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New York State S1464/A1749:

The Packaging Reduction and Recycling Infrastructure Act

Final Report

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EXECUTIVE SUMMARY

In 2025, New York State generated 3.8 million tons of packaging waste (Gitlitz, 2025). Once discarded, packaging waste enters the waste management system, where it is sent to receptors such as landfills, incinerators, and chemical recycling centers. At these facilities, packaging waste degrades, disseminating chemicals and microplastics into the surrounding environment. Once in the natural environment, these pollutants are transported through soil, water, and air, infiltrating deeper into local ecosystems and negatively impacting human and environmental health (Christensen et al. 2001).

To limit waste-related pollution, New York needs to reduce the volume of waste managed by the state. An effective approach adopted by other states is the idea of extended producer responsibility (EPR). EPR is a policy approach that shifts the financial and operational responsibility of waste management from the municipalities to the producers and manufacturers of the waste. This responsibility is achieved through eco-modulated fees that encourage producers to reduce the volume of packaging waste they create by improving recyclability and limiting superfluous packaging.

New York Senate Bill 1464, Assembly Bill 1749, The Packaging Reduction and Recycling Infrastructure Act (PRRIA), aims to address the issue of packaging waste by establishing an EPR system to reduce the volume of waste (New York State Senate Bill 2025-S1464A). Through eco-modulated fees, phased reduction targets, packaging content standards, and toxic chemicals bans, the bill aims to reduce waste related pollution at the source, addressing environmental and human health issues and alleviating the financial burden carried by municipalities.

This report examines the bill by detailing its provisions, evaluating the environmental and human-health issues involved, outlining its proposed solution, and identifying the major challenges to implementation. By the end, readers will have a clear understanding of the problem the bill addresses and the reasoning behind its proposed approach.

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INTRODUCTION

I. INTRODUCTION

New York State has a waste management problem. According to the New York State Department of Environmental Conservation (NYSDEC), in-state landfills are expected to reach capacity in 16-25 years (Department of Environmental Conservation, 2020). What's more, individual production of Municipal Solid Waste is on the rise, aligning with national consumption trends (New York State Department of Environmental Conservation 2023, Hoke et al., 2024).

Single-use packaging materials, which function solely to enclose the product and which have no subsequent function after removal, collectively make up about 20% of total municipal solid waste (PRRIA, p. 3; New York State Department of Environmental Conservation, 14). These packaging materials contain toxic chemicals that are introduced into the environment upon disposal. These toxic substances have a variety of associated health implications for people, including reproductive damage, increased cancer risk, and respiratory illness (Goswami et al., 2024).

The impact of waste related pollution is felt in communities across New York State. In Brookhaven, Long Island, an underground contamination plume of roughly 8,000 feet has spread from a local landfill into the groundwater beneath homes and a national wildlife refuge. As a result, local groundwater contains elevated levels of per- and poly-flouralkyl substances (PFAS) and 1,4-dioxane above New York State standards. Exposure to these chemicals compromises reproductive health, impairs brain development, and increases the risk of cancer, highlighting how waste related pollution translates into a public health hazard.

To address these problems, New York State legislators have proposed the Packaging Reduction and Recycling Infrastructure Act, which seeks to reduce packaging waste at the source, ban toxic chemicals, and fund the waste management system.



BILL OVERVIEW

II. BILL OVERVIEW

New York State Senator Peter Harckham (D) introduced The Packaging Reduction and Recycling Infrastructure Act, S1464/A1749, during the 2025–2026 legislative session, with Assemblymember Deborah Glick serving as the bill's Assembly sponsor. Senator Harckham described the Packaging Reduction and Recycling Infrastructure Act (PRRIA) as "the strongest Extended Producer Responsibility legislation in the country," emphasizing the bill's goal of reducing waste, plastic pollution, and exposure to toxic substances (Harckham, 2024).



S1464 Sponsored by New York Senator Peter Harckham (D)



A1749 Sponsored by New York Assemblymember Deborah Glick (D)

Summary

PRRIA was introduced to address the growing environmental and economic challenges associated with managing packaging waste (NY State Senate Bill S1464A, 2025). The bill…

- Establishes an Extended Producer Responsibility (EPR) program that shifts the financial and operational responsibility for managing packaging waste from municipalities and consumers to producers.
- Defines packaging as a material that can be both flexible, foam, or rigid in form including paper, cardboard, plastic, glass, metal and is used for containment, transport, protection, handling, presentation and distributed for sale in New York State, with exemptions.

- Requires covered producers to register with a designated Packaging Reduction and Recycling Organization (PRO), which will oversee the implementation of the program and ensure compliance.
- Establishes a nineteen-member Advisory Council, appointed by the New York State Department of Environmental Conservation, with representatives from key stakeholder groups. The Council is charged with reviewing the PRO's implementation plan and providing recommendations to the NYSDEC regarding its approval.
- Requires covered producers to progressively reduce the amount of packaging waste they generate, ultimately achieving a 30% reduction from each producer's baseline year within 12 years of implementation
- Prohibits the use of ten classes of toxic chemicals in packaging materials, which are orthophthaates, bisphenols, per- and polyfluoroalkyl compounds (PFAS), heavy metals, benzophenone, formaldehyde, toluene, antimony, and polyvinyl chloride.
- Establishes minimum recycled-content and recyclability requirements (S1464, 2025).

Overall, PRRIA aims to reduce packaging waste at its source while shifting the cost of packaging waste management away from municipalities and consumers. By requiring covered producers to finance and participate in the management of packaging waste, the bill intends to incentivize more sustainable packaging design, increase recycling rates, and reduce municipal waste management costs to better protect public health and the environment.

Preceding Legislation

PRRIA serves as a successor to the New York Senate Bill S4246D, which was introduced in the 2023–2024 legislative session and required producers of packaging materials to register with a designated organization responsible for developing a statewide packaging reduction and recycling plan. S4246D introduced core components of the current bill, including producer registration requirements, program planning mandates, and the creation of a centralized organization responsible for implementation. In contrast to S1464, the previous bill had a 50% reduction target.

S1464/A1749 reintroduces and expands upon this earlier framework by adding explicit reduction targets, expanding restrictions on toxic substances, and further detailing the funding and enforcement mechanisms. This bill passed the State Senate on May 28, 2025, and was sent to the Assembly. On January 7, 2026, after failing to advance in the Assembly, the bill was returned to the Senate where it is currently on the floor calendar. On May 21, 2026, it advanced to a third reading. On June 05, 2025, the bill was sent to the Assembly Rules Committee for further review.



THE PROBLEM

III. THE PROBLEM

Introduction

There are many challenges associated with waste management, from collection to final disposal. It is an intensive process that disproportionately harms communities who host waste processing and disposal sites. As the volume of waste increases, so does the stress on the management system and surrounding communities. Waste processing and its pollution byproducts increase local environmental and human health hazards, such as respiratory illness from air pollutants and exposure to toxic chemicals through contaminated water, compromising the health of the community. Pollution from waste management persists in the environment years after its initial disposal, and transports further into the regional ecosystem through environmental media like soil, water and air. The persistence and dispersion of waste pollutants amplify its environmental and human health impact, and substantiate the need to reduce and limit waste.

The Toxicity of Packaging Waste

Toxic Substances Banned by PRRIA

PRRIA seeks to ban ten classes of toxic chemicals, including:

- orthopthalates
- bisphenols
- per- and polyfluoroalkyl compounds
- heavy metals
- benzophenone, and
- polyvinyl chloride

These toxic compounds are absorbed, transmitted, and released throughout the lifecycle of plastic packaging (Stevens et al., 2024; Rafa et al., 2024).

PFAS

Per- and polyfluoroalkyl substances (PFAS) are human-made compounds used in many types of food packaging for their grease-proof and

waterproof properties (US Food and Drug Administration, 2026). The chemical structure of PFAS is largely hydrogen atoms connected to a long carbon chain, with additional hydrogen atoms substituted for fluorine atoms. The fluorine-carbon bond is incredibly strong and does not break easily in the environment, earning PFAS the nickname “forever chemicals,” as can persist in the environment for decades or longer (National Institute of Environmental Health Sciences, 2026). This chemical structure also allows PFAS compounds to interact easily with human and animal bodies, acting as an endocrine disruptor (Mokra, 2021).

BPA

Bisphenol A (BPA) is used in the manufacturing of various packaging materials. It is frequently used in plastic bottles and liners of metal cans to minimize corrosion of metal and prevent migration of metal into food (US Food and Drug Administration, 2018). Since the chemical structure of BPA is very similar to estradiol, the major female sex hormone, it has the potential to interact with a range of hormone receptors in humans and animals (MacKay & Abizaid, 2018).

Orthophalates

Orthophthalates are used to make plastics, such as polyvinyl chloride, more pliable and strong during manufacturing. Like BPA, it also has potential impacts as an endocrine disruptor (US Food and Drug Administration, 2026).

Heavy Metals

Heavy metals, such as lead, cadmium, and mercury, have been used in packaging for coloring plastic, thermal and UV stabilization in plastics, and pigments in ink (van Putten, 2011). Heavy metals can accumulate in human bodies and cause negative health impacts via their capacity to interfere with the body’s antioxidant defense mechanism (Jomova et al., 2024).

PVC

Polyvinyl chloride (PVC) is a synthetic polymer that is often mixed with plasticizers to make transparent or translucent packaging (brownpackaging, 2024). On its own, PVC is not very versatile and requires additives to make it more suitable for packaging purposes (Campisi et al., 2025). Research has shown that it is these same additives that make PVC products harmful to human health. For instance, orthophthalates and BPA are often added to PVC products, and are considered potential endocrine disruptors (Allsopp & Vianello, 2000).

What are plastics?

Plastics are made of polymers, which are assemblages of synthetic macromolecules formed through the polymerization of monomers sourced from fossil-based materials. Polymerization is the process in which chemical reactions unite individual, repeating monomers into chained polymers. Plastics are frequently used in packaging material because they are cheap, light, and versatile. Chemicals are used throughout the manufacturing process of plastic to facilitate polymerization, and to manipulate properties like color and malleability (United Nations Environment Programme and Secretariat of the Basel, 2023).

Microplastics

Once plastics are discarded, they can end up in landfills. Solar radiation combined with oxygen fuel chemical reactions that break down plastics into microplastics, or plastic particles smaller than 5 mm. Nanoplastics are plastics that degrade even further to the submicron level. The threats that plastics pose are magnified by their diversity in size and shape, which also influences their capacity to absorb and transmit contaminants and infiltrate into more environments (Bel Hassen, 2025; Gupta, 2025).

