IMPROVING MUNICIPAL SOLID WASTE MANAGEMENT GOVERNANCE IN VIRGINIA

Prepared for the Office of Senator Ghazala Hashmi
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DISCLAIMER

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, or by any other agency.

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HONOR PLEDGE

On my honor as a student at the University of Virginia, I have neither given nor received unauthorized aid on this assignment.

GLOSSARY

Landfill
Facilities for the disposal of municipal solid waste (US EPA, 2016b).

Mega-landfill
In the Commonwealth of Virginia, landfills with a capacity to accept more than 3,500 tons of municipal solid waste per day (Southern Environmental Law Center, 2020)

Municipal Solid Waste (MSW)
The collection of items used and thrown away in residential and commercial settings – also commonly known as trash or garbage (US EPA, 2016)

Tipping Fee
Levies paid by anyone who disposes waste at a landfill or transfer center - commercial waste haulers typically pay these fees based on their tonnage (Neil, 2021)

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EXECUTIVE SUMMARY

The Commonwealth of Virginia does not govern municipal solid waste (MSW) well. The lack of interjurisdiction decision making at the local level invites intrastate health, environmental, and infrastructural inequities while the lack of a centralized approach to curb out-of-state waste creates interstate inequities across the same dimensions. For example, the cost associated with each ton of out-of-state MSW imported into the state is $33.70.

Elected to the Virginia Senate in 2019, Senator Ghazal Hashmi has introduced legislation to strengthen environmental regulatory oversight for landfills and include localities affected by new landfill sitings in the decision-making process. However, both bills ultimately died in the Senate Committee for Agriculture, Conservation, and Natural Resources.

Considering the lack of legislative success, the Senator is interested in a new, economically oriented approach with Virginia MSW management governance. To appropriately target a new legislative strategy that addresses both intrastate and interstate inequities, one must answer the core question: Who needs to do what to improve MSW management governance?

In answering this question, literature on multi-level governance and market-based instruments, both broadly and in the MSW management space, were consulted to develop various policy interventions. This analysis considers the following alternatives:

1. Imposing a statewide tipping fee
2. Incentivizing localities to adopt a minimum tipping fee
3. Empowering regional boards to set regional tipping fees

Each alternative is evaluated with respect to the following criteria: equity, cost-effectiveness, political feasibility, and administrative feasibility. Effectiveness is measured as the expected reduction in out-of-state waste disposed of in the Commonwealth. This analysis suggests that alternative three, empowering regional boards to set regional tipping fees as the strongest policy alternative considered – ranking at least medium or high when evaluated against each of the criteria. While passing this policy in the General Assembly may require the Senator to strategize with members of her party before the 2023 session and implementation of the policy will require outreach by the Virginia Department of Environmental Quality, realizing this policy is more than reasonable.

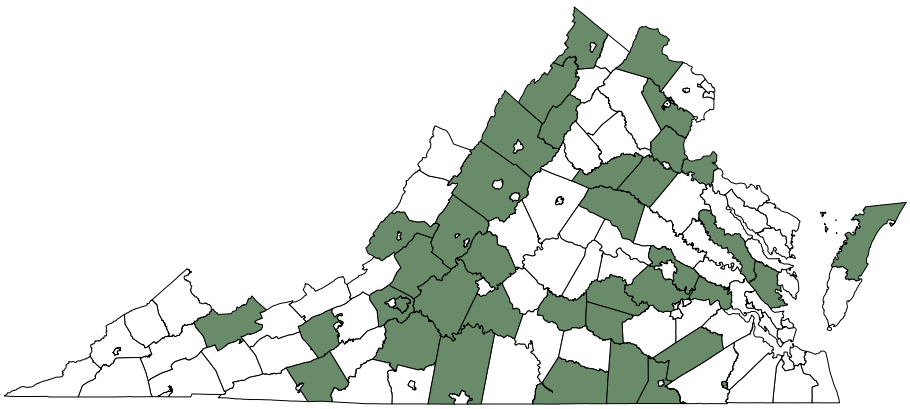
PROBLEM STATEMENT

Landfill siting and permitting across the Commonwealth presently generates inequitable outcomes for Virginians. Given the historically lax environmental regulation and relatively low-cost dumping fees compared to other states on the East Coast, Virginia has a large market for solid waste. These conditions contribute to an overbuilt waste management apparatus across the Commonwealth, where landfill corporations develop sites despite existing landfills not nearing capacity – consequently producing negative environmental, health, and infrastructural externalities. Further, given the current decision-making power held at the locality level, poor, rural localities willingly host landfills as means to generate revenue and strategize landfilling siting on local boundaries to shift negative externalities unto neighboring jurisdictions.

LANDFILLS IN VIRGINIA

As of February 2022, there are 71 active landfills, both public and private, situated across 41 of Virginia's 133 localities – shaded green in the map below (US EPA, 2022).

Active Landfills in Virginia Localities, February 2022



"Project and Landfill Data by State", EPA Landfill Methane Outreach Program

Considering only about 1 in 4 Virginian localities host landfills, local decisions have regional and statewide consequences. The Green Ridge Recycling and Disposal Facility proposal epitomizes this dynamic. In 2018, the Cumberland County Board of Supervisors approved a plan for the facility, a 500-acre private mega-landfill near Cumberland County's eastern border with Powhatan County (*Mega-Landfill in Cumberland County*, 2021). Supervisors approved the proposal citing economic benefits, as in its 25-year lifespan, the landfill would generate $74 million in county tax revenue; a significant gain in a rural county where 80% of students are on reduced lunch (Watson, 2021).

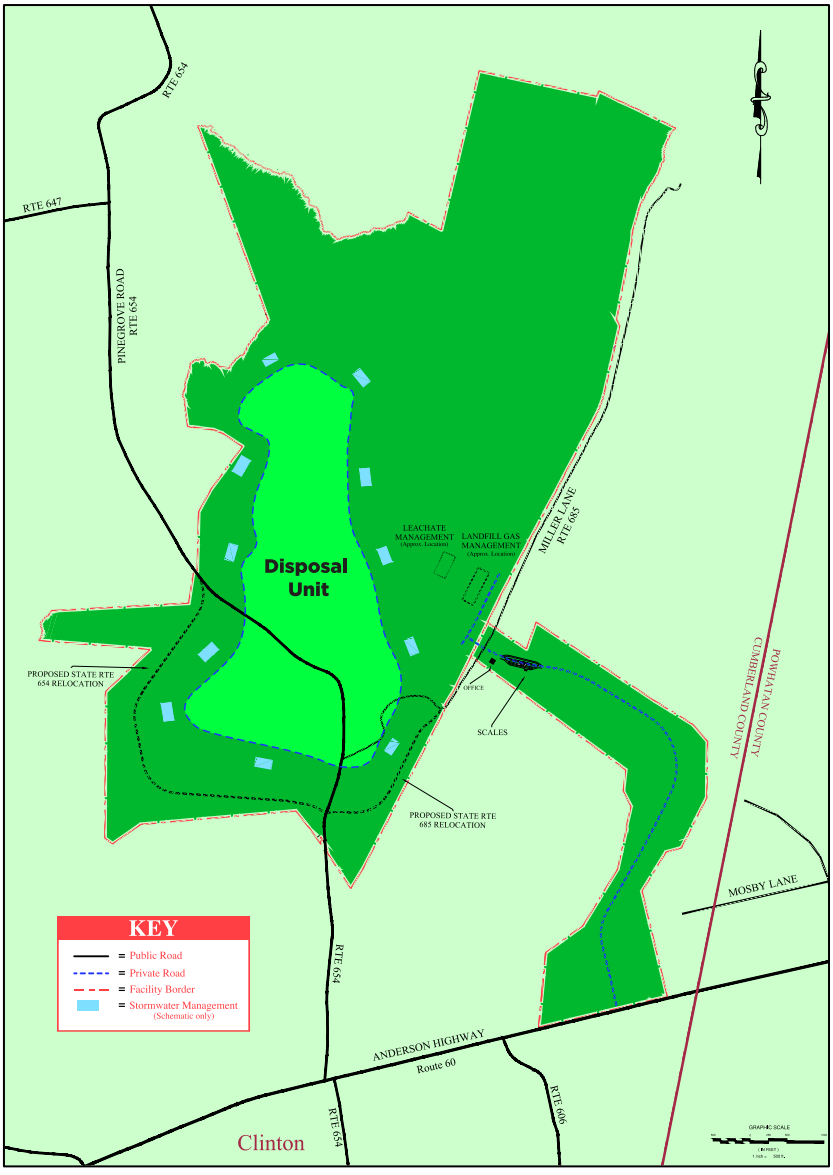
However, a landfill in Cumberland County estimated to accept between 3,500 and 5,000 tons of daily trash from a 500-mile radius bear substantial costs outside its local boundaries (Southern Environmental Law Center, 2020). Groundwater contamination and air quality degradation are among the primary environmental and health concerns from nearby residents in Powhatan County (Mathieu, 2019). Additionally, increased traffic along US Route 60 activate congestion worries among Virginians who rely on the road for daily use (McFarland, 2018). These residents understandably worry about the impacts of the decisions made in the locality next-door.

