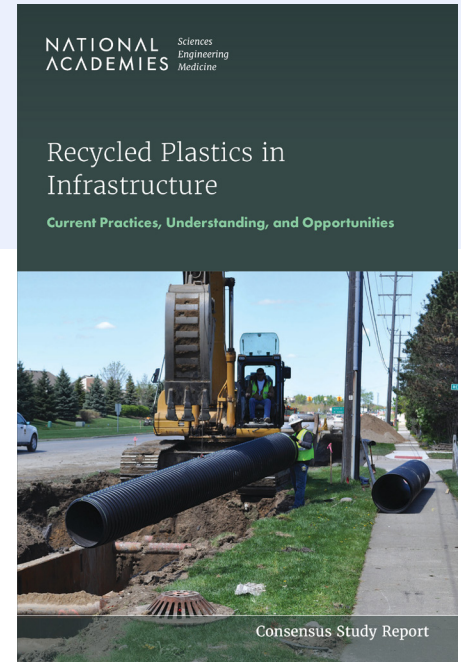


Recycled Plastics in Infrastructure

Current Practices, Understanding, and Opportunities

Plastics are ubiquitous in modern society. As synthetic materials designed for specific end applications, plastics offer unique qualities that make them materials of choice for many products. These advantages, however, also have contributed to the growing use of plastics for short-life, single-use applications that has led to marked growth in plastics waste, much of it ending up in landfills and litter. Less than 10 percent of plastics waste is recycled annually in the United States. Recycling of plastics for infrastructure applications is a potential means of diverting plastics waste from landfills and litter. There is some use of recycled plastics in infrastructure materials at present, and other applications are in development. However, until more plastics waste is captured, sorted, and cleaned for secondary applications, the use of limited recycled plastics in infrastructure could divert supplies from other, higher-value uses. Assessments of the relative value of different uses for plastics waste are therefore needed along with more concerted efforts to reduce plastics waste generally and to ensure that a higher percentage of the waste stream that is produced is recycled.

At the request of Congress, a committee convened by the National Academies of Sciences, Engineering, and Medicine was asked to review the current use of recycled plastics in asphalt pavements and other transportation and non-transportation infrastructure and to identify and evaluate barriers and opportunities for using more recycled plastics for these purposes. The committee's report, *Recycled Plastics in Infrastructure: Current Practices, Understanding, and Opportunities*, identifies a number of existing and candidate



applications for the reuse of plastics in infrastructure. In particular, the report documents how five types of plastics, polyethylene terephthalate (PET), high-density polyethylene (HDPE), low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE), and polypropylene (PP) exhibit properties that can make them conducive to use in infrastructure. These plastic types are being used in drainage pipe, asphalt pavement mixes, railroad ties, and marine piles. While all of these applications have attracted a degree of commercial interest, only drainage pipe (where recycled HDPE feedstocks are being substituted for virgin plastic feedstocks) has generated significant demand from infrastructure owners. Factors inhibiting commercial interest vary by application, but include high material and installation costs, uncertainties about long-term performance and environmental impacts, general lack of familiarity with the products, and lack of historical data regarding their engineering and environmental performance.

To have commercial value for reuse in infrastructure or any other application, a recycled plastic must be able to meet the application's desired properties consistently; free of undue environmental, health, and safety risks; available in sufficient supplies on a reliable basis; cost-competitive with conventional materials; and socially acceptable and permitted under the law. Furthermore, when used in long-lived infrastructure, the recycled plastic must contribute to sustained acceptable levels of service and environmental performance when considered on a life-cycle basis.

To reduce plastics waste litter and disposal in landfills, and to capture energy and resources embodied in plastic materials, it is in society's economic and environmental interest to expand and standardize the collection of plastics waste, increase the recycling of plastics for reuse, and advance new applications for their use. Because the collection, processing, and reuse of plastics waste in the United States is affected significantly by government policies and regulations, the public sector—at the federal, state, and local levels—will need to play a prominent role in furthering these interests. However, public policy decisions about whether to place greater emphasis on the

reuse of plastics waste in infrastructure will require more information and analyses to assess economic and social benefits and costs.

The study committee was not able to establish whether infrastructure applications offer a promising avenue for the economically and socially beneficial reuse of plastics waste due to a paucity of life-cycle analysis studies as well as data on recycled plastics supply and demand and the environmental, human health, economic, and material performance of infrastructure products that use recycled plastics. The report therefore makes recommendations to the federal sponsors of the study, the U.S. Department of Transportation (USDOT) and the U.S. Environmental Protection Agency (USEPA), to support sound public policy choices through coordinated policies and investments that support research and development, pilot and field testing, and standards setting.