▼ **Simplified illustration of the production of plastics**

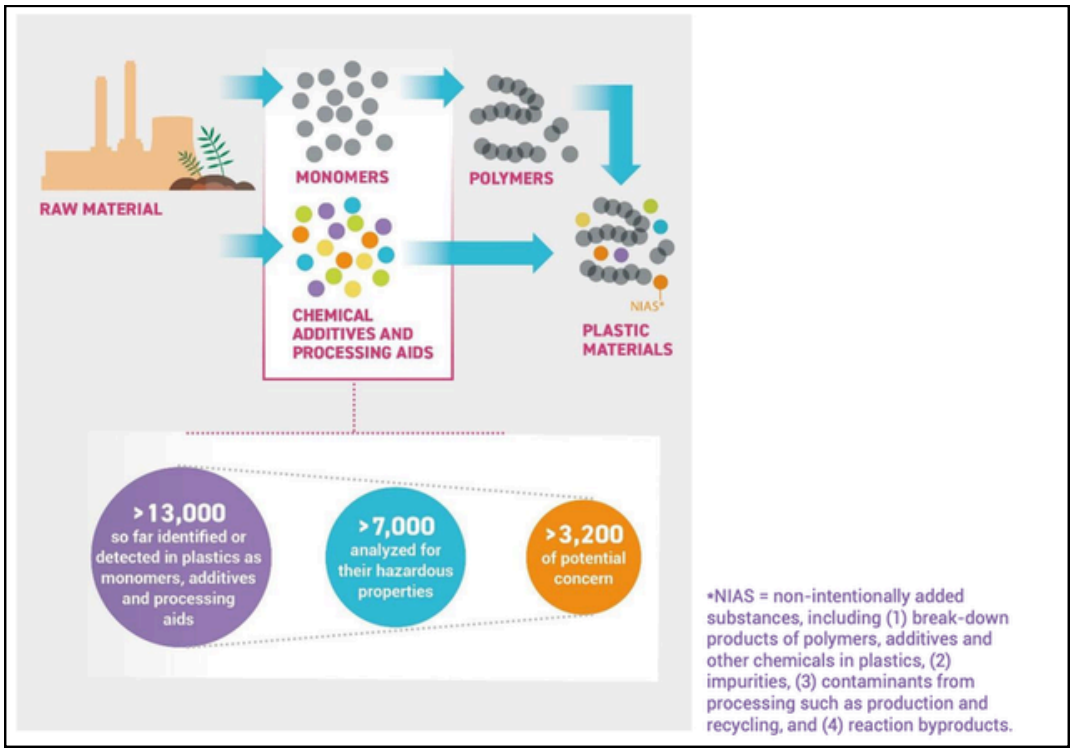


Image from the United Nations Environment Program.

Environmental Degradation and Packaging Waste

Air Quality and Global Warming

Most air pollutants associated with packaging waste come from incinerators that combust municipal waste. Incinerators function by burning waste at high temperatures to break down materials into simpler, smaller compounds and gases (Chemical Volume Reduction Methods in Waste Management, 2025). Through this process, incineration can reduce the volume of waste by up to 90% (ScienceDirect, n.d.). The remaining byproducts are bottom ash, which is coarse, non-combustible residual that settles at the bottom of the incinerator, and fly ash, which is fine, powdery residual that contains high concentrations of heavy metals (*What Are the Differences between Bottom Ash and Fly Ash from Incineration?*, 2025). When improperly managed, these byproducts pollute the environment. This is a real problem posed by large-scale facilities such as the Corvanta Hempstead municipal waste combustion facility in Nassau County, New York. Corvanta, produced 600 to 650 tons of ash daily, violating its operating permit and compromising the health of the surrounding community (New York State Department of Environmental Conservation, 2024).

Landfills are another major source of pollution. The anaerobic decomposition of organic material emits a combination of approximately 50% methane and 50% carbon dioxide (US EPA, 2025). Methane and carbon dioxide are greenhouse gases, heat trapping vapors, that accumulate in the atmosphere. There is greater concern with methane emissions because its atomic geometry gives it a higher heat potential making it up to 80 times more powerful than carbon dioxide as a heat-trapping gas (Krol, 2023; Moseman, 2025).

Water Quality

As waste in landfill decomposes, rain and other sources of moisture pick up microplastics and pollutants, creating leachate. Leachate makes its way through soil as runoff, eventually making its way to a stream, river, or other parts of a watershed. Packaging product debris including foam (50%), beverage bottles (29%), and food packaging (5%) have all been found in marine samples within the New York State water system (Polanco et al., 2020). Sampling in the Hudson River watershed, including along the length of the Mohawk River to the Erie Canal, has revealed the presence of microplastic particles (Cockburn & Garver, 2017). Additionally, microplastics have also been found throughout the surface waters of the Lower Hudson River Estuary in New York (Polanco et al., 2020).

Wildlife

Several kinds of wildlife are threatened by packaging waste, specifically plastic packaging waste. Runoff from landfills containing toxic leachate and microplastics enters local waterways, and eventually, the ocean. In water, microplastics can be suspended in the water column, float on the surface, or sink to the bottom; as a result, aquatic species often mistake microplastics for food (Benson 2022). Ingestion of microplastics in marine species leads to internal injuries, toxicity, intestinal issues, and malnutrition. Since microplastics carry additional contaminants, marine organisms can spread antibiotic-resistant genes and pathogens. Additionally,

marine species face increased risk of starvation from microplastics that take up physical space in marine species' stomachs and give a false sense of fullness (Gupta, 2025).

Microplastics never fully degrade and thus remain in digestive tracks of organisms across the food web, or bioaccumulate. Accumulation of microplastics in predator organisms from prey that contain microplastics is called biomagnification, and could be lethal to the predator organisms (Benson 2022). Microplastics can be found in seabirds that consume fish, as seen in the plasticosis, a fibrotic disease that originates from plastic exposure, found in seabird stomach tissue (Gupta 2025).

▼ Diagram visualizing the biomagnification of mercury, one of the heavy metals banned by this legislation.

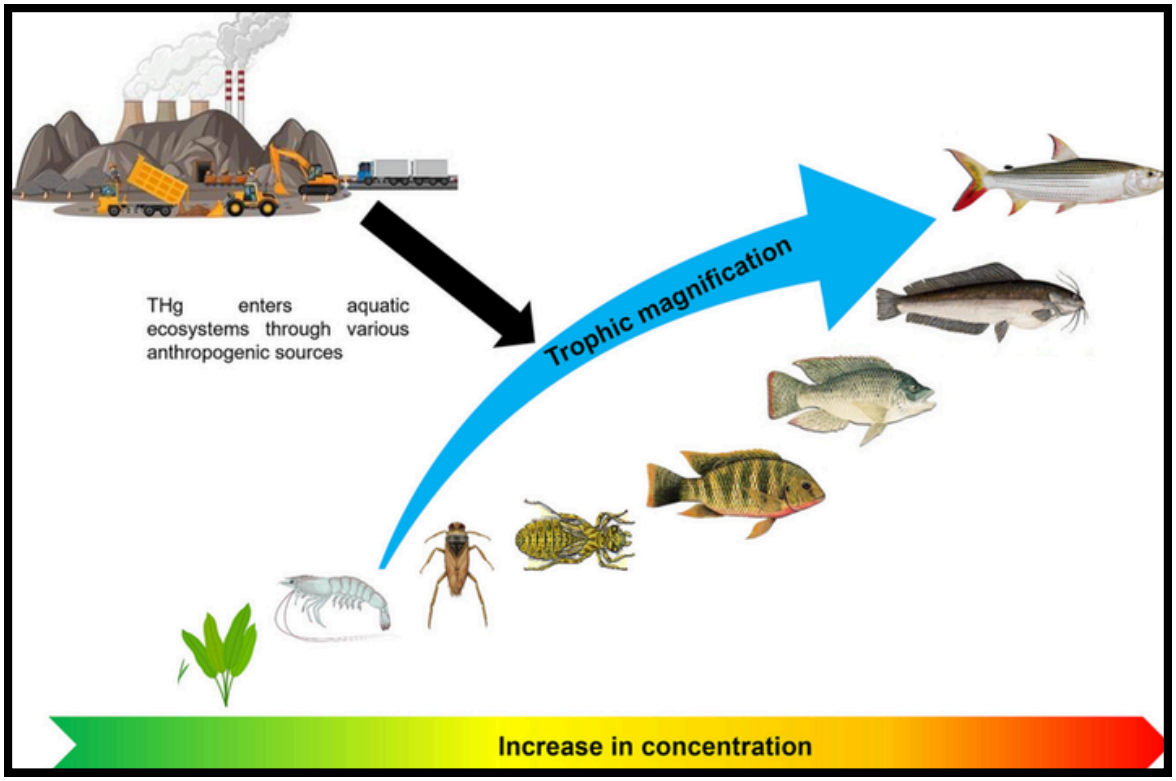


Image from Science of the Total Environment Journal (2023).

Human Health Implications

Microplastics in Packaging Waste

Microplastics pose a unique set of health risks. There are 3,200 chemicals associated with plastics that are a significant threat to human health and/or the environment. Plastics release BPA, phthalates, PFAS, dioxins, furans, and heavy metals during their production, use, and degradation. These chemicals can cause cancer, endocrine disruption, immune system disruptions, respiratory issues, and other chronic illnesses in humans (Abahussain, 2025; United Nations Environment Programme and Secretariat of the Basel, 2023).

The process by which ultraviolet radiation from the sun and oxidation from the air degrade plastic is irregular, resulting in coarse, uneven textures that allow for other molecules to easily attach themselves to microplastics. The jagged shape of microplastics is one of the reasons they are so dangerous; they carry various contaminants such as heavy metals, persistent organic pollutants, pathogens, antibiotics, endocrine-disrupting chemicals (Gupta, 2025). The threat posed by microplastics is not only in the plastics themselves, but in the harmful substances they carry. Endocrine-disrupting chemicals can decrease fertility in men and lead to neurobehavioral disorders in women and children (United Nations Environment Programme and Secretariat of the Basel, 2023).

It is estimated that the average person consumes 5 grams, or a credit card's worth, of plastic a week (Gupta, 2025). Once microplastics are ingested, they can permeate cell membranes and cause oxidative stress and inflammation. The magnitude of microplastics' impact is dependent on its chemical composition, size, shape, and surface charge. These plastics have also been linked to higher mortality rates from cardiovascular and respiratory diseases and lung cancer (Vethaak, 2021).

Air Pollutants

Incineration, or burning, discarded packaging waste leads to atmospheric pollution and human inhalation of said pollutants. Incineration releases two types of ash: fly ash and bottom ash. Fly ash and bottom ash both contain microplastics and toxic heavy metals (Cr, Cu, Zn, Pb). Acid rain causes heavy metals to leach more into bottom ash than fly ash, making bottom ash more dangerous to human and environmental health (Shen, 2021). Exposure to and prolonged inhalation of combustion-related pollutants, which are associated with incineration, have been correlated with increased risks of cardiovascular disease, aggravated respiratory conditions such as asthma and emphysema, as well as headaches, nausea, skin irritation, and broader damage to the nervous system. Among the most toxic dioxins emitted from incineration is 2,3,7,8-tetrachlorodibenzo-p-dioxin, a persistent organic pollutant associated with cancer, neurological damage, and disruptions to reproductive, thyroid, respiratory, and immune system function (Verma et al., 2016).