BACKGROUND

Transboundary Pollution

Localities strategize their landfill placement to minimize the external costs incurred when hosting a landfill in their jurisdiction. In environmental policy more broadly, this deliberate passing of externality costs manifests as transboundary pollution (Jeffrey, 1992). For example, Lipscomb and Mubarak found re-drawing of county lines in Brazil to cause shifts in pollution intense development toward the downstream most part of the county's rivers (2017)

The site plan for the Green Ridge Landfill illustrates this exact phenomenon in Virginia (*Green Ridge Recycling and Disposal Facility*, 2018). As shown in the diagram, the disposal unit comes within 3,000 feet and the access road within less than 500 feet of the Cumberland-Powhatan County line. Clearly, the local negative externality costs associated with the landfill in Cumberland County are passed off to residents in Powhatan County.

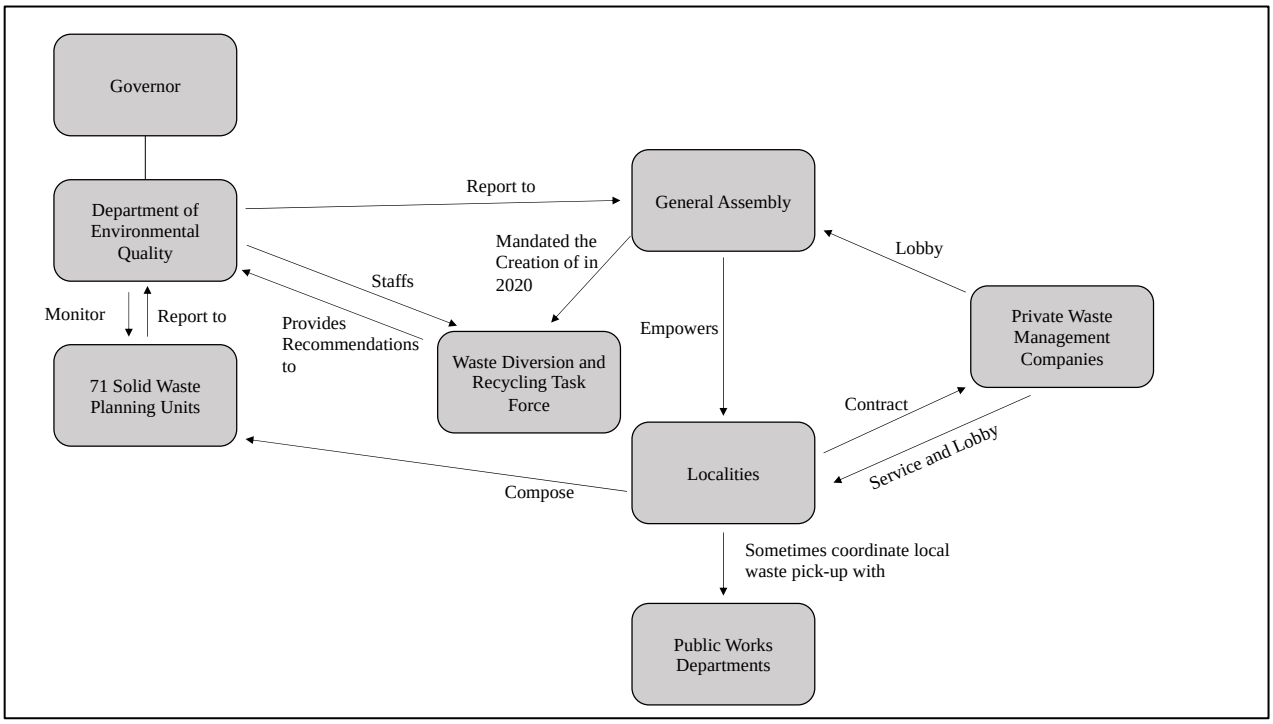


Governance Structure

In Virginia, private landfill operators may propose site selection, where the host local government may approve the proposal (*9VAC20-81-410. Permits-by-Rule and Other Special Permits.*, n.d.) and Virginia Department of Environmental Quality serves as the primary regulatory body (*§ 10.1-1408.1. Permit Required; Open Dumps Prohibited*, n.d.). This approach is both rigid in its adherence to geographic boundaries and fairly decentralized, lacking strong oversight and review by statewide representatives in Richmond. Considering Virginia's status as a Dillon's rule state[1], the legislature has the ability to institute meaningful structural governance changes regarding waste management.

[1] "Dillon's rule" refers to localities' lack of autonomous governance, where state legislatures must expressly grant powers to localities (Richardson, 2011).

The creation and implementation of a truly meaningful waste management strategy in the Commonwealth requires active participation by a number of actors to collect representative data on the local level, synthesize on the regional level, and enact corresponding change at the state level.



The center of this diagram features a cycle where localities compose SWPUs that report to VDEQ before reporting ultimately to the General Assembly. Then, given Virginia's status as a Dillon rule state, the General Assembly can empower localities to act in accordance with their waste management needs. However, given the lapse in ability for regional entities, like SWPUs, to take action in the wake of multi-jurisdictional issues (i.e. mega-landfills with environment and health externalities bleeding into other jurisdictions), democratic inequities persist for impacted individuals.

Additionally, the role of private waste management firms with both the General Assembly and localities across the Commonwealth further complicates enacting meaningful change. From the local level, localities rely on private waste management firms to collect, in terms of haulers, and dispose, in terms of landfill operators, the municipal solid waste generated in their jurisdiction. Localities are somewhat beholden to these private businesses that support a system where homes and streets are not filled with refuse. Ultimately, these firms hold an upper hand when working with localities. At the General Assembly, private waste management firms have successfully lobbied to kill legislation that would effectively ban the construction of more mega-landfills in the Commonwealth. Clearly, they hold sway, especially with members of the Senate Committee on Agriculture, Conservation, and Natural Resources, posing an additional barrier for enacting a stronger waste management strategy in Virginia.

Regulatory Structure

The Virginia Department of Environmental Quality (VDEQ) serves as the primary regulatory body for waste management in the Commonwealth. For example, in the Green Ridge mega-landfill case, the department serves as the permit granting entity that ensures state-set design and operation standards are met by the applicant. Anecdotally, VDEQ has been perceived as a more conservative department that adheres primarily to satisfying state code rather than an aggressively scrutinizing body who safeguards against environmental externalities.

Additionally, VDEQ oversees and supports the 71 solid waste planning units (SWPUs) across the Commonwealth. SWPUs vary in composition, with some encompassing only one locality and others including four of five localities. Regardless of size, SWPUs are required by administrative code to meet waste management planning guidelines and a mandatory recycling rate. While SWPUs provide the potential springboard for regional solid waste management planning, the structure serves mostly to pass through required reporting documents in compliance with state code. Effectively, the potential for bodies to engage in dynamic strategizing processes that improved waste management related outcomes is never realized.

