et al. "Assessment of Microplastics Production from Waste Plastics-Modified Asphalt Pavement." *Resources, Conservation and Recycling,* vol. 202, 2024, p. 107329, doi:https://doi.org/10.1016/j.resconrec.2023.107329.

innovative asphalt materials. Finally, infrastructure owners, contractors, and operators tend to rely on materials with well-understood behaviors, so new materials often require additional engagement and communication, which demonstration projects and targeted industry outreach can help address.

Another key consideration for implementing PCRP in roadway infrastructure is the role of specifications and standards. While NYC will likely need to develop its own standards (which must receive state approval), several states have already drafted specifications for plastic-modified pavements. These can be consulted and adapted, but must address formulation, dosage, method of incorporation, structural performance, and recyclability at end-of-life. A general project pipeline would likely proceed as follows: (1) lab testing, (2) field demonstration, (3) draft specifications (drawing on existing state models), and (4) industry feedback and comment. It is recommended that the City support a multiyear field testing program to evaluate environmental impacts, long-term service life, and end-of-life recyclability.

LIMITATIONS OF THIS REPORT

Although this analysis is grounded in the NAS, several limitations shape the scope of its conclusions. Most of the evidence available to the NAS comes from laboratory studies or small pilot projects rather than long-term field evaluations. As a result, core questions about durability, structural performance under real traffic and climate conditions, environmental life-cycle impacts, and RAP recyclability remain unresolved. The report also highlights the uneven quality and availability of recycled plastic feedstocks, as well as the lack of standardized specifications for processing or certifying these materials. Because these gaps cannot yet be addressed through consistent field data, neither the NAS nor this analysis can draw definitive conclusions about performance or feasibility beyond controlled test settings.

Additionally, the Commonwealth of Pennsylvania did not respond to requests for information, which limited the comparative value of the case study review. Furthermore, existing plastic-modified asphalt mixtures used in domestic and international projects are protected by patents or commercial confidentiality. Proprietary additives, including the product used in the Staten Island pilot, do not disclose key details such as composition, additive ratios, or processing requirements. Because mixture designs cannot be independently examined, this report cannot evaluate whether these products align with best practices identified in the NAS report or how they compare to conventional polymer-modified binders currently used in NYC.

Finally, this report has been prepared by a team of graduate students from NYU Wagner's MPA in Public and Non-Profit Policy Analysis program, working within a single academic semester and without expertise in engineering or materials science. The team's strengths lie in policy and regulatory analysis, rather than asphalt chemistry or pavement mechanics, which means the project relies on interpreting existing research rather than generating its own technical findings. The aforementioned time constraints also limited the ability to gather primary data or conduct additional stakeholder interviews. In several instances, publicly available information or proprietary restrictions narrowed the scope of what can be assessed. Collectively, these factors support a policy-oriented analysis of whether and how recycled plastics can be implemented into city infrastructure. They cannot independently validate technical performance or resolve the scientific uncertainties identified in the NAS report.

CONCLUSION

This literature review finds that the potential benefits of incorporating PCRPs into NYC's roadway asphalt are currently not supported by sufficient scientific, environmental, or operational evidence to justify their broad adoption. While the concept aligns with NYC's circular economy goals and presents an appealing pathway for diverting low-value plastics, the existing research does not clearly prove any performance benefits or verified environmental advantages when compared to conventional asphalt mixtures. As a result, environmental risks related to microplastic generation, chemical release, air emissions, and the recyclability of reclaimed asphalt pavement have also not been sufficiently evaluated. Moreover, feedstock purity and supply consistency pose practical constraints for any recycling system, and economic claims associated with material substitution require more rigorous analysis to determine their validity.

For NYC, the lack of evidence proves to be an opportunity. As the PCRPs would be supplied by DSNY, the key feedstock issue that other jurisdictions have struggled with will need to be resolved. Indeed, NYC's waste stream contains polymers that could serve as suitable inputs for PCRP-modified binder, and NYCDOT's asphalt plants have the technical capacity to test controlled formulations. Further, NYC's climate legislation and procurement frameworks create incentives for alternative materials, provided they meet performance and environmental standards. Together, these conditions suggest that it is appropriate to support research that evaluates whether PCRP-modified asphalt has the purported gains. If preliminary findings are positive, this knowledge can be transferred into pilot projects that allow for long-term field performance evaluations to confirm the aforementioned findings before scaling is adopted.

For now, the evidence merely shows that PCRP-modified asphalt remains limited to controlled pilots that aim to cover the outstanding knowledge gaps regarding economic, environmental, and performance aspects.

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William Buttlar, PhD, Founding Director, Missouri Center for Transportation Innovation

ABBREVIATIONS

BABA - Buy America/Build America Act

BUDs - Beneficial Use Determinations

CEQR - City Environmental Quality Review

DDC - New York City Department of Design and Construction

DSNY - New York City Department of Sanitation

EPA - United States Environmental Protection Agency

EPD - Environmental Product Declaration

FHWA - Federal Highway Administration

GHGs - Greenhouse gases

HDPE - High-density polyethylene

LDPE - Low-density polyethylene

LLDPE - Linear low-density polyethylene

MM - Materials Method

MPA - Master of Public Administration

MR8 - MacRebur MR8 proprietary plastic additive

MoDOT - Missouri Department of Transportation

NAS - National Academies of Sciences, Engineering, and Medicine (Consensus Study Report on Recycled Plastics in Infrastructure)

NRS - National Recycling Strategy

NYC - New York City

NYCDEP - New York City Department of Environmental Protection

NYCDOT - New York City Department of Transportation

NYCRR - New York Codes, Rules and Regulations

NYS - New York State

NYSDEC - New York State Department of Environmental Conservation

NYSDOT - New York State Department of Transportation

NYU - New York University

PCRP - Post-consumer recycled plastic

PET - Polyethylene terephthalate

PFAS - Per- and polyfluoroalkyl substances

PG - Performance Grade (asphalt binder grade)

PP - Polypropylene

R&D - Research and development

RAP - Recycled asphalt pavement

RCRA - Resource Conservation and Recovery Act

RTR - Recycled tire rubber

SWMP - Solid Waste Management Plan

US - United States

USDOT - United States Department of Transportation

eLCA - Environmental life-cycle assessment