▼ Exposure routes to chemicals and associated health impacts

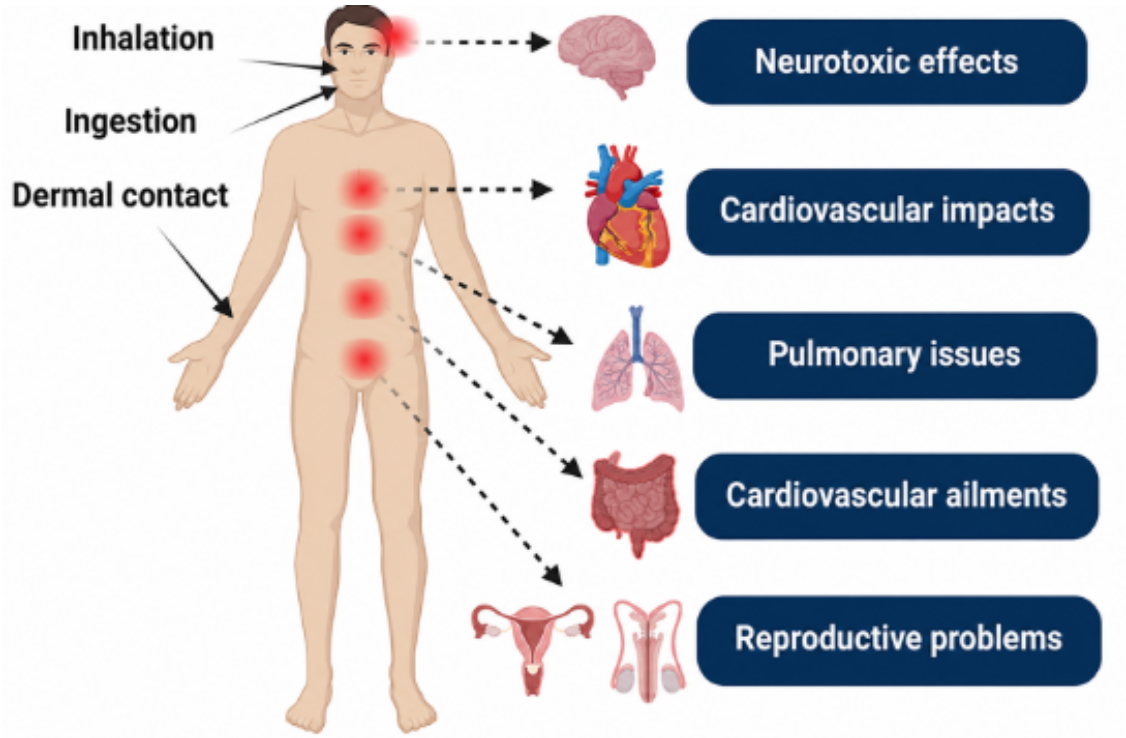


Image modified from Goswami et al. (2024).

Proximity to Landfills

Toxicological health impacts of landfills are difficult to quantify given the inherent uncertainties that come with attributional studies in epidemiology. Thus, it is difficult to attribute an increase in health issues to proximity to landfills given how many compounding variables and environmental factors there are that impact human health. There are, however, case studies and correlations between adverse human health effects and proximity to landfills, including reports of low birth weight, birth defects, and certain types of cancers. Some of the most common reported symptoms near landfills include fatigue, sleepiness, and headaches (Vrijheid, 2000).

The gas emitted by landfills can also have negative effects on the health and well-being of nearby community members. Landfill gas emissions contain foul-smelling compounds which, inhaled for prolonged periods, have been associated with physical symptoms like headaches, eye irritation, respiratory problems, nausea, vomiting, and emotional distress (Palmiotto, 2014).

The Seneca Meadows landfill has raised concern from residents about the odor and leachate contamination. ▼



Image from The New York Times, *"Why a Landfill as Tall as the Statue of Liberty May Rise Even Higher"*.

Waste Management

The Municipal Burden of New York State's Waste Management Crisis

The US produces approximately 265.3 million tons of garbage per year. New York State produces nearly 16% of the national total (Horrocks, J. et al., 2025). In 2018, New York State generated 42.2 million tons of total solid waste, of which municipal solid waste comprised 17.9 million tons. Annually, New York State recycles less than 20% of its total waste, combusting 15%, sending 39% to the state's shrinking landfills, and paying to export the remaining 27% for disposal out of state (NYS Department of Environmental Conservation, 2023).

According to the New York State Comptroller's office, local governments spent $917 million on "garbage related activities" in 2017 alone, and that is excluding New York City (Office of the New York State Comptroller, 2018, p.1). In the Fiscal 2025 Executive Plan for New York City, over half a billion dollars was budgeted for waste disposal (Singh, T., 2024). In response to the growing financial burden placed on municipalities and taxpayers as a result of increases in municipal trash , the New York State Department of Environmental Conservation has declared a goal of 85% reduction in landfilling and combustion by 2050 as part of the State's Waste Vision Management for 2050 plan (NYSDEC, 2023).

The Limits of Recycling

In order to reduce the quantity of waste sent to landfill or incineration, PRRIA aims not only to decrease waste production, but also to increase the amount diverted to reuse or recycling. Unfortunately, plastic recycling is a complex process. Combined, plastic and paper represent approximately 50% of all municipal solid waste in the state; plastics alone represent 15%. According to the 2023 New York State Solid Waste Management Plan, "new packaging features can pose challenges for recycling facilities that cannot recover and market many of these new types of packaging," meaning without technological development or legislative intervention, the amount of plastic going to landfill and combustion will likely increase. Currently, the plastics category encompasses a variety of chemical compositions, expressed in varying physical structures. Many of these are not only incompatible with current

cycling treatments, but also are not even “designed to be compatible with recycling facility infrastructure” (NYSDEC, 2020).

Thus, while 20% of all plastic waste can be recycled, only 4% of US plastic waste (including both plastic packaging and plastic durable goods) gets recycled (Organisation for Economic Co-operation and Development, 2032, Table 1). That small quantity of plastic diverted from landfill and incineration undergoes the process of “pyrolysis,” the technical term for chemical recycling, at dedicated chemical recycling plants. Unfortunately, chemical recycling generates more emissions than new production would (Sharp, R. et al., 2025). The economic costs of plastic recycling are also frequently greater than the price of generating new plastic, and the cost of plastic recycling is not limited to the operational charges for pyrolysis. Transporting, sorting, breaking down old plastics, and remedying contamination problems caused by poorly cleaned or sorted plastic items result in an economic toll. Furthermore, recycled plastic does not always result in usable new plastic, and degraded plastic outputs must also be included in the accounting of recycling costs (Sullivan, L. 2020).

Consumer Burden

Producers foist the costs of packaging materials on to the consumer at point of sale and, for imported goods enswathed in secondary or tertiary packaging, once more in the form of shipping charges. However, these initial, upfront expenses are not the only costs passed on to the consumer. For New Yorkers with privately contracted waste management services, the charges for waste removal, sorting, and processing are paid directly as fee-for-service. For residents who have municipal sanitation departments to manage waste, their taxes subsidize the collection, transportation, and disposal of their packaging waste. Thus, whether through municipally provided services or via private contractors, consumers ultimately bear the costs of both creation and disposal of their packaging waste (NYSDEC, 2020).

Additional Costs: Transportation

While the lightweight nature of most packaging waste means transport vehicles weigh less and consume less fuel than vehicles with heavier products, the fuel use aggregates as production and usage increase (Stegmann, P. et al.,2022). The New York State Climate Leadership and Community Protection Act, 6 NYCRR part 253, "Mandatory Greenhouse Gas Reporting" mandates waste haulers transporting municipal solid waste to landfills or combustion sites out-of-state that produce greenhouse gas emissions (GHG) in excess of 10,000 megatons per year must produce and submit third party verified emissions reports. The first of these reports will be due June 1, 2027, so specific data is not yet available (NYSDEC, 2025). Although New York State data on current waste haulage emissions are not yet publicly available, the impact can be inferred from other states' data.

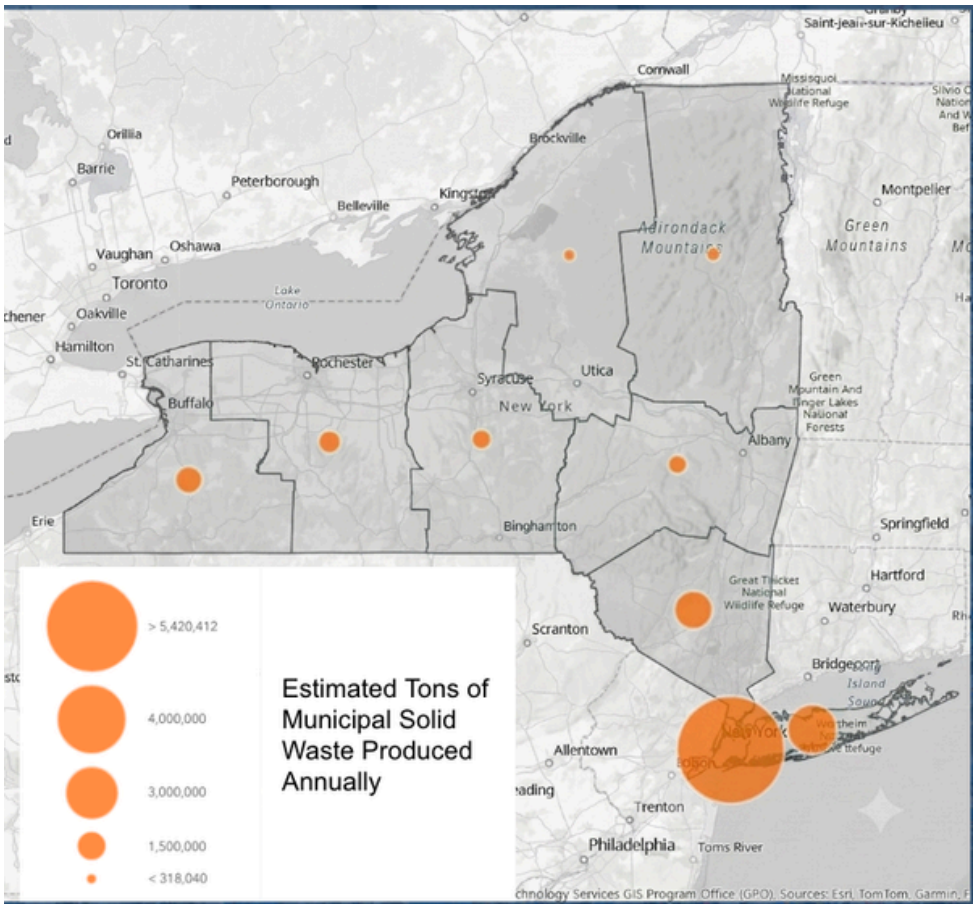
When Connecticut increased its out of state waste flow by 860,000 tons per year, the additional emissions from transporting that amount of waste approximately 407 miles to its destination were quantified as 100,000 to 150,000 metric tons of CO2 (Connecticut Department of Energy & Environmental Protection, 2023)**.** Based on the 2018 figures for New York State, a back of the envelope calculation of 27% (percent exported) of the 17.9 total tons of municipal solid waste means that 4.83 million tons of New York State municipal solid waste is exported annually (NYSDEC, 2023). Though the mileage and types of trucks used may be different from those in Connecticut, the total tonnage of New York's exported municipal solid waste is more than 5.6 times that of Connecticut's municipal solid waste. Therefore, a conservative approximation of New York State's GHG emissions from the transport of exported municipal solid waste would be at least 500,000 metric tons of CO2, and likely more.