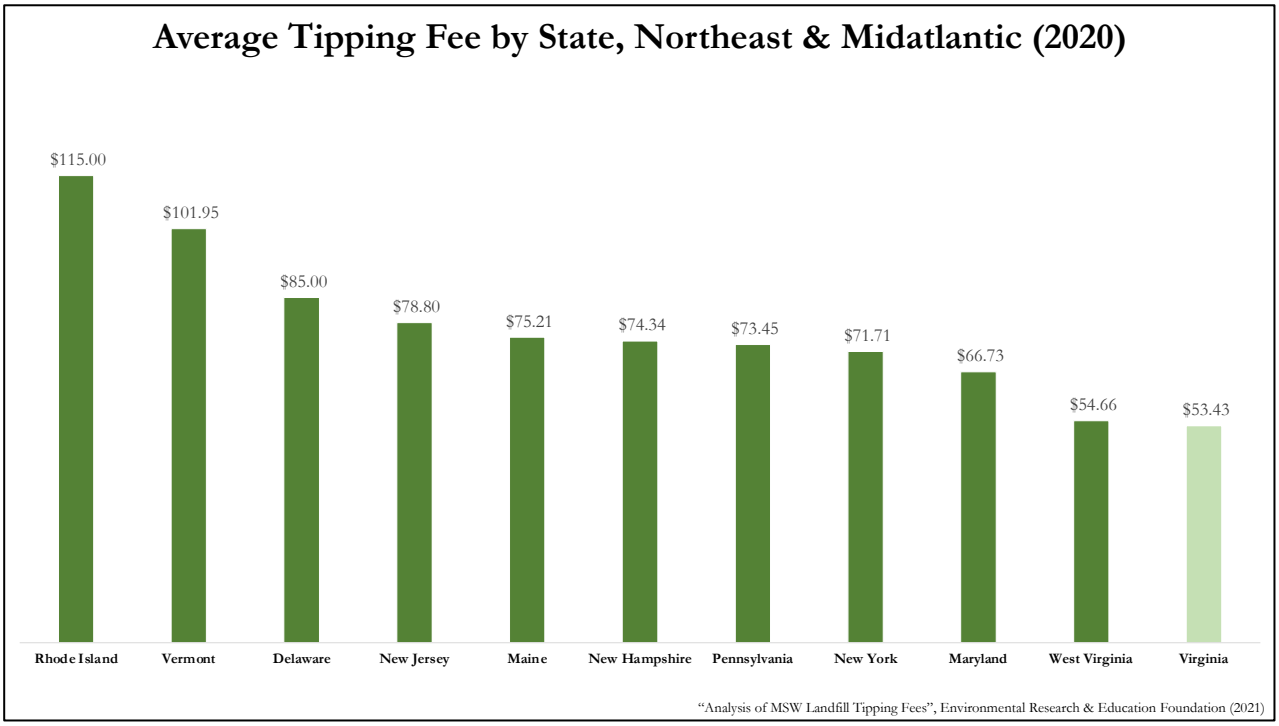
An exacerbating factor in VDEQ's ability to provide more comprehensive and visionary waste management planning is its lack of funding. In 2020, the Generally Assembly attempted to manage this budgetary gap, proposed funding was later cut in response to the COVID-19 pandemic (Vogelsong, 2020).

Out-of-State Waste

Nearly a quarter of waste managed in Virginia during fiscal year 2020 came from out of state, totaling 4,070,341tons MSW (Virginia DEQ, 2021). This is par for the course in the Commonwealth where over the past decade out-of-state waste has accounted for between 23% and 27% of all managed waste in the state – namely from Maryland, New Jersey, and New York (Vogelsong, 2021).

On the national level, interstate waste disposal has risen in recent decades out of response to the Resource Conservation and Recovery Act of 1976 and subsequent Hazardous and Solid Amendment of 1984 (Katers et al., 2009). While originally intended to protect public health and the environment, the increased regulation ultimately favored well-capitalized companies that could afford the liners and technologies that were beyond the budget of small enterprises and local governments (Seldman, 2018). Thus, large private landfills that could fully exploit the economies of scale of the operation gained prominence and expanded collection areas beyond local boundaries (Katers et al., 2009). Consequentially, MSW became more frequently transported across state lines. While interstate MSW disposal was challenged in C&A Carbone v Clarkstowne, NY in 1994[2], the Supreme Court ultimately determined that state and local governments may not enact laws that, "favor enterprises by prohibiting patronage of out-of-state competitors or their facilities," as per the Commerce Clause of the United States Constitution (C & A Carbone, Inc. v. Town of Clarkstown, New York, 1994).

[2] The Town of Clarkstown, NY adopted an ordinance that all MSW generated within their jurisdiction must be processed at the local transfer station, thus prohibiting patronage of out-of-state competitors (C & A Carbone, Inc. v. Town of Clarkstown, New York, 1994)



Although state and local governments are not able to directly control waste haulers, they do retain the ability to make the cost of waste disposal within their jurisdiction. Further, a team of researchers at the University of Wisconsin – Green Bay argue that interstate cost disparities majorly contribute to interstate waste shipment patterns (Katers et al., 2009). Considering Virginia's position as the cheapest state among the Northeast and Mid-Atlantic states to dispose MSW and the second largest out-of-state MSW accepter, Katers et al.'s hypothesis appears to hold (Boxman & Staley, 2021; Vogelsong et al., 2020).

Demographics

Disproportionalities by Race

Communities of color experience the effects of environmental racism associated with poor and exclusive waste management planning practices. Specifically, Black communities have been disproportionately cited for landfill placement, retaining three of the four communities with hazardous-waste in the eight southern states composing EPA Region IV[3] (Villarosa, 2020). With the Green Ridge project, that mega-landfill is slated to interfere with the Pine Grove School, a historically Black schoolhouse that serves as a social center for the Black community in Cumberland County today (Southern Environmental Law Center, 2020).

Disproportionalities by Socioeconomic Status

Localities with lower socio-economic status may be overrepresented in the vicinity of waste management facilities. Kearney and Kiros found that socioeconomic disparities play a substantial role in landfill placement in Florida, while Martuzzi et al. found the same in the European context (2009; 2010). Considering Green Ridge's placement in Cumberland County where about 18% of people live below the federal poverty line, these findings from other contexts might apply in Virginia as well.

[3] Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee

Limited economic opportunity in rural localities offer one theory for describing this phenomenon. Localities accept offers to construct landfills in their jurisdiction, as there are limited other means to generate revenue for the locality and best serve their residents. Again in Cumberland County, the County Board of Supervisors had to consider the tradeoff between revenue generated from the construction and operation of the Green Ridge landfill against the environmental impacts felt by Cumberland and Powhatan County residents (Mathieu, 2019; McFarland, 2018). Localities like Cumberland County are more predisposed to opt into these opportunities as there are limited other options.

POLICY CONTEXT

Sen. Ghazala Hashmi was elected to the Virginia Senate in 2019 and has been at the forefront of promoting healthy and just environmental policies throughout her tenure (Friends of Ghazala Hashmi, 2021). As evidence, during the 2020 session, Senator Hashmi served as the patron for SB406, a bill that defined environmental justice and created a framework for state agencies to monitor the impacts of policies and projects on communities of color, indigenous communities, low income, and fence line communities (2020).

The Senator is also deeply involved in conversations regarding the MSW management in the Commonwealth. During the 2021 session, she introduced two bills pertaining to the regulation and governance of landfills: SB409 and SB1200. Under SB409, VDEQ would be required to thoroughly analyze and determine the environmental impacts of mega-landfills before providing the landfill operator a permit. The legislation stalled in the Senate Committee for Agriculture, Conservation, and Natural Resources where it died at the end of session (Hashmi, 2021a). SB1200 attempted to mitigate the transboundary pollution phenomenon present in Virginia by requiring localities considering the opening of a new landfill to gain approval from adjacent localities within a five-mile radius of the proposed landfill site. Similar to SB409, this bill also died in the Senate Committee for Agriculture, Conservation, and Natural Resources (Hashmi, 2021b).

In the 2022 Session, Senator Surovell introduced SB250, which increases the annual permitting fees for nonhazardous MSW management facilities, and found bipartisan support across both chambers (including Senator Hashmi) (2022). If signed by Governor Youngkin, the legislation will help close the funding gap between annual fees for MSW operators, at about $2.9 million, and program costs, at $6.8 million (Vogelsong et al., 2022). While a step toward improved MSW governance in the Commonwealth, these remains substantial ground to cover.

This policy project aims to recommend a legislative strategy the Senator can employ during the 2023 session to govern MSW more equitably in the Commonwealth. Given the lack of legislative success with her more outwardly environmental approach in the aforementioned efforts, the alternatives considered focus at the intersection of the MSW market and government.

Per § 10.1-1408.1 of Virginia State Code, host local governments and other relevant parties must demonstrate a need for additional capacity in order to receive permitting for the construction of a new solid waste management facility or expansion of an existing facility (Permit Required; Open Dumps Prohibited., n.d.). This code suggests a distinction in waste to manage: necessary and unnecessary. For the intent and purpose of this report, we can consider the waste generated within the Commonwealth as necessary to manage and the waste generated out-of-state as unnecessary – Virginia should be responsible for managing its own waste but has no obligation to manage that from other states.