RECOMMENDATIONS TO THE U.S. ENVIRONMENTAL PROTECTION AGENCY

As the federal government's lead environmental agency with the primary responsibility for developing and planning the implementation of the 2021 National Recycling Strategy, USEPA is best positioned to provide the overall strategic leadership, coordination, and support for decision making through information gathering, research, and analysis. To capitalize on these capabilities, the committee recommends the following:

Recommendation 1

To promote life-cycle-based economic and environmental assessments of existing and potential new uses of recycled plastic waste, including in infrastructure, USEPA should support the research and data collection that will be required to understand and evaluate each use's potential environmental, human health, economic, and performance implications.

Recommendation 2

To support assessments of how existing and new applications of recovered plastics will affect the total demand for plastics waste in relation to supplies, USEPA should expand means for tracking and modeling

the supply of recycled plastics and the demand that is generated by different applications. These means should make distinctions about the demand for and supply of recycled plastics by quality and polymer type and account for geographic imbalances in supply and demand.

Recommendation 3

To provide specific plastics-waste-focused guidance, tools, and other support for communities and private-sector organizations, USEPA should build out the general concepts and goals of the 2021 National Recycling Strategy for improved plastics waste management and reuse. There are significant challenges and needs for all five of the major objectives of the National Recycling Strategy: (1) improve markets for recycled commodities, (2) increase collection and improve materials management infrastructure, (3) reduce contamination in the materials recycling stream, (4) enhance policies and programs to support circularity, and (5) standardize measurement and increase data collection.

Recommendation 4

To develop best practices specifically focused on next-generation plastics that are designed for recycling and reuse, USEPA should build on the tools and guidance offered in its Green Chemistry program. The tools and guidance should assist plastics manufacturers in using plastics that will satisfy the performance and quality requirements for the products in which they are used, while also minimizing adverse effects when considered on a life-cycle basis.

Recommendation 5

To explore interest in, and opportunities to bring about, the development of quality criteria and standards for recycled plastics, USEPA should take steps to encourage and facilitate more collaboration among plastics manufacturers, suppliers, recyclers, industrial, and infrastructure users. Having pledged an interest in working together and with USEPA to improve the nation's recycling system, the 380 signatories to the America Recycles Pledge may be early candidates for the creation of a community of practice that collaborates on the development and introduction of such quality standards as well as processes for verifying and certifying compliance.

Recommendation 6

To foster a policy and regulatory environment at the federal, state, and local levels that aligns with the goal of increasing the supply of high-quality recycled plastics that can be used in infrastructure and other applications, USEPA should work with members of the community of practice to identify specific policies and regulations that have been shown, or hold promise, to support and incentivize plastics recycling in an efficient and equitable manner, including (a) the use of processes for managing plastic waste, (b) the establishment of quality standards and certification processes for materials with recycled plastic content, and (c) the development and use of next-generation plastics that are more amenable to recycling.

Recommendation 7

To leverage federal government capabilities, USEPA should lead in strengthening interagency coordination of federal agencies, including USDOT, U.S. Department of Energy, National Science Foundation, National Institute of Standards and Technology, and the U.S. Army Corps of Engineers, that have expertise, interest, and research capabilities related to plastics waste recycling and use.

RECOMMENDATIONS TO THE U.S. DEPARTMENT OF TRANSPORTATION

USDOT, through its research and funding efforts and other support of state transportation projects, is well positioned to advance research, field testing, and standards development for use of recycled plastics for infrastructure applications in the transportation domain across multiple modes. To capitalize on these capabilities, the committee recommends the following:

Recommendation 8

To enable more conclusive assessments of the practicality, potential side effects, and life-cycle cost and performance implications of adding recovered plastics from waste to asphalt pavement formulations, USDOT and the Federal Highway Administration should build on existing efforts that are under way to support a multiyear field testing program to assess the environmental and health impacts, overall service life, and effects of plastics additives on the use and recyclability of the asphalt pavements.

Recommendation 9

To identify the research and field testing that would be needed for the potential future development of standards, specifications, and design guidelines for use of recycled plastics in asphalt pavements and other infrastructure applications, USDOT should work with the states, in collaboration with the American Association of State Highway and Transportation Officials, local transportation agencies, and other standards-setting organizations.

Recommendation 10

With the long goal of developing applications of recycled plastics in infrastructure that are viable and

have economic, societal, and environmental benefits, USDOT should, with involvement of the modal agencies, inventory all current and prospective transportation applications of recycled plastics, assess their likelihood (in conjunction with USEPA and the recommended interagency working group) of having a significant impact on plastics waste reduction, and try to understand the factors that may be slowing or impeding their development and use and how these factors could be addressed to increase marketplace demand in infrastructure industries for recycled plastics where appropriate.

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FOR MORE INFORMATION

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