Landfill Capacity and Waste Disposal

Landfills remain the primary destination for a large portion of New York State's municipal solid waste despite decades of investment in recycling and waste diversion programs. According to the New York State Department of Environmental Conservation (NYSDEC, 2023), New Yorkers

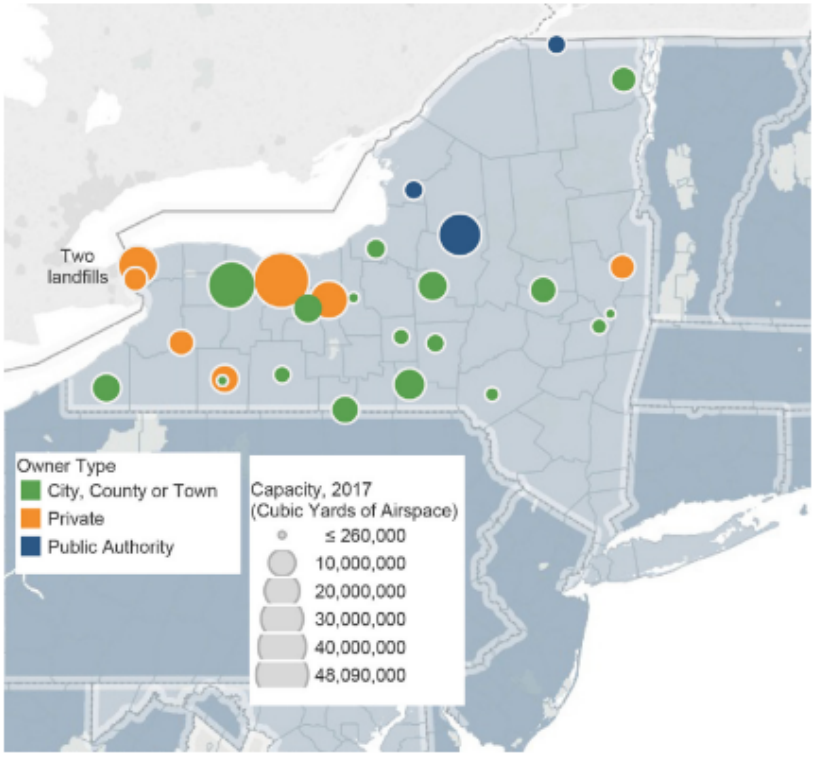
generate approximately 14 million tons of municipal solid waste each year, much of which is ultimately disposed of in landfills or incinerated.

Disposal continues to consume valuable landfill capacity while creating long-term management obligations for state and local governments (NYSDEC, 2023). The 2023–2032 New York State Solid Waste Management Plan identifies waste prevention as a priority because reducing waste generation is more sustainable than expanding disposal infrastructure (NYSDEC, 2023). These same principles are reflected in PRRIA, which proposes reducing packaging before it enters the waste stream while shifting the financial responsibility for managing packaging waste from municipalities to producers (NYSDEC, 2023).



▲ Breakdown of municipal solid waste in tons produced across New York State

Map produced using GIS. Data sourced from New York State Solid Waste Management Plan: Building the Circular Economy Through Sustainable Materials Management (2023-2032).



▲ Landfills accepting municipal solid waste in New York State and their capcity

Map from New York State Solid Waste Management Plan: Building the Circular Economy Through Sustainable Materials Management (2023–2032).

Packaging Waste Management

Packaging represents a particularly important component of New York's waste stream because most packaging materials are designed for single use and are discarded shortly after purchase (NYSDEC, 2023). Although these products often have useful lives measured in days or weeks, they may remain in landfills for decades following disposal (Tchobanoglous et al., 2002). According to Tchobanoglous et al. (2002), source reduction provides greater environmental benefits than downstream waste management because it decreases the amount of material requiring collection, transportation, treatment, and final disposal. More recently, Lazarevic and Valve (2020) argue that reducing packaging generation is an essential component of transitioning toward a circular economy because recycling alone cannot offset continually increasing material consumption. Rather than continually expanding disposal infrastructure, PRRIA emphasizes reducing packaging generation while strengthening producer responsibility throughout a product's life cycle.

Landfill capacity has become an increasing concern throughout New York. NYSDEC (2023) notes that constructing new municipal solid waste landfills has become increasingly difficult because of limited land availability, extensive urban development, and stringent environmental permitting requirements. As existing facilities approach their permitted capacity, municipalities have become increasingly dependent on transporting waste to regional landfills located elsewhere in New York or neighboring states (NYSDEC, 2023). Tchobanoglous et al. (2002) explain that transporting waste over longer distances increases disposal costs while expanding the environmental footprint associated with waste management. Similarly, Mousania et al. (2024) found that transportation can represent a significant contributor to the overall environmental impacts associated with packaging disposal, particularly in regions where landfill capacity is limited and waste must be hauled over long distances. These findings further support New York's emphasis on waste prevention as a long-term strategy for extending landfill capacity (NYSDEC, 2023).

Modern Landfills and Long Term Management

Modern landfills differ substantially from the open dumps that characterized waste disposal several decades ago. Tchobanoglous et al. (2002) describe modern municipal solid waste landfills as highly engineered containment systems designed to isolate waste from surrounding soils and groundwater. Modern facilities incorporate composite liners, leachate collection systems, groundwater monitoring wells, and landfill gas recovery infrastructure to reduce environmental impacts (Christensen et al., 2001; Tchobanoglous et al., 2002). Active landfills continue receiving waste while operating these environmental control systems under state permits. Once disposal operations cease, landfill management continues for decades because biological decomposition remains active beneath the landfill surface (Christensen et al., 2001). Consequently, groundwater monitoring and landfill gas collection remain essential components of post-closure maintenance long after a landfill has stopped accepting waste (Christensen et al., 2001).

Leachate and Groundwater Contamination

One of the defining environmental processes occurring within landfills is the formation of leachate. Kjeldsen et al. (2002) explain that leachate

develops when precipitation infiltrates through buried waste and dissolves organic matter, dissolved salts, nutrients, trace metals, and numerous anthropogenic contaminants. Its chemical composition changes as decomposition progresses, making treatment increasingly complex throughout the operational life of a landfill (Kjeldsen et al., 2002). Newer landfills generally produce leachate containing elevated concentrations of biodegradable organic matter, whereas older facilities often generate leachate characterized by higher ammonia concentrations and more persistent contaminants (Kjeldsen et al., 2002). Christensen et al. (2001) demonstrated that engineered liners and leachate collection systems substantially reduce groundwater contamination compared with historical disposal practices. Nevertheless, recent reviews emphasize that landfill leachate remains one of the most technically challenging byproducts to manage because contaminant concentrations evolve over time and treatment requirements vary among facilities (Foo et al., 2021).

▼Visualization of how leachate can reach drinking wells through groundwater contamination

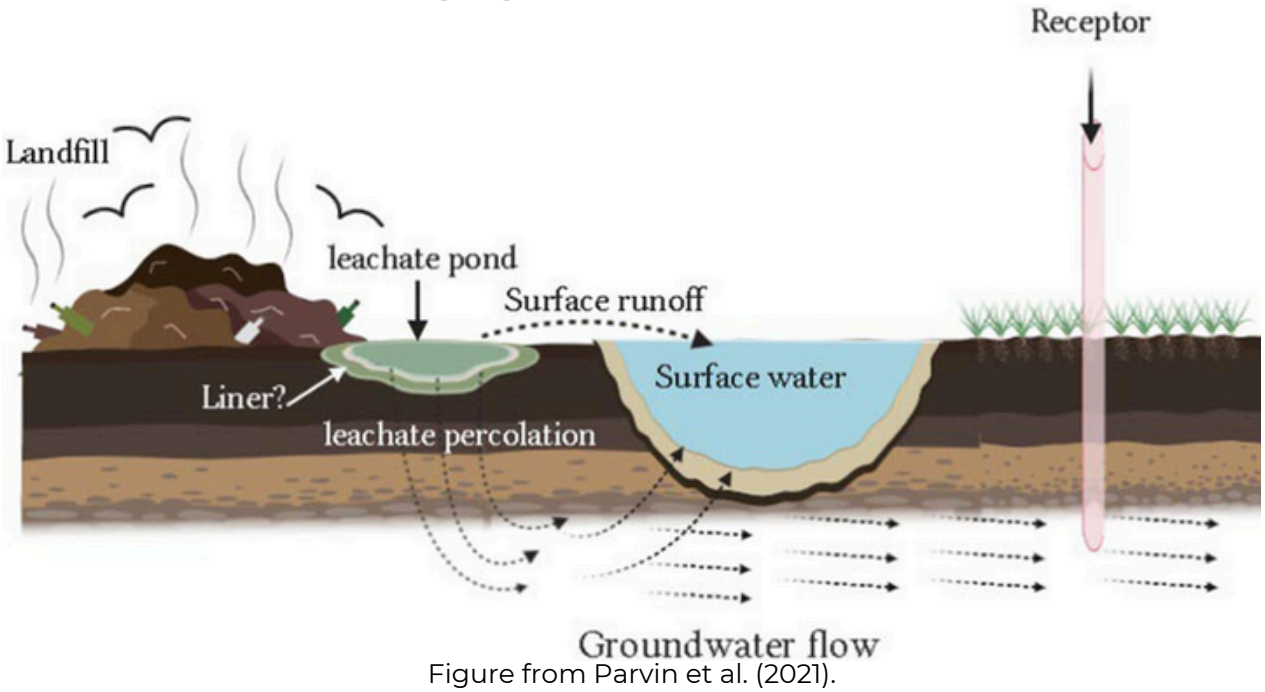


Figure from Parvin et al. (2021).