QUANTIFYING THE COST OF MUNICIPAL SOLID WASTE

Disposing of MSW carries costs that are not being considered within the Commonwealth's current waste management apparatus – thus making Virginia a breeding ground for out-of-state waste haulers. To estimate the costs associated with MSW imported from out-of-state, we can consider the environmental, infrastructural, and health externalities. The purpose of these estimates is to provide an approximation of the marginal cost burdening Virginians with each additional ton of waste imported from jurisdictions outside the Commonwealth.

By consulting the recent scholarship and completing several back of the envelope calculations, the cost associated with out-of-state MSW is $33.70/ton.

Environmental

The two broad categories of cost associated with the environmental externalities include storage and transportation. Much like the waste generated within the Commonwealth, MSW stored in high-density polyethylene lined landfills emit greenhouse gases both before and after closure. A team of researchers at l'Ecole des Mines argue that among all the greenhouse gases present with landfills, methane gas (CH_4) generate the most cause for concern from a narrowly environmental point of view – specifically considering the gas' contribution to global climate change (Rabl et al., 2008). Using the social cost of methane provided by the Internal Panel for Climate Change, the team estimated each ton of waste to be associated with 13€, which if adjusted for 2020 accounts for $17.28/ton.

The primary environmental cost of transporting waste from out-of-state stems from waste hauling trucks. Considering that 91% of out-of-state MSW comes from jurisdiction's north of Virginia, and the majority of private, mega-landfills are concentrated in the Eastern part of the state (Virginia DEQ, 2021), the back of the envelope calculation[4] assumes that out-of-state waste haulers travel 150 miles on Virginia roads. Then, considering that the average hauler carries 14 tons MSW, one can calculate the total amount of carbon dioxide (CO_2) emissions using a standard truck mileage (South Carolina Department of Health and Environmental Control, n.d.). Then using the EPA's social cost of carbon, at $42, the cost of out-of-state MSW is estimated to be $0.99/ton (2016a). However, considering that out-of-state haulers also leave the Commonwealth upon dumping, this figure is doubled at $1.98/ton.

Infrastructural

Similar to the environmental cost associated with transporting waste, Virginians also bear infrastructural costs given the out-of-state waste haulers on the road. The estimated cost of highway pavement damage due to truck traffic is about $0.02 per mile (Bai et al., 2010). So, by using the same travel distance and tonnage per truck estimates above, as well as the same logic to double the one-way approximation, the infrastructural cost of out-of-state MSW is $0.42/ton[5].

[4] See Calculation 1 in Appendix A
[5] See Calculation 2 in Appendix A

Health

The major human health costs associated with municipal solid waste are due to increased cardiovascular hospitalizations and hydrogen sulfide (H_2S) mortality. According to EPA Landfill Methane Outreach Program, the average landfill in Virginia has the capacity to hold 10 million tons of MSW (2022). To proxy the value of folks living within a 3-mile radius of landfills[6], one can consider the public interest meeting concerning the proposed Green Ridge Landfill, where about 250 people were in attendance, then assume only one in twenty of the people in attendance could be expected to incur the negative health externalities (McFarland, 2018).

To determine the costs associated with increased cardiovascular hospitalizations, we can use the estimates purported by researchers with the Italian Department of Epidemiology. They suggest that proximity to a landfill increases one's likelihood of cardiovascular hospitalization by 8 percentage points (Mataloni et al., 2016). Using $16,000 as the mean per-patient cost of a cardiovascular visit (Kilgore et al., 2017), the cardiovascular health cost of MSW is $0.02/ton[7].

The same Italian Department of Epidemiology researchers found that living proximate to MSW landfills increased exposure to H_2S gas by about 3 percentage points. They then continued to estimate that of people exposed to the highly poisonous gas had a mortality rate 10 percentage points higher than people not exposed to H_2S (Mataloni et al., 2016). Using these results, and the EPA's value of statistical life estimate, the respiratory health cost of MSW is $14.00/ton[8].

[6] Studies analyzing the relationship between human health and residential proximity to a landfill typically consider a three mile radius (Bridges et al., 2000; Mataloni et al., 2016; Vrijheid, 2000)
[7] See Calculation 3 in Appendix A
[8] See Calculation 4 in Appendix A

LITERATURE REVIEW

In developing meaningful policy alternatives to help improve the waste management apparatus in the Commonwealth, one should analyze the question: Who needs to do what?

In effort to answer that question, the following overviews the two governance frameworks, centralization and adaptability, as well as outlines the benefits and liabilities associated with centralized, decentralized, rigid, and adaptable systems. Then, it explores the market-based instruments the various levels of government have at their disposal to make meaningful policy interventions that curb out-of-state waste.

Centralization Framework

When assessing a governance structure's proclivity to centralization, one should consider who is making decisions, how the geographic boundaries are drawn, and which body bears liability to environmental hazards. Centralized governance in the waste management space typically grants authoritative power to few, select parties and are pre-disposed to concentrate a limited number of large-scale solid waste management facilities within few geographic areas (Massoud et al., 2019; Thompson, 2016). Also, central government is held accountable for waste management issues directly (Körner et al., 2008). Conversely, decentralized governance disperses authority among various governing bodies and are more likely to distribute small-scale waste management facilities across many geographic areas (Massoud et al., 2019; Thompson, 2016). Additionally, waste management accountability falls under the purview of the local government where the issue manifests (Körner et al., 2008).

Lessons on centralization can be pulled from both private and public center management strategies. In the private sector, successful waste management programs are managed centrally with clear communication flow from a central office to individual operators, citing benefits in operating efficiently and more easily reaching the critical mass necessary to most easily manage different types of waste materials (Spiegel & Orozco, 2018). Additionally, more centralized waste management systems tend to yield lower costs per waste unit (Araya, 2018). Further, more centralized and concentrated systems remove the perception of environmental and ecosystem burdens in local communities (Araya, 2018).

The benefits of a decentralized governance structure comprise higher quality and better targeted services (Faguet, 2014). Additionally, decentralized governance, with its tendency for smaller, more dispersed disposal sites, also has the potential to improve local economics by creating new jobs (Singh, 2016; Thompson, 2016). Further, transportation costs are relatively lower as waste remains local, rather than being disposed of in large, central landfills (Araya, 2018).

Adaption Framework

In assessing a governance structure's flexibility when addressing policy issues writ large, one could consider: Should governance be centered around serving particular geographic communities or centered around particular policy problems (Hooghe & Marks, 2003)? The former lends itself to a system of non-overlapping jurisdictions that cleanly delineates authoritative packages, like federalism in the United States (Hooghe & Marks, 2002). The latter envisions a fluid collage of overlapping jurisdictions that ebb and flow as demands for governance change (Hooghe & Marks, 2002). To be clear, neither of these are fundamentally attached to a particular level of centralization, rather these

structures consider who is involved when governance decisions are being made (Baldwin et al., 2016).

Governance models that employ non-overlapping general-purpose jurisdictions possess strengths in its ability to ease administration and improve accountability. Given the rigidity of this structure, governing institutions are more durable, thus making administration easier to complete (Hooghe & Marks, 2003). Further, governance vis-à-vis rigid boundaries provides the potential to work with existing communities that may share a common purpose (Lenz et al., 2014).
In contrast, more adaptable governance models that enable interdependent decision-making from multiple centers rather than the aforementioned rigid structure possess a number of strengths of its own. Within environmental policy contexts, adaptive governance systems often show up with water management. For example, Huitema et al. identifies several strengths in a bioregional approach to governance in the case of river-basin management through the use of river-basin organizations, tending more to the ecological priorities of the water rather than the power dynamics of localities within the river-basin (2009).

Governance can also be dispersed and overlap boundaries using a more adaptive approach. For another example, the success of transportation planning in San Francisco where four county transit districts, a state authority, a city commission, and regional commission work fluidly together to provide a high quality of service demonstrates the potential benefits associated with governance by complex systems (Chisolm, 1992). Rather than working within rigid boundaries, this interconnected network of governing bodies collaborates to address their targeted need, in this case, providing high quality transportation services.

While the literature presently has gaps when directly applying an adaptive or rigid governance framework specifically to solid waste management, one can still the extrapolate the core benefits and liabilities present within each model.