This issue has become particularly relevant in New York because collected landfill leachate is commonly transported to publicly owned wastewater treatment plants. According to the NYSDEC (2023), landfill leachate is an important component of the state's overall materials management system and requires continued oversight even after landfill closure. Investigations conducted by Riverkeeper (2024) documented that landfill leachate generated at facilities throughout New York was transported to wastewater treatment plants discharging into the Hudson and Mohawk Rivers. Public records reviewed during that investigation estimated that approximately 89 million gallons of treated landfill leachate were discharged annually into these watersheds between 2019 and 2023 (Riverkeeper, 2024). While conventional wastewater treatment effectively removes many traditional pollutants, recent studies have shown that treatment plants were not designed to remove every emerging contaminant found in landfill leachate, including PFAS and other persistent chemicals (Lang et al., 2023). Consequently, reducing the amount of packaging entering landfills through legislation such as PRRIA addresses pollution earlier in the waste management process rather than relying entirely on downstream treatment.

Methane Emissions and Climate Impacts

Landfills generate methane as microorganisms decompose biodegradable materials under anaerobic conditions. Bogner et al. (2008) explain that packaging waste, including paper products and cardboard all contribute to methane production during decomposition. Because methane possesses a substantially greater warming potential than carbon dioxide over shorter time horizons, landfill gas management has become an increasingly important component of climate policy (IPCC, 2021). Modern landfills capture a significant portion of this methane through engineered extraction systems that allow landfill gas to be flared or converted into renewable energy (Bogner et al., 2008). However, satellite observations conducted by Cusworth et al. (2022) demonstrated that fugitive methane emissions continue to occur even at facilities equipped with gas collection infrastructure, suggesting that reported emissions may underestimate actual releases. These findings reinforce that reducing biodegradable waste entering landfills remains one of the most effective long-term approaches for lowering greenhouse gas emissions associated with waste disposal.

Environmental Justice Impacts

The distribution of landfill infrastructure has raised environmental justice concerns throughout New York. Bullard (2000) argues that waste management facilities have historically been concentrated in communities with fewer political and economic resources to oppose undesirable land uses. More recent analyses by Mohai et al. (2009) found lower-income communities and communities of color experience disproportionate exposure to waste management infrastructure and other environmental hazards. Recognizing these inequities, the NYSDEC (2023) identifies environmental justice as a guiding principle within the state's Solid Waste Management Plan while emphasizing waste prevention as a means of reducing dependence on disposal infrastructure. By requiring producers to reduce unnecessary packaging and finance end-of-life management, PRRIA seeks to decrease the amount of material requiring disposal while supporting New York's broader transition toward a more circular and equitable materials economy.

Incineration

Waste incineration, often referred to as waste-to-energy (WTE), remains an important component of New York State's solid waste management system. According to the New York State Department of Environmental Conservation (NYSDEC, 2023), municipal waste combustion serves as one of the state's primary disposal methods after landfilling, particularly for communities with limited landfill access. While landfills receive the majority of municipal solid waste, combustion facilities process a significant portion of the remaining waste stream by reducing its volume while recovering energy through electricity generation (NYSDEC, 2023).

The state's 2023–2032 Solid Waste Management Plan emphasizes that long-term waste management should prioritize source reduction and recycling over both landfilling and combustion because preventing waste generation reduces environmental impacts throughout the entire waste management system.

Packaging Waste and Incineration

Packaging materials contribute substantially to the waste processed by waste-to-energy facilities because paper products, cardboard, plastics, and composite packaging frequently remain in the municipal waste stream after recyclable materials have been removed. As packaging consumption continues to increase, greater quantities of these materials require either landfilling or combustion. By decreasing the amount of packaging entering New York's waste stream, PRRIA has the potential to reduce the volume of material requiring combustion while extending the lifespan of existing waste management infrastructure (NYSDEC, 2023).

Unlike landfills, waste-to-energy facilities actively process municipal solid waste through controlled combustion. New York currently operates several municipal waste combustion facilities, including plants located in Niagara Falls, Hempstead, and Hudson Falls, while additional waste generated within New York, particularly from New York City, is transported to facilities in neighboring states such as New Jersey and Pennsylvania (New York City Department of Sanitation, 2026). In 2023, approximately one-third of New York City Department of Sanitation-managed waste was disposed of through waste-to-energy facilities, while the remaining two-thirds were transported to landfills (NYC Department of Sanitation, 2026). These interstate waste transfers illustrate that combustion remains an important component of New York's overall waste management strategy despite increasing emphasis on waste reduction.

The Incineration Process

The technical process of waste incineration differs substantially from landfill disposal. Municipal solid waste is delivered to enclosed storage bunkers before being fed into high-temperature combustion chambers, where temperatures commonly exceed 850–1,000°C to maximize combustion efficiency and reduce the volume of waste requiring final disposal (Tchobanoglous et al., 2002). Heat generated during combustion converts water into steam, which drives turbines that produce electricity for the regional power grid. Although combustion reduces the original waste volume by as much as 90%, bottom ash and fly ash remain after combustion and require disposal in permitted landfills or specialized management because these residues may contain concentrated

contaminants which can contaminate the local environment (Tian et al., 2023; Tchobanoglous et al., 2002).

▼ Diagram showcasing the incineration process

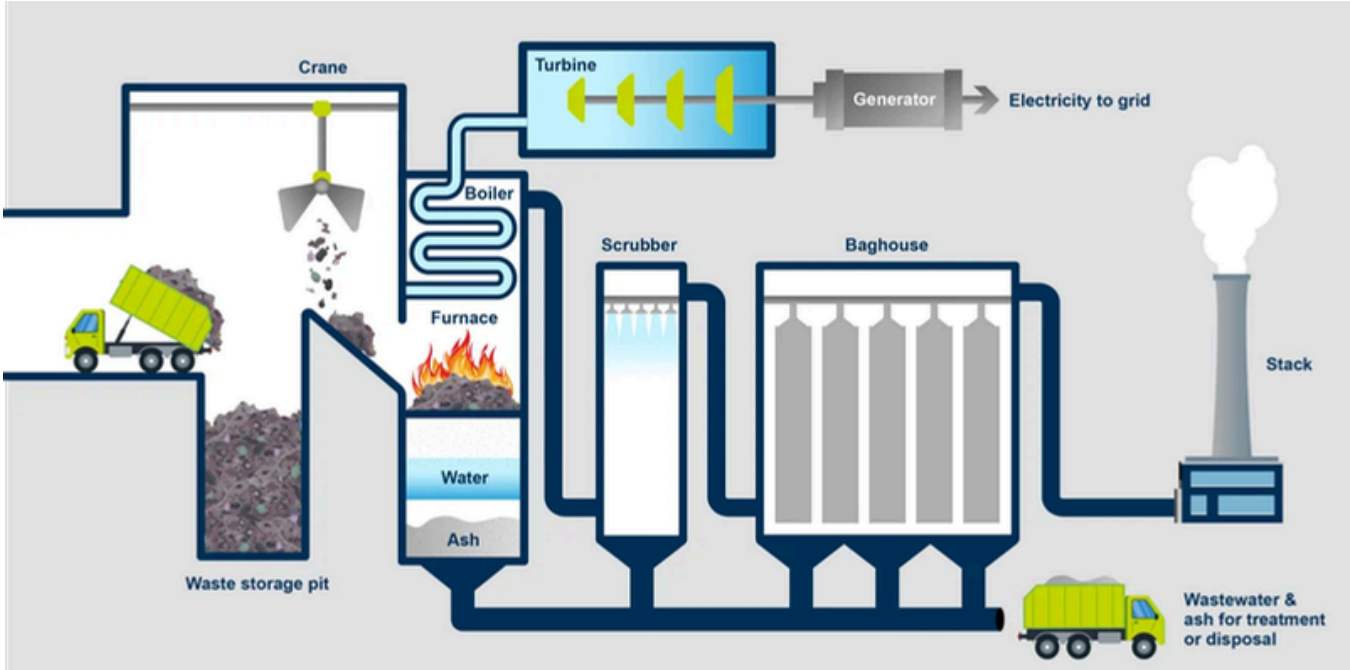


Image from Central Queensland University (2021).

Modern waste-to-energy facilities are equipped with extensive air pollution control technologies intended to reduce emissions before flue gases are released through smokestacks. These systems typically include fabric filters, scrubbers, activated carbon injection, and selective catalytic reduction units that remove particulate matter and neutralize acidic gases while reducing emissions of nitrogen oxides and certain trace contaminants (Tian et al., 2023). Even with these controls, combustion generates carbon dioxide because carbon contained in paper products, plastics, and other combustible materials is oxidized during the incineration process (Bogner et al., 2008). Depending on waste composition, facilities may also emit nitrogen oxides, sulfur dioxide, particulate matter, and trace quantities of metals such as mercury, although these emissions are regulated under federal and state air quality standards (Tian et al., 2023).

Waste combustion has also become an environmental justice issue within New York and nationally because combustion facilities are often located near communities that already experience disproportionate environmental burdens. The New York State Solid Waste Management Plan acknowledges that disadvantaged communities have historically borne a greater share of impacts associated with waste management infrastructure and identifies environmental justice as a guiding principle for future materials management decisions (NYSDEC, 2023). Public comments submitted during development of the plan similarly emphasized concerns regarding waste combustion facilities located within or near environmental justice communities and highlighted the importance of reducing reliance on disposal infrastructure overall.

For PRRIA, the relevance of waste incineration extends beyond the operation of individual facilities. Packaging materials represent a substantial fraction of the combustible waste stream, particularly plastics and paper-based products that possess relatively high calorific values.

Reducing unnecessary packaging therefore decreases the amount of material requiring combustion while supporting New York's broader goals of reducing greenhouse gas emissions, improving recycling rates, and transitioning toward a circular economy (NYSDEC, 2023). Rather than relying on technological improvements at waste-to-energy facilities alone, PRRIA addresses the issue earlier in the product life cycle by reducing the amount of packaging placed on the market in the first place.

Conclusion

New York State’s waste management system struggles to manage the packaging waste that moves through the state’s landfills and incinerators, imposing a financial burden on municipalities and taxpayers while also inflicting lasting environmental and public health harms onto communities. From watershed infiltration to air contamination, packaging ackaging waste releases toxic pollutants that compound over time and fall disproportionately on communities already burdened with waste management infrastructure. By shifting financial responsibility to producers and banning the most dangerous classes of chemicals, PRRIA addresses the root of this problem in New York State.

Landfills	Incinerators
45 active landfills in New York State	**10** active waste incinerators in New York State
Waste Accepted • Municipal Solid Waste • Construction and Demolition debris • Sludge and non-hazardous Industrial Waste • Bulky Items	Waste Accepted • Municipal Solid Waste • Non-recyclable paper, plastics, and carboard • Commercial and industrial non-hazardous waste
Pollutants Emitted • Methane and carbon dioxide • Volatile organic compounds and hydrogen sulfide • Leachate	Pollutants Emitted • Carbon dioxide, water vapor, nitrogen oxides, and sulfur dioxide • Dioxins, furans, heavy metals • Fly ash and bottom ash



THE SOLUTION

IV. THE SOLUTION

Introduction

The Packaging Reduction and Recycling Infrastructure Act (PRRIA) addresses the environmental problems associated with New York State's growing packaging waste stream, including plastic pollution, toxic chemical exposure, and the financial burden that waste management places on municipalities and communities. Rather than focusing primarily on waste disposal after packaging has already been discarded, the bill addresses these problems at the source by establishing an extended producer responsibility (EPR) program. Under PRRIA, producers would be required to reduce the amount of packaging they use, improve the recyclability of packaging, and discontinue the use of select toxic substances. The bill also requires producers to help fund packaging collection and waste management through eco-modulated fees, shifting some of the financial responsibility away from municipalities and consumers. Overall, the bill aims to prevent packaging waste before it is created while improving the collection, recycling, and management of the waste that remains.

Processes

To inform the PRRIA program, the first phase of implementation requires the New York Department of Environmental Conservation to conduct a statewide needs assessment. The assessment evaluates the state of packaging reuse, recycling, and disposal; identifies barriers to reducing packaging waste, and locates opportunities to increase packaging reuse and recyclability. The department then solicits public input and reports results to the public, state legislature, and governor. The needs assessment informs the minimum recyclable list and determines the cost associated with program implementation and eco-modulated fees. This needs assessment becomes the foundation of the PRRIA program.

Covered Groups and Governance Structure

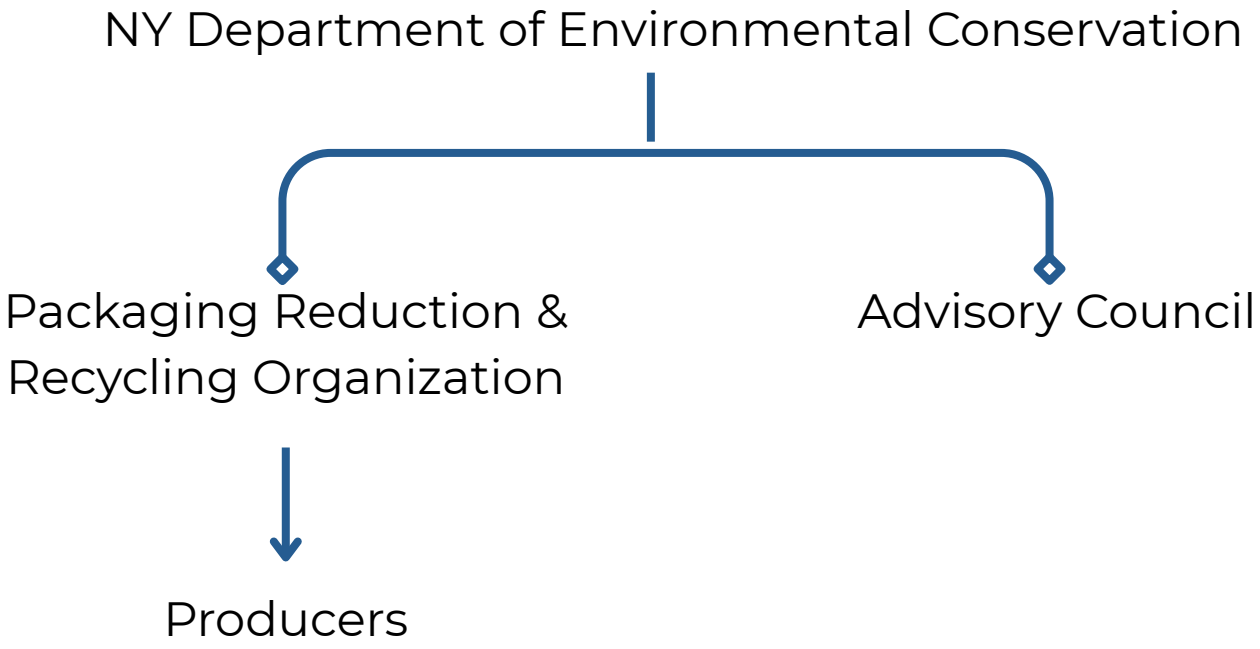
PRRIA targets New York's largest producers of packaging materials. De minimis producers, or producers who annually introduce less than two tons of covered material or annually earn less than $5 million in global gross revenue, are exempt from this legislation.

A producer can apply for a partial or complete waiver if compliance is not possible due to federal law, federal health, safety, or labeling

requirements and regulations. These exemptions ensure the bill is directed towards producers who excessively contribute to the volume of packaging waste in New York and require these non-exempt producers to register with the Packaging Reduction and Recycling Organization (PRO). The PRO is a non-profit designated by the New York Department of Environmental Conservation to develop, implement, and oversee the provisions laid out in PRRIA. The PRO works with producers to facilitate compliance with standards, packaging waste collection, and fee collection.

An Advisory Council composed of nineteen members representing a range of stakeholders oversees the PRO to ensure equitable interpretation and implementation of the bill and its provisions. The members are appointed by the New York Department of Environmental Conservation and represent municipalities, producers, retailers, environmental organizations, environmental justice groups, recycling associations, consumers, public health experts, and other affected parties. The Council provides recommendations to the Department of Environmental Conservation and the PRO. The Council exists to mitigate producers' concerns about the impact and control of the PRO, and to temper concerns that the bill's mandates will hinder free-market capitalism and profitability.

GOVERNANCE STRUCTURE



Standards

Together, the Department of Environmental Conservation, the Packaging Reduction Organization, and the Advisory Council govern the implementation of the PRRIA standards. There are five categories of standards outlined in the bill:

1. Non-reusable packaging reduction standards
2. Non-plastic & plastic packaging recycling rate standards
3. Recycling content targets
4. Reuse &/or refillable standards
5. Banned chemicals

These standards are implemented in a phased approach and, ultimately, reduce the volume and toxicity of packaging waste, limiting its environmental and human health impacts. This mitigation is achieved through PRRIA standards that reduce the tonnage of packaging waste produced, eliminate excessive packaging, and improve the quality and safety of packaging.

Conclusion

PRRIA offers a policy solution to waste management, toxicity, and waste volume problems in New York by establishing recyclability standards, banning chemicals, charging producers for the packaging waste they generate, and mandating a decrease in packaging waste over time. By taking advantage of various policy tools associated with funding and regulation, PRRIA proposes an elegant response mechanism that holds producers accountable for the waste they contribute to the state and corresponding environmental harms.



MEASURING SUCCESS

V. MEASURING SUCCESS

Introduction

New York State generated approximately 3.8 million tons of packaging waste in 2025 alone (NYSDEC, 2023). The majority of packaging waste enters the disposed waste stream rather than being recovered through recycling (Tonjes et al., 2024). The PRRIA addresses this problem by requiring producers to reduce packaging and ban selected toxic substances. To measure PRRIA's success in meeting its targets, this assessment therefore evaluates three measurable dimensions: reductions in packaging generation, reductions in toxic contaminants entering the environment, and improvements in material-specific recycling rates.

Key Metrics

PRRIA sets three measurable targets: a phased reduction in packaging volume, from 10% within 3 years to a 30% reduction within the first 12 years following its implementation, based on each covered producer's baseline year. It also imposes a two-stage ban on 10 classes of toxic substances, including PFAS and PVC, beginning 4 and 7 years after rule promulgation, roughly 5.5 and 8.5 years post-enactment. In addition, the law mandates phased recycling rate increases, targeting 25–75% for plastic packaging and 35–75% for non-plastic packaging by 2052.

Each target is tracked differently. Total packaging tonnage, using NYSDEC's annual reports and the 2025 baseline of 3.8 million tons, tracks overall weight, but it does not break progress down by chemical or material type. Soil, water, air, and fish-tissue contaminant levels, drawn from existing NYSDEC and Hudson River monitoring programs, will be used to track toxicity targets. A material-specific recycling baseline would track the recycling target, but this baseline has yet to be measured, pending NYSDEC's Statewide Needs Assessment.

The volume reduction target, however, applies to each producer's own baseline rather than to the state's total tonnage. Even if individual producers fail to meet their targets, aggregate statewide tonnage could still appear to decline, masking non-compliance. Therefore, verifying compliance requires the Packaging Reduction Organization (PRO) to collect and monitor each producer's annual tonnage individually, rather than relying on the statewide total alone.

Soil Measurements

To measure success in reducing pollution in the soil, we focus on toxicity reduction by examining PVC. PVC is a widely used plastic polymer found in packaging such as cling film and rigid containers, and it is one of the substances banned under the bill. PVC infiltrates soil primarily through landfill leachate, so we propose concentrating sampling at fixed distances from landfill boundaries (50m, 200m, 500m, 1km), where contaminant concentrations should be highest near the source and attenuate with distance. A reduction in PVC concentrations at each of these distances over time, particularly nearest the landfill, would indicate less PVC is being introduced to the landfill, signaling the success of the ban.

Methods for detecting PVC in soil range from traditional approaches to newer techniques. One traditional approach, thermogravimetric analysis paired with infrared spectroscopy heats soil samples and analyzes the released gases to identify PVC's chemical signature (Nosova & Uspenskaya, 2023). The second traditional approach is pressurized liquid extraction, combined with combustion ion chromatography dissolves and burns samples to isolate and measure PVC directly (Kamp et al., 2023). More recently, terahertz (THz) spectroscopy has emerged as a newer approach that scans soil with a specific light wave to detect PVC without any chemical processing at all.

We propose phasing a monitoring protocol around these methods. Initial screening would use THz spectroscopy for low-cost, rapid detection across multiple sites. Sites showing elevated concentrations would then be confirmed using pressurized liquid extraction and combustion ion chromatography for more precise quantification. This sampling design would serve as its own corroboration: the resulting PVC concentration gradient, from highest near the landfill to lowest farther away, is a predictable pattern that can confirm the method is working even without

a historical baseline. Repeating sampling at intervals of 5, 10, and 20 years would align monitoring with known plastic degradation timescales, allowing soil PVC concentrations to be tracked directly against PRRIA's two-stage toxicity enforcement timeline of 4 and 7 years after PRRIA's implementation.

Water Measurement

Water represents the next measurable point along the contamination pathway, as leachate-borne contaminants run off from soil into nearby waterways. To effectively identify the measure of water contamination, this section tracks three regulated contaminants, PFOA, PFOS, and 1,4-dioxane, for which New York State has established both drinking water limits and stricter ambient water guidance values.

New York State has established drinking water limits of 10 parts per trillion for PFOA and PFOS, and 1 part per billion for 1,4-dioxane (NYS DOH, 2024), alongside stricter ambient water guidance values of 0.0067 µg/L for PFOA, 0.0027 µg/L for PFOS, and 1 µg/L for 1,4-dioxane (NYSDEC, 2023b). These three contaminants are tracked continuously through the New York State Department of Environmental Conservation's (NYSDEC) monitoring network, which rotates through the state's 17 major basins on a five-year cycle. While this ongoing monitoring provides a valuable and consistent dataset, it presents a complication when attempting to isolate plastic packaging's specific contribution to contamination. PFAS illustrates this attribution problem particularly well, as it crosses material boundaries: the same compound found in plastic packaging is also present in unrelated consumer products such as stuffed toys, meaning that elevated water contamination levels cannot be attributed to plastic packaging specifically (Nowak et al., 2026).