Market-Based Instruments

The policy interventions, regardless the implementing level or consortium of government, can be described into two broad categories: command-and-control and market-based instruments. Command-and-control policies rely on regulation, typically through standard settings, to achieve a desired outcome (OECD, 2001).Considering the previously described connection between command-and-control policies in the 1970s and interstate waste today, as well as the Senator's desire to explore new waste management legislative strategies, the following focuses on market-based instruments.

Primarily in the sustainability space, market-based instruments are tools that modify economic conditions to provide incentives and help achieve a stated goal (*Market-Based Instruments*, 2015). Within this collection of tools include price-based instruments, where government adjusts the price to reflect environmental and social costs, rights-based instruments, where government sets a limit on the quantity of a given good or service, and market-friction reduction instruments, where government helps bridge any information asymmetries (*Market-Based Instruments*, 2015).

The instrument commonly employed with MSW management is a price-based instrument known as a tipping-fee. These fees are taxes paid by waste haulers based on the weight of the waste per ton when dumping at a landfill (Neil, 2021).

In practice, the tipping fee is an effective and simply policy instrument for incentivizing desirable MSW management behaviors. In Wisconsin, which had a similar out-of-state recycling dynamic to Virginia with bordering Illinois and Minnesota due to its lower tipping fee, researchers modeled various surcharge amounts aimed at diverting waste from beyond its borders. They ultimately found that raising Wisconsin's statewide tipping fee within $5 of the exporting states could divert near 70% of Wisconsin's out-of-state waste (Katers et al., 2009). Additionally, in Belgian, tipping fees were the preferred intervention in comparison to other market-based instruments, like a tradable credit or a refunded tax program – especially in terms of internalization and revenue generation (Dubois et al., 2015).

POLICY ALTERNATIVES

Alternative #1: Impose a Statewide Tipping Fee

The Virginia General assembly passes legislation during the 2023 session that imposes a statewide sanctioned tipping fee for all landfills, both public and private, in all localities across the Commonwealth. This state tax, based on the volume of waste received at the landfill over the year, is collected by the municipal solid waste landfill operator and regulated by VDEQ. Again, considering the research presented in Katers et al., the fee would need to be set at a rate similar to that of the exporting jurisdictions, around $70/ton, with the potential for amendment in future years (Boxman & Staley, 2021; 2009).

The revenue generated by this new state-wide tax would be split between the 66% to the locality and 34% to a research and development fund that supports improved data collection across the waste management system. The 66/34 division of revenue will maintain or increase the levels of local revenue in most localities, while also supporting the major need shared for improved data by stakeholders throughout the current MSW management system – it is difficult to appropriately craft comprehensive policy without reliable data (A. Johnson, personal communication, October 1, 2021).

Broadly, the statewide tipping fee aims to internalize the negative externalities associated with the development and use of municipal solid waste landfills, raising the private marginal cost of landfill operations closer to the social marginal cost. Further, a statewide tipping fee should disincentivize out-of-state haulers from importing their waste into Virginia. While the alternative may be effective reducing the waste disposed of in all of Virginia, it fails to directly address the interstate equity concerns. The central question with this alternative asks, "Does the magnitude of intrastate waste reduction cover for the persisting interstate inequities of the same vain?"

Alternative #2: Incentivize Localities to Adopt the State-Set Tipping Fee

The Virginia General Assembly passes legislation during the 2023 session that sets the state-wide tipping fee which includes funds scheduled to be retained by the locality and funds scheduled to enter the research and development fund outlined in Alterative 1 – all of which is outlined in state code. To incentivize locality adoption of the state-set tipping fee, compliant localities are eligible for local economic development funds from the Virginia Department of Housing and Economic Development (VDHED) (similar to the 1984 National Drinking Age Act, which withheld federally available highways funds from states failing to comply with the new drinking age requirement). The tax, which will be determined as an aggregate of existing tipping fees across Virginian localities, will encourage localities like Greene County with a $52/ton to raise their tipping fee while also possibly encouraging localities like Fairfax County, where haulers pay $66/ton with an additional $70 in arrival fees, to lower their fee (should they consider the benefits associated with additional economic development funds greater than the revenue they current generate from existing tipping fees).

Foremost, this alternative addresses intrastate equity concerns. Presently, waste haulers can exploit the discrepancy in tipping fees by locality and transport the waste farther from its origination (which yields more negative environmental and infrastructural externalities). Leveling the playing field, or at least reducing the gap, between different localities should curb this behavior. Additionally, poor, rural localities welcome landfill development within their jurisdiction as, without other economic drivers, the landfill can generate substantial revenue (Vogelsong et al., 2018). By providing localities

with an alternative means to stimulate economic development in the jurisdiction, they might also be less inclined to welcome landfill development and expansion.

However, tradeoffs for this alternative include take-up and program administration. Some localities may strategize to not take the VDHED funds and leverage the lack of localities willing to host large, private landfills in Virginia to bargain for better contracts with landfill developers. Additionally, given the heavy involvement of localities and VDHED, this alternative appears less administratively feasible.

Alternative #3: Empowering SWPUs to Impose Tipping Fees

The Virginia General Assembly passes legislation during the 2023 session that first reorganizes the existing 71 Solid Waste Planning Units[9] (SWPUs) to match the organization of Virginia's 21 planning district commissions as outlined in § 15.2-2210 of Virginia State Code and second empowers the SWPUs to impose an interjurisdictional tipping fee that funds regional waste planning effort by the SWPU. The tipping fee would be set by each individual SWPU on the same cycle as the five-year solid waste report due to VDEQ and based on its regional goals, consideration of participating localities, and capacity of the SWPU. This rectifies the negative externalities that present throughout the region with the construction of large, mega-landfill projects, especially when built on the border of two jurisdictions.

Authorizing SWPUs to generate revenue and enhance their solid waste planning efforts should also yield better decision making throughout the Commonwealth's waste management apparatus in the future. Presently, SWPUs lack the resources to collect and verify data from waste haulers and landfill operators, especially in terms of waste composition. With an improved understanding of waste flow throughout the Commonwealth, waste management priorities can be better scoped and properly addressed.

While this alternative address the issue with jurisdictional boundary landfill sitings within the same SWPU, the alternative fails to directly address that same dynamic for bordering localities in different SWPUs. Nevertheless, by funding and legitimizing the SWPUs to enact meaningful solid waste reduction planning and monitoring activities, localities will feel the regional pressure to limit their hyper-development of unnecessary landfills. Another potential liability with this alternative includes its administrative feasibility, considering the participation required by consortia of localities within each SWPU.

[9] Solid Waste Planning Units are administrative entities supervised by VDEQ that facilitate the regional efforts in solid waste planning, monitoring, and evaluation. Anecdotally, however, SWPUs' nominal budgets inhibit their ability to execute any meaningful solid waste planning or monitoring activities.

EVALUATIVE CRITERIA

Equity

Implementing fair and equitable policies is a key tenant of all the Senator's legislative priorities. Given the embedded difficulty in evaluating fairness, this criterion has been operationalized using four binary indicators that address the marked inequities present within Virginia's current waste management apparatus. These include jurisdictional disparities, historically marginalized communities' involvement in the decision-making process, and inter-generational environmental stewardship.

- *Jurisdictional Participation.* Presently, landfill siting decisions made at the local level yield disparate health, environmental, and infrastructural externalities on Virginians outside the landfill's jurisdiction. Does the proposed alternative provide effected Virginians a legitimate opportunity to advocate for their interest regardless of their locality of residence?
- *Rural Poverty.* Landfills are welcomely sited in poor, rural localities as local decision makers perceive the landfill as a means of driving economic activity in the community. Does the proposed alternative impose a significant barrier to a locality's ability to achieve economic prosperity?
- *Environmental Justice.* Environmental policies disadvantage or harm historically marginalized communities. Considering the Environmental Protection Agency's definition of environmental justice, does the proposed alternative meaningfully involve all people regardless of race, color, national origin, or income with respect to its implementation, enforcement, and regulation?
- *Environmental Stewardship.* An aim in implementing environmental policy is to preserve and protect existing natural resources for the prosperity of future generations; to be a good ancestor. Does the proposed alternative facilitate a reduction in landfill development in the Commonwealth?

Cost-Effectiveness

Considering the aforementioned health, environmental, and infrastructural cost associated with managing MSW from outside Virginia, the social cost of out-of-state MSW is $33.70 per ton. Multiplying that figure by the amount of out-of-state MSW managed in Virginia during 2020, this cost the Commonwealth approximately $137 million. By extension, the Commonwealth is past the point of asking *if* they should do something, but rather *which* intervention is most effective.

In this analysis, the unit of effectiveness is measured as the amount of out-of-state waste diverted from the Commonwealth's waste streams per $1. Using a five-year time window, the present value costs are divided by the total waste diverted for each intervention to determine the cost-effectiveness ratio. General assumptions include a standard 3% discount rate an inflation rate of 11% (Mid-Atlantic Information Office, 2022).

Additionally, the analysis focuses exclusively on reducing waste specifically from Maryland, New Jersey, and New York. Together, these three states account for 76% of all Virginia's imported waste (Virginia DEQ, 2021). Further, considering each of these states have average tipping fees within a similar range, one might expect similar responses to increased tipping fees from waste haulers across all three states.

To standardize the continuous cost-effective ratios, the following discrete categories are used.

- *Low*. The cost-effectiveness ratio is less than 1.
- *Medium*. The cost-effectiveness ratio is greater than 1 but less than 33.7[10].
- *High*. The cost-effectiveness ratio is greater than 33.7.

Political Feasibility

Good legislation means very little without substantial buy-in from key decision makers. Especially considering the Senator's previous legislative impasses within the Senate Committee for Agriculture, Conservation, and Natural Resources, the political feasibility of the alternatives presented need be considered. The rankings of this criterion attempt to standardize the proposed alternative's ability to ascend the legislative system into Virginia State Code.

- *No Value*. The proposed alternative dies in committee. Considering this was the outcome of the Senator's previous attempts to make progress on waste management reform in Virginia and functionally changes nothing, any alternative ranked this should not be further pursued.
- *Low*. The proposed legislation passes through a Senate committee other than that on Labor and Commerce but does not pass in the Senate. While the proposal may generate or revitalize waste management conversations in Richmond, waste management is not seen as a commerce issue (a priority of the Senator).
- *Medium-Low*. The proposed legislation passes through the Senate Committee on Labor and Commerce but does not pass with the whole Senate body. The proposal, though not effective in waste management reform, facilitates the Senator's framing that waste management is a commerce issue.
- *Medium-High*. The proposed legislation gains approval by both the Virginia State Senate and House of Delegates, but does not receive the Governor's approval to be enacted. With support from both chambers apparent, future legislative avenues for waste management are paved for more amiable administrations.
- *High*. The proposed legislation gains approval by both the Virginia State Senate and House of Delegates and is signed by the Governor.

This criterion will be evaluated considering peer legislation introduced in the Virginia General Assembly within the past twenty years.

Administrative Feasibility

This criterion captures the ease of implementation when ultimately enacting the policy alternative. Given that including additional actors in the execution of a new policy augments the complexity of its administration, this criterion operationalizes its evaluation of the alternatives accordingly. Here the term actor describes state agencies, governmental bodies at the local, regional, and state levels, quasi-governmental agencies (i.e. planning district commissions), as well as other administrative bodies (i.e. Solid Waste Planning Units).

- *Low*. The alternative requires participation by more than six actors for its implementation.
- *Medium*. The alternative requires the participation of between four and six (inclusive) actors for its implementation.
- *High*. The alternative requires the participation of three or less actors for its implementation.

[10] This threshold was chosen given the back of the envelope calculations described in Quantifying the Cost of Municipal Solid Waste. Alternatives with a cost-effectiveness ratio should yield greater than a second order benefit.

POLICY ALTNERATIVE EVALUATION

Alternative #1: Impose a Statewide Tipping Fee

Equity

- *Jurisdictional Participation:* The tipping fee, imposed consistently across all landfills in all localities, provides all Virginians the opportunity to advocate for their interests through their Delegate or Senator regardless of their locality of residence. (✓)
- *Rural Poverty:* The statewide tipping fee directly curtails rural localities' ability to attract out-of-state waste haulers to dump at their facility, threatening potential revenue streams. Thus, implementing a tipping fee imposes a barrier for rural localities to achieve economic prosperity.
- *Environmental Justice:* The research and development fund generated by the statewide tipping fee will help support improved waste management governance at the local and state level – including more coordinated efforts to involve historically marginalized communities in MSW planning (✓).
- *Environmental Stewardship:* Imposing a statewide tipping fee will weaken the waste market in Virginia, disincentivizing out-of-state waste haulers from using Virginia as their dumping grounds. Therefore, this tax will facilitate a reduction in landfill development across the Commonwealth. (✓)

Considering the positive outcomes associated with three out of four of the binary indicators, the equity criterion for this criterion ranks **medium-high**.

Cost-Effectiveness

As outlined in Appendix B, imposing a statewide a statewide tipping fee can reduce 46.4 tons of municipal solid waste per dollar spent regulating and administering the program, scoring **high** in cost-effectiveness. The primary costs of the tax are personnel – regulatory and administrative at VDEQ and administrative at the Virginia Department of Taxation (VDT) – valued at about $232,842 over the next five years in hourly wages. Assuming that raising the average tipping fee in Virginia to match the average tipping fee in states that export waste into Virginia reduces imported waste from those states by 70%, the statewide tipping fee can reduce over 11 million tons of waste from those states over a five-year period. The effectiveness per dollar spent of the tax is calculated by dividing 11 million tons of waste by 232,842 in personnel costs.

Political Feasibility

In the past twenty years, there have been two attempts to implement a statewide tipping fee, both to no avail: first under Governor Mark Warner's tenure in 2002 where he attempted to attach a $5 tipping fee as part of large, omnibus waste management reform bill and second in 2007 when republican Harry Purkey from Virginia Beach introduced HB 1492 requiring a $1 tipping fee.

Senator Hanger introduced SB 592 in 2002 and both the Senate and the House of Delegates comfortably approved the legislation that directed the Virginia Waste Management Board to develop a new permit fee schedule for hazardous and solid waste programs (Hanger Jr., 2002). Rising through both the Senate Committee on Agriculture, Conservation, and Natural Resources and its sister committee in the House, the legislation reached the governor's desk where he added the $5 tipping fee on every ton of waste disposed at a landfill. The amendment was rejected by the Senate

(23 – 17), and the bill was ultimately referred back to committee. At the end of the session, the committee unanimously voted on the legislation's continuation in 2003, however it died there in committee that following year.

Just five years later, Delegate Harry Purkey introduced HB 1492, which was eventually assigned to the House Sub-Committee on Agriculture, Chesapeake, and Natural Resources. The bill also ultimately stalled in committee (Purkey, 2007). This bill's journey through the legislative process is interesting as it demonstrates potential interparty republican politics. Purkey, a Republican representing a district which at the time was closing its major landfill, introduced the legislation to a sub-committee chaired by republican Delegate Lee Ware, the representative for the part of Chesterfield County home to the large Shoosmith Landfill. Perhaps this indicates that the politics surrounding tipping fees in Virginia centers more on the local impact present among their constituents and relations with their local landfill operators more so than partisan politics.

Both these cases considered, imposing a statewide tipping fee ranks **low** in political feasibility. In both prior attempts, the tax centers on the environment and conservation intentions rather than its commercial or financial aspects. Further, while the legislation in 2002 did in fact make it to the Governor's desk, the tipping fee was not amended into the bill until reaching the Governor's desk – essentially attempting to bypass the legislative hurdles and ultimately being unsuccessful.

Administrative Feasibility

The imposition of the statewide tipping fee will be monitored by the Virginia Department of Environmental Quality (VDEQ) and collected by VDT. Once collected, the revenue will ultimately return to VDEQ's budget for research and development. Considering the state-wide tipping fee requires only two actors in its implementation and its revenue returns to VDEQ, this alternative ranks **high** in administrative feasibility.