Measurements of microplastic concentrations remain comparatively less standardized, as no government-established baseline or testing protocol currently exists for microplastics. In the absence of such a standard, a four-year study of the Hudson River Estuary (2016–2019) offers one available data point, reporting a median concentration of 198,000 particles per square kilometer, with residence times reaching up to four months seasonally within the estuary itself (Polanco et al., 2020). Residence time, or how long contaminants remain measurable before

flushing out, varies sharply by water body type: lakes (Santiago et al., 2026), river headwaters (Drummond et al., 2022), the Hudson estuary (Polanco et al., 2020), and groundwater (Esfandiari et al., 2022). This means monitoring windows need to be designed around each system's own residence time.

Groundwater monitoring could be integrated into the existing U.S. Geological Survey (USGS)–NYSDEC Ambient Groundwater Quality Monitoring Project, which tested nearly 1,100 wells statewide for over 100 constituents, including PFAS and 1,4-dioxane, as part of its first comprehensive statewide analysis in 2024, with sampling scheduled to resume in summer 2026 (USGS, 2024). Rather than requiring the construction of new infrastructure, PRRIA-related monitoring could draw directly on this existing network. However, NYSDEC has not yet finalized formal groundwater quality standards for PFAS against which these results could be interpreted.

Air Measurements

Incineration represents a separate route through which packaging waste enters the environment, distinct from the leachate pathway traced through soil and water. Combustion residue is the first measurable point along this pathway. When waste, including plastic packaging, is burned rather than landfilled, it separates into bottom ash and fly ash. New York State's Ash Residue Management Plan requires the collection of multiple composite ash samples over multiple days of facility operation, conducted on a semi-annual basis (NYSDEC, 2024).

Under this plan, the target ratio of bottom ash to fly ash changed from 70% bottom ash and 30% fly ash to 62% bottom ash and 38% fly ash. This ratio, however, governs overall ash composition and hazardous waste determination rather than microplastic concentration specifically. Bottom ash is collected through quench tank operations that cool the material as it exits the incinerator, while fly ash is processed in a mixing device called a pugmill, where moisture is added to prevent the material from becoming airborne. Both ash types are subsequently contained by baghouse filters for this same reason. Because plastic packaging is among the most combustible components of municipal solid waste, a measurable decline in fly ash's share of total ash output over time could

serve as an indirect proxy for reduced plastic packaging entering the waste stream, though this ratio alone cannot confirm PRRIA's direct effect since incineration also processes non-packaging plastic and other combustible materials. Direct measurement of airborne microplastics near both landfills and incinerators is possible, although neither currently has an established baseline. Ambient air microplastic concentrations around a municipal landfill range between 0.2 and 2.8 particles per cubic meter, based on active air sampling combined with Raman spectroscopy (Davoudi et al., 2026). Concentrations should increase closer to the landfill boundary, using a distance-based sampling design. Separately, field sampling conducted directly within incinerator flue gas streams, both before and after air pollution control devices such as selective non-catalytic reduction, semi-dry deacidification, fabric filters, and selective catalytic reduction, has demonstrated that combustion itself constitutes a measurable source of atmospheric microplastics, distinct from the ash residue discussed above (Su et al., 2025).

Organism Tissue Measurements

Organism tissue represents another measurable point along the contamination pathway, as contaminants accumulate in living organisms after moving through soil, water, and air. A statewide survey of 1,292 measurements of fish PFOS concentrations in New York State waters indicates that over 88% of fish have PFOS concentrations exceeding 1 nanogram per gram of fish (Great Lakes Consortium, 2025). Like the water contamination data discussed above, PFAS is not plastic-specific, so this indicator cannot be attributed directly to packaging.

The Hudson River Biological Monitoring Program, which operated from 1974 to 2017, preserved millions of fish samples, including scales, over its four decades of operation. Researchers have found that scale samples from this archive can reveal a fish's lifetime PFAS exposure trends, since scales accumulate contaminants over the course of an organism's life rather than reflecting a single point-in-time snapshot (Chemical & Engineering News, 2026). This archive presents a distinctive opportunity: retrospective scale analysis could establish a pre-PRRIA PFAS exposure baseline without requiring any new sampling effort. Resuming collection at the same historical sites following implementation would allow for a direct before-and-after comparison using an existing, previously validated

method, rather than necessitating the construction of an entirely new monitoring system.

With respect to microplastics specifically, a study of blueback herring in the Hudson River found that these fish were able to identify and avoid ingesting particles larger than 335 micrometers (Ryan et al., 2019). This threshold suggests that gut content analysis could be used to track ingestion rates of particles just below this size, representing the fraction most likely to enter the food web and thereby offering a more plastic-relevant indicator than PFOS concentration alone.

Magnified fish scale containing mercury, a heavy metal used in packaging materials

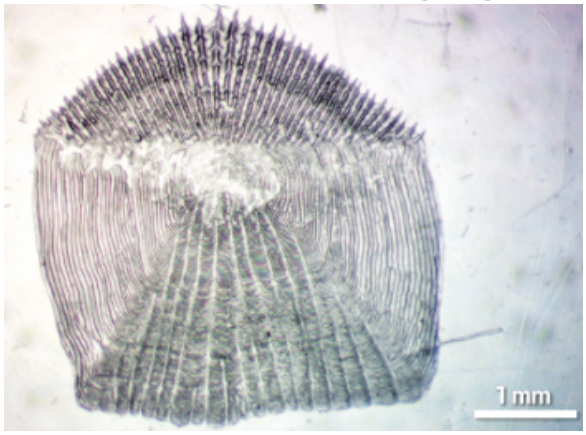


Image from Stony Brook University.

Timeline of Measurements

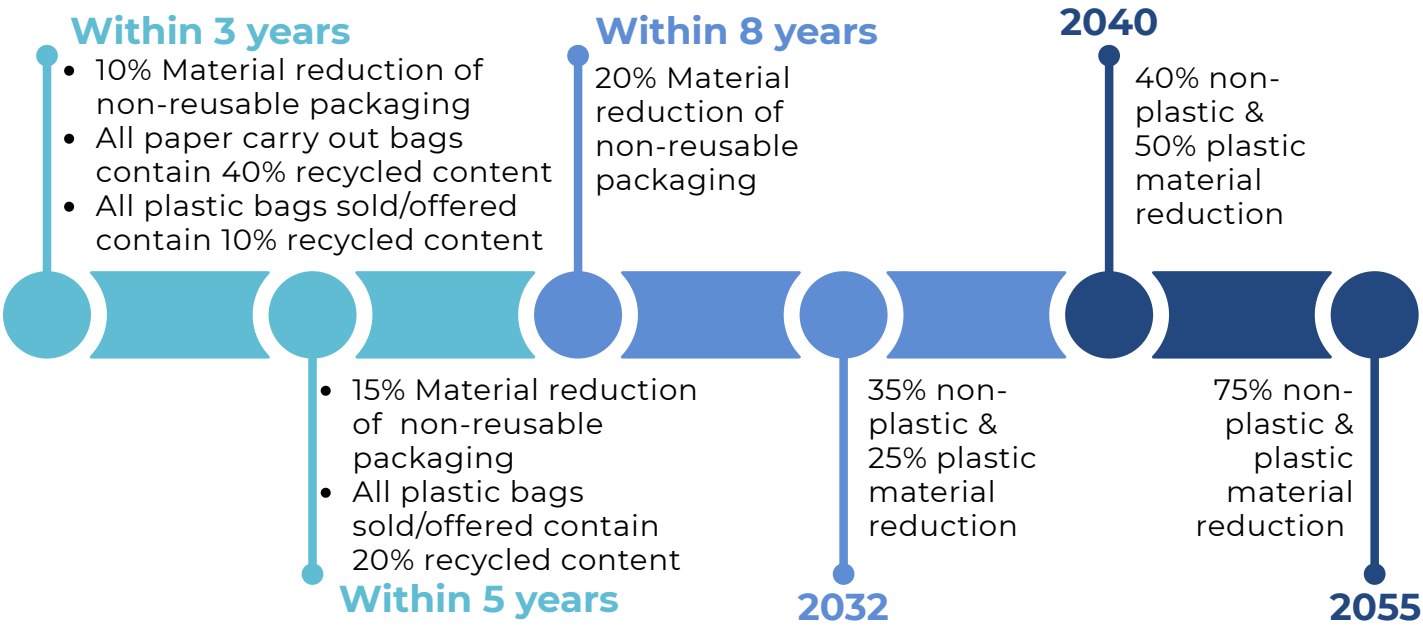
One year after the bill's effective date marks two foundational milestones. NYSDEC's Statewide Needs Assessment begins, establishing the material-specific recycling baseline currently missing for plastic, glass, metal, and paper packaging individually. Baselines must be set to measure future pollutant levels against and to quantify progress. Around the same period, NYSDEC promulgates the implementing rules and regulations required under the bill. This date marks the true starting point for the toxicity ban's two-stage enforcement clock, which is measured from rule promulgation rather than from the bill's effective date.

From this point, the volume reduction target follows its own phased schedule. Each producer must reduce packaging mass by 10% within 3 years, 15% within 5 years, 20% within 8 years, 25% within 10 years, and 30% within 12 years, each measured against that producer's own baseline year. Total packaging tonnage, tracked through NYSDEC's annual reports

gainst the 2025 statewide baseline of 3.8 million tons, provides the reference point against which this schedule can be assessed, though verifying individual compliance still requires the Packaging Reduction Organization to monitor each producer's tonnage separately.

The toxicity target follows a separate timeline measured from rule promulgation rather than from the bill's effective date. Stage 1 begins 4 years after promulgation, approximately 5.5 years after enactment, prohibiting the intentional addition of any of the ten banned substance classes, including PFAS and PVC. Stage 2 begins 7 years after promulgation, approximately 8.5 years after enactment, extending the prohibition to any person or entity and applying regardless of intentional addition once concentrations exceed a department-established threshold. Soil PVC sampling should begin around Stage 1 and be repeated at 5, 10, and 20-year intervals to align with known plastic degradation timescales, allowing concentrations to be tracked directly against both enforcement stages.

The recycling rate target follows a fixed calendar schedule rather than a per-producer or rule-promulgation timeline. Plastic packaging must reach a minimum recycling rate of 25% by 2030, 50% by 2037, and 75% by 2052, while non-plastic packaging must reach 35%, 50%, and 75% over the same three milestones.



Conclusion

Given the distinctiveness of each policy provision, each of PRRIA's three measurable targets need to be tracked differently. To assess packaging waste reduction, the PRO is responsible for collecting and monitoring each producer's annual tonnage and comparing it to its individual baseline. This tracks each covered producer's progress toward achieving the required 30% reduction within 12 years of implementation. To evaluate whether fewer pollutants are entering the environment through the waste stream, concentrations of banned substances, such as Polyvinyl Chloride (PVC), can be measured in soil at fixed distances from landfill sites to monitor changes in contaminant levels over time. Lastly, progress toward the bill's recycling targets can be measured by tracking material-specific recycling rates for plastic, glass, metal, paper, and cardboard against the phased benchmark rates established in the bill. Together, these metrics provide a comprehensive framework for evaluating whether PRRIA is achieving its intended environmental outcomes by reducing packaging waste at the source, limiting toxic contaminants in packaging materials, and increasing the recovery of recyclable materials.



CHALLENGES

VI. CHALLENGES

Introduction

Isolating PRRIA's specific contribution to any observed environmental changes is difficult, regardless of how fully the monitoring system described above is implemented. These challenges span three distinct dimensions: scientific uncertainties in the detection methods themselves, attributional concerns in tracing observed contamination back to packaging specifically, and deeper questions about whether banning a substance under the precautionary principle actually reduces environmental or health risk. Taken together, these challenges all affect how well PRRIA's success can be measured.

Scientific Uncertainties

Detection methods for microplastics currently lack standardized laboratory protocols. Differing methodologies employed across studies produce substantial variation in readings taken at the same location over time, and this measurement noise has the potential to obscure PRRIA's true environmental effect (Carrington, 2026).

Laboratory contamination introduces an additional source of measurement error. Dry contact between nitrile or latex gloves and laboratory equipment produced an average of 2,000 false-positive microplastic readings per square millimeter in one study, since the stearate coatings applied to ease glove removal during manufacturing share a nearly identical spectral signature with polyethylene (Clough et al., 2026). Switching to uncoated cleanroom gloves substantially reduced this contamination in the same study.

Further complicating matters, many published findings on microplastics contradict current human anatomical knowledge. The standard detection technique, pyrolysis gas chromatography-mass spectrometry, is often used without a full understanding of the data it produces. Studies have reported substantial quantities of microplastics ranging from 3 to 300 micrometers in human bloodstreams, despite the fact that particles of

this size cannot cross the blood barrier. Nanoplastics, which are smaller and derived from microplastics at 1 to 1000 nanometers, are capable of crossing this barrier, but current testing equipment cannot yet reliably detect their presence (Carrington, 2026).

▼ Size classification of plastic particles

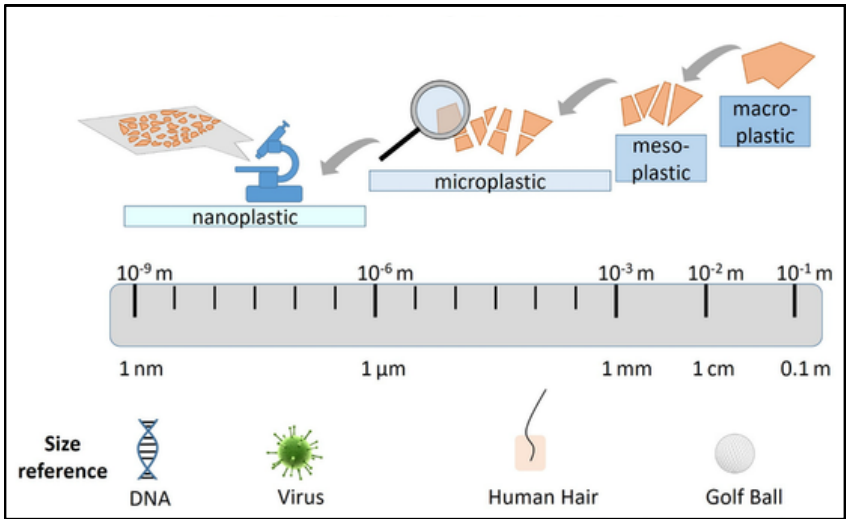


Image from Professor Beizhan Yan (2026).

Uncertainty extends to bisphenol A (BPA) as well. While an extensive body of laboratory animal research since 1997 has reported effects from low-dose BPA exposure, and a Chapel Hill expert panel found that acute animal exposure findings were comparable to human exposure levels (vom Saal et al., 2007), a subsequent systematic review found that few of these studies were actually conducted at BPA concentrations within the range of real human exposure. The term “low-dose” across these studies varied by eight to twelve orders of magnitude, undermining direct comparability to human-level exposure (Teeguarden & Hanson-Drury, 2013).

Attributional Concerns

Contaminant source apportionment presents a significant challenge to measuring PRRIA’s effect. Once microplastics degrade in the environment, current chemical analysis methods cannot determine which producer or product they originated from. Microplastics resulting from a degraded PET bottle and those resulting from a degraded PET food package exhibit identical chemical signatures, making them indistinguishable through standard testing. This difficulty extends

beyond simple material identification: packaging itself is rarely a single, uniform material, and treating it as one undifferentiated category obscures the distinct contributions of individual components such as closure systems and liners (Fernandes et al., 2026).

Location-based attribution faces a similar obstacle, as the polymer composition of microplastics found in landfill leachate varies significantly depending on a landfill's age and regional waste composition, meaning even identifying a specific polymer type cannot reliably indicate which landfill, or which producer's packaging, it originated from (Kabir et al., 2023). PFAS presents a comparable limitation, as PFAS detected in the environment may originate from packaging materials or from unrelated industrial sources, and detection methods alone cannot determine the true source.

Confounding variables at the environmental level further complicate efforts at attribution. Climate change independently alters precipitation patterns and river flow, both of which in turn affect contaminant residence time and dispersal throughout the environment. Population growth, economic development, and shifting consumption patterns similarly affect total packaging waste independently of PRRIA's implementation, weakening the observed relationship between packaging waste consumption trends and the policy itself.

New York State already has laws directly regulating packaging waste, including the New York State Returnable Container Act, commonly known as the Bottle Bill, the New York State Plastic Bag Waste Reduction Act, and the Expanded Polystyrene Foam Containers and Loose Fill Packaging Ban. Evaluating a policy within a system that is constantly evolving and lacks a clear counterfactual makes clean attribution inherently difficult, further compounding the scientific measurement challenges described above.

Criticisms on the Precautionary Principle

Even where a substance is successfully banned under PRRIA, its removal may not translate into a real reduction in environmental or health risk. A 2025 scientific review responding to the European Union's proposed PFAS ban argues that the persistence and bioaccumulation of PFAS

compounds does not, on its own, constitute conclusive evidence of environmental or human health harm (Hanekamp et al., 2025). The same review highlights a phenomenon known as regrettable substitution: banning a chemical under the precautionary principle does not necessarily encourage industry to adopt safer alternatives, but instead often prompts a shift to structurally similar chemicals within the same class that remain equally persistent, equally toxic, or both. If PRRIA's toxicity indicators are limited to tracking only the ten specifically named substance classes, this creates a measurement blind spot: a decline in the concentrations of banned substances could reflect substitution with an untested or unregulated replacement rather than a genuine reduction in packaging-related toxicity.

Conclusion

While PRRIA does have provisions in place to collect baseline data and establish protocols for understanding the status quo, there are too many confounding variables to determine the effectiveness of the policy itself. Additionally, an August 2026 audit by the New York State Comptroller revealed that New York Department of Environmental Conservation currently does not reliably measure how much waste is produced in the state and has failed to submit reports and accurate information on numerous occasions (The Office of the New York State Comptroller, 2026).

The main challenges that may impede the monitoring and success of PRRIA's environmental impact include insufficient scientific methodology in microplastic research, attributional concerns on the origins of microplastics, and whether banning certain toxic substances could lead to the use of more toxic, less studied substances in packaging.



CONCLUSION

VII. CONCLUSION

This report has examined New York's Packaging Reduction and Recycling Infrastructure Act (S1464/A1749) in depth by detailing its provisions, evaluating the environmental and human-health issues at stake, outlining its proposed solution, and identifying the major challenges to implementation.

This bill offers powerful tools to address the waste management and environmental health problems facing New York State. Extended producer responsibility (EPR), the approach at the center of this bill, offers a proven model: by shifting the financial and operational responsibility for waste management from municipalities to producers and pairing that responsibility with eco-modulated fees, producers are incentivized to limit superfluous packaging and improve recyclability. Through eco-modulated fees, reduction targets, packaging content standards, and toxic chemical bans, PRRIA offers New York a path to reduce packaging waste-related pollution at its source, address longstanding environmental and public health harms, and relieve the financial burden currently carried by municipalities.

The Future of PRRIA

The Packaging Reduction and Recycling Infrastructure Act failed to pass in the 2025-2026 legislative session (NY State Senate Bill 2025-S1464A, 2025). After receiving sufficient votes to pass through the New York State Senate, legislators never brought the bill to the floor for a vote in the New York State Assembly. For three years in a row, PRRIA or similar legislation has passed the Senate. However, despite public support showing 73% of registered New York voters support the bill, the Assembly has yet to vote on it (Harckham, 2026). There is widespread concern that the retirement of bill sponsor Assemblymember Deborah Glick will result in a loss of political momentum, with a "watered-down" version of the bill anticipated for the 2026-2027 legislative session (Lisa, 2026). The bill has faced heavy opposition from industry, with S1464 and A1749 accounting for the first and second most lobbied bill during the final two months of

the 2025 state legislative session, respectively (Beyond Plastics, 2025). The toxic substance ban has proven to be the most controversial component of the legislation, with industry advocates claiming there are no viable alternatives available to substitute the materials PRRIA would ban. Looking to the future, it is unknown whether the bill will be re-introduced and, if so, with what modifications.



ABOUT THE TEAM



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Majored in Political Science and double minored in Spanish & Business at Gettysburg College. After College, served as a Peace Corps Volunteer in the Dominican Republic. Interned at MobilizeGreen, and volunteers at Disaster Accountability Project.

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Bay Area native and studied ecology and environmental science at Scripps College. Two-time NSF REU Scholar studying oysters as habitat-building species in salt marshes and climate effects on plant-fungal endosymbiont relationships.





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Columbia MFA graduate bringing professional writing and performance experience to environmental policy. BA from Yale with a double major in Military History and Theatre Studies. Trained Climate Reality leader. Motivated by the conviction that the climate crisis requires all of us, and a desire to tell her children she did all she could.

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Graduated from William & Mary with a degree in Environmental Policy & Integrative Conservation. Researched sustainable livelihoods for Maasai women's collectives in Amboseli, Kenya. Conducted field research on riparian corridors in Costa Rica. Passionate about civic action and systemic change for the environment.

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Graduated from Boston College with a degree in Political Science and minor in Environmental Studies. Worked in state-level lobbying and campaigns before moving to an urban planning nonprofit, focused on climate resilience and urban sustainability in Boston. Passionate about mitigating climate impacts on the city scale.

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