Alternative #2: Incentivize Localities to Adopt the State-Set Tipping Fee

Equity

- *Jurisdictional Participation:* Rolling out a tipping fee on an option take-up basis does not address the transboundary pollution concerns under Virginia's current waste management governance structure, nor provide Virginians an adequate channel to voice concern on the externalities they experience given the decisions made in a different locality. Further, implementing this patchwork policy may generate bifurcated reactions for localities with a large landfill presence. While some localities accepting low amounts of excess waste may find a greater utility in the community development funds, localities already accepting high amounts of excess waste may inherit more waste at a higher premium.
- *Rural Poverty:* This alternative targets rural Virginian counties. Providing local economic development funds to a locality subsidizes the lost benefits associated with the revenue with reduced dumping. By extension, this alternative does not impose any barriers for rural localities ability to achieve economic prosperity, rather it enables them to another means of cultivating financial well-being. (✓)
- *Environmental Justice:* This alternative does not make any progress on involving marginalized groups and populations in the implementation, enforcement, and regulation of MSW.
- *Environmental Stewardship:* This alternative's effect on the MSW market in Virginia is ambiguous. While, as mentioned earlier, certain localities may strategize to opt in or out of the tipping fee,

there is not adequate data available to suggest how that might affect landfill development in Virginia en masse. (✓-)

Given the positive equity outcomes for rural poverty and the ambiguity related to environmental stewardship, this alternative ultimately scores **medium-low**.

Cost-Effectiveness

Incentivizing localities to adopt the state-set tipping fee can reduce 0.12 tons of municipal solid waste per dollar spent by the Commonwealth. The costs required to regulate and administer this program include personnel cost at VDEQ, VDT, and VDHCD, technology cost to support the new hires VDT and VDHCD, and the actual cost of the community development grant at $10 million. The analysis of the benefits for this version of the tipping fee tax resembles Alternative #1, as it measures a reduction in tonnage by out-of-state haulers, however accounts for potentially low take-up into the program by localities, estimated to be 50%[11]. Dividing the reduction in waste tonnage over five-years (about 5.5 million tons) by the present value of costs (about $51 million), the 0.11 tons of municipal solid waste per dollar spent figure is calculated, ultimately ranking **low** for cost-effectiveness.

Political Feasibility

During the 2020 Session, Senator Adam Ebbin (D – Alexandria) introduced SB 11, a bill that authorized localities to impose a five-cent tax on disposable plastic bags provided to consumers. Referred to the Senate Committee on Finance and Appropriations, both the Senate and the House ultimately approved the bill with comfortable majorities in both chambers (26 – 14 and 52 – 46, respectively) (Ebbin, 2020). Governor Northam signed the bill in April 2020 and presently the Cities of Roanoke, Alexandria, and Fredericksburg and the Counties of Fairfax and Arlington maintain a bag tax (Virginia Tax, 2021).

The two key lessons to walk away from the bag tax's passing in 2020 include the legislature's willingness to empower and authorize localities to have autonomy in implementing taxes on their own prerogative and the ability for seemingly environmental legislation to rise through the Committee on Finance and Appropriations. Sculpting legislation that provides opportunity for localities to take-up a state-set tipping fee mirrors both these themes present in the 2020 bag tax and can be considered when thinking about its political feasibility.

The non-trivial difference between the bag tax and the proposed alternative involves the incentive structure: the bag tax has fewer moving parts and no incentive for localities to take-up the tax where the proposed tipping fee incentivizes localities with VDHCD funds in exchange for its compliance. While funding streams in the Commonwealth carry compliance measures, like State 599 funds that require locality police departments meet various criteria before receiving funds, inter-departmental contingencies do not appear to exist (Virginia Department of Criminal Justice Services, n.d.). Given the ambiguity surrounding the incentive structure, the alternative ultimately ranks **medium-low**, despite having the potential to garner wide political support and re-orient the narrative on tipping fees as one of finance rather than environmentalism.

[11] Programs like State 599 funds have wide-scale participation by 40 cities, 9 counties, and 126 towns in Virginia (Virginia Department of Criminal Justice Services, n.d.). Considering the novelty of the new grant program, the take-up is estimated at 50%.

Administrative Feasibility

VDEQ first needs to set the state tipping fee based on existing rates within localities. Once determined, local governments will then have to vote on their adoption of the tipping fee. If adopted, VDEQ and VDT will play the same roles as those outlined in Alternative #1. Additionally, VDHCD will provide community development funds to be administered by non-profit organizations within the participating jurisdiction. Counting at minimum five actors in implementing this alternative, it ranks **medium** in administrative feasibility.

Alternative #3: Empowering SWPUs to Impose Tipping Fees

Equity

- *Jurisdictional Participation:* Decision-making at the regional level will provide Virginians the opportunity to advocate for their interest via their local government representative. While this alternative may help resolve disparities in tipping fees between localities in the same SWPU, this alternative may not address the transboundary pollution effects at the boundaries of SWPUs – generating an ambiguous impact on jurisdictional participation. (✓-)
- *Rural Poverty:* SWPUs are administrative bodies composed of representatives from participating jurisdictions, rural and urban alike. Given rural localities' representation and participation in the SWPU's decision-making process, rural localities should not adopt a tax that imposes their ability to ascertain economic prosperity. (✓)
- *Environmental Justice:* In a regional consortium, localities may feel more on display (and therefor more inclined) to incorporate environmental justice principles and thereby include all people it their processes. Further, with the funds made available if and when localities adopt an interjurisdictional tipping fee, better decision making, and incorporation of many important perspectives may manifest. (✓)
- *Environmental Stewardship*: Similar to Alternative #2, there is no data available to assert that the tax really targeted to suppress intrastate differences in waste does not manifest as changes in interstate waste. While hopefully better than the take-up problem that presents with individuals localities opting into or out of the program, the effect of empowering SWPUs to impose an interjurisdictional tipping fee also remains ambiguous. (✓-)

Given the improved representation of rural localities and historically marginalized communities, as well as the combined ambiguous effects regarding jurisdictional participation and environmental stewardship, this alternative scores high in **equity**.

Cost-Effectiveness

Empowering SWPUs to optionally impose an interjurisdictional tipping fee wields the second highest effectiveness-cost ratio at 29 tons of MSW reduced per dollar spent by the state and local government. This alternative's cost involves nominal administrative support from VDEQ at $46,000, as well as $116,000 by administrators at the SWPU level over five-years. Similar to the benefits analysis conducted for the other alternatives, this alternative assumes similar tipping fees between Virginia and exporting states reduces out-of-state waste by 70% and a 50% SWPU take-up – summing to about 4.3 million tons of solid waste reduced over five-years. Dividing the waste reduced by the administrative cost from VDEQ generates the effectiveness-cost ratio of 29 tons reduced per dollar spent, ranking **medium** in cost-effectiveness.

Political Feasibility

Sen. Hanger Jr. introduced SB 1326 in the first 2021 special session, which empowered regional boards to work with the VDT to set a regional cigarette tax. Rising and passing through the Senate Committee on Finance and Appropriations and its sister committee in the House, the legislation passed both chambers comfortably (26 – 12 in the Senate and 65 – 35 in the House) (Hanger Jr., 2021).

Considering that the legislation required to implement a program that empowers SWPUs to consort localities in establishing a regional tipping fee, the easy passing of cigarette tax board legislation in 2021 may provide a potential insight into the political feasibility of other regional initiatives and locality tax collectives. By providing the opportunity for local actors to play a major role in decision making, a generally more conservative value, in the context of a more liberal subject matter, waste management reform and the environment, there appears to be substantial opportunity for this alternative to generate bi-partisan support.

Finally, reflecting on current Governor Greg Youngkin's preference for lower taxes and reduced government involvement, this alternative might only attain a **medium-high** level of political feasibility.

Administrative Feasibility

SWPUs are composed of at least two localities, however typically more, and are often administered by a regional or planning district commission. Additionally, VDEQ and VDT would be involved in monitoring waste collected and collecting appropriate taxes. With the implementation of this program involving at minimum six, however in most cases more actors, this alternative ranks **low** in administrative feasibility.

OUTCOMES MATRIX

Each of the criteria included in this analysis (equity, cost-effectiveness, political feasibility, and administrative feasibility) were included to illustrate the utility of the proposed alternatives across several dimensions. In tailoring the analysis to the values and prerogative of the Senator's office, the criteria are weighted as following:

Equity	30%	The Senator has been a champion of equity since her campaign in 2019 and helped pass legislation on environmental equity during the 2020 session. The premise of this policy project stemmed from developing more equitable waste management decision making across the Commonwealth, thus the equity criterion is weighted more heavily.
Cost-Effectiveness	20%	While the cost of any policy initiative bears considerable significance for the holistic quality of the policy, three of the four alternatives evaluated should generate the revenue to off-set its cost. For this reason, the cost-effectiveness is weighted marginally less.
Political Feasibility	40%	A key objective in this policy evaluation is providing the Senator actionable strategies to move the needle on waste management reform in the Virginia General Assembly. Accordingly, the political feasibility criterion is weighted more heavily.
Administrative Feasibility	10%	The target audience for the recommended policy is legislators rather than bureaucrats. Still, ease of implementation matters when crafting any meaningful policy. This considered, administrative feasibility is included in the evaluation, but weighted the least.

	Weightings	Alternative #1: State-Wide Tipping Fee	Alternative #2: Incentivize Localities to Adopt State-Set Tipping Fee	Alternative #3: Empower SWPUs to Impose Regional Tipping Fee
Equity	30%	High (3/4)	Medium Low (1.5/4)	High (3/4)
Cost-Effectiveness	20%	High (3/3)	Low (1/3)	Medium (2/3)
Political Feasibility	40%	Low (1/4)	Medium-Low (2/4)	Medium-High (3/4)
Administrative Feasibility	10%	High (3/3)	Low (1/3)	Medium (2/3)
Score (Scaled to 100)		**63**	**41**	**73**

RECOMMENDATION & IMPLEMENTATION

Given the evaluation of each proposed alternative and the weighting of each criterion, empowering SWPUs to impose a regional tipping fee clearly ranks as the best strategy for the Senator moving forward. While not as administrative feasibility or lucidly equitable as the state-wide tipping fee strategy, this alternative's scores of at least medium in every category demonstrates its high quality across our various dimensions of interest.

Next Steps

To enact the recommended alternative, the Senator and her office will need to complete several legislative actions before state agencies and regional government bodies can take-up the tax. First, the Senator will introduce legislation in the 2023 session that empowers regional government bodies to set and manage intra-locality tipping fees. This legislation, replicating language from SB 1326[12], should rise and pass through the Senate Committee on Finance and Appropriations. To solidify legislative success, the Senator should meet with committee chair Janet Howell before the beginning of the session. After passing through both the Senate and House of Delegates, the legislation will require authorization from Governor Glen Youngkin. The Senator should also try to schedule a meeting with the Governor to advocate for the benefits of these regional tipping fee.

Once authorized by the Governor, the Virginia Department of Environmental Quality (VDEQ) will sensitize the administering bodies of the 71 solid waste planning units (SWPUs) across the Commonwealth. Prina Chaudasma in VDEQ's central office will likely oversee this sensitization and explain the SWPUs role in facilitating intra-locality conversations regarding take-up into the program. Also, a representative from the Virginia Department of Taxation (VDT) will connect with the SWPU administrators to explain how the funds move between waste managers, localities, SWPU and the Commonwealth.

Thereafter, SWPUs will be able to implement their regional tipping fee beginning 1 January 2024. As means to optimize take-up into the program, the Senator's office might consider working with environmental organizations like the Virginia Conservation Network or the Southern Environmental Law Center to lobby SWPUs across the state.

Challenges and Opportunities

Embedded in this alternative include several challenges and opportunities throughout implementation. In terms of challenges, the Senator may still encounter legislative push-back from Senators with strong connections to the waste management lobby – while this proposal is substantially less explicit in its pro-environment vantage that previous legislation by the Senator, legislators may buy-in to regional decision making for waste management quite the same as they had for cigarette sales. Additionally, should even the legislation pass and receive authorization from Governor Youngkin, SWPUs may choose to not opt into the regional fee. This challenge particularly demonstrates the essential role that lobbying groups play in the achieving substantial effectiveness of the new policy.

The major opportunity associated with this alternative is its ability to kickstart and sustain better waste management planning efforts at the regional level. Presently, SWPU administrators do not

[12] This legislation enabled regional government bodies to work with the Virginia Department of Taxation in setting a multi-locality cigarette tax.

have the funding available to meaningfully engage with regional stakeholders, develop waste reduction or recycling strategies, and support member localities. With the revenue made available from the regional tipping fee, SWPU administrators are better equipped to fulfill their mandate.

Evaluation

The success of this alternative can be indicated across several dimensions, namely political effectiveness and waste reduction. With a political lens, should the policy not be enacted after the 2023 session, the legislation's ability to be taken-up by the Senate Committee on Finance and Appropriations and received by the General Assembly more broadly can be evaluated. For example, one can consider the legislation's assignment to the Senate Committee on Finance and Appropriations indicative that waste management can be discussed outside the typical environmental policy space.

In terms of waste reduction, several figures can be considered for evaluation. First, one can consider the take-up rate of the tax across the newly reorganized 21 SWPUs – the idea being that more SWPUs taking-up the tipping fee should help facilitate a reduction waste managed in the region. The geographic distribution of the SWPUs taking-up the tax may also be interesting to analyze from a regional equity perspective.

Additionally, VDEQ publicly releases annual reports that include the amount of out-of-state tonnage disposed of across the Commonwealth. Using this data, one can evaluate any immediate effect that the regional tipping fees have on reducing out-of-state waste from entering Virginia. Further, included in the report are data that track waste across SWPUs. Tracking those data as SWPUs take-up into the program should be able to help verify the central assumption of the policy that increased tipping fees disincentivize haulers from managing waste in higher costing jurisdictions.

APPENDICES

Appendix A: Value of Reduced Tonnage Calculations

Calculation #1: Environmental Cost of Transporting Waste from Out-of-State

$$150\ miles\ \cdot \frac{1\ truck}{14\ ton\ MSW} \cdot \frac{1\ gallon\ diesel}{5\ truck-miles} \cdot \frac{10\ kg\ CO_2}{1\ gallon\ diesel} \cdot \frac{1\ ton\ CO_2}{907\ kg\ CO_2} \cdot \frac{\$42}{1\ ton\ CO_2} \cdot 2 = \frac{\mathbf{\$1.98}}{\mathbf{1\ ton\ MSW}}$$

Calculation #2: Infrastructural Cost of Transporting Waste from Out-of-State

$$150\ miles\ \cdot \frac{1\ truck}{14\ ton\ MSW} \cdot \frac{\$0.02}{1\ mile} \cdot 2 = \frac{\mathbf{\$0.42}}{\mathbf{1\ ton\ MSW}}$$

Calculation #3: Cardiovascular Health Cost of MSW

$$\frac{1\ landfill}{10M\ tons\ MSW} \cdot \frac{250\ people}{1\ landfill} \cdot \frac{1\ person}{20\ people} \cdot \frac{1.08\ increase\ in\ hospitalizations}{1\ person} \cdot \frac{\$16{,}000}{1\ hospitalization} = \frac{\mathbf{\$0.02}}{\mathbf{1\ ton\ MSW}}$$

Calculation #4: Respiratory Health Cost of MSW

$$\frac{1\ landfill}{10M\ tons\ MSW} \cdot \frac{250\ people}{1\ landfill} \cdot \frac{1\ person}{20\ people} \cdot \frac{1.03\ increase\ H_2S\ exposure}{1\ person} \cdot \frac{1.10\ increase\ in\ mortality}{1\ exposure} \cdot \frac{\$9{,}890{,}000}{1\ human\ life} = \frac{\mathbf{\$14.00}}{\mathbf{1\ ton\ MSW}}$$

Assumptions

Calculation 1

Assumption	Value	Source
Truck travel from state boundary to landfill	150 miles	Google Maps
Tonnage of MSW per 1 Truck	14 T	(South Carolina Department of Health and Environmental Control, n.d.)
Truck diesel gas mileage	5 miles/G	(Brown, 2013)
Diesel-CO2 emission rate	10kg/G	(Brown, 2013)
Social cost of carbon	$42/T	(US EPA, 2016a)

Calculation 2

Truck travel from state boundary to landfill	150 miles	Google Maps
Tonnage of MSW per 1 Truck	14 T	(South Carolina Department of Health and Environmental Control, n.d.)
Highway truck-use damage-rate usage	$0.02/mile	(Bai et al., 2010)

Calculation 3

Average Virginian landfill capacity	10,000,000 T	(US EPA, 2022)
Attendance at Cumberland County public interest meeting	250 people	(McFarland, 2018)
Likelihood of cardiovascular hospitalization associated with living proximate to landfill	1.08	(Mataloni et al., 2016)
Average cost of cardiovascular hospitalization	$16,000	Kilgore et al.

Calculation 4

Average Virginian landfill capacity	10,000,000 T	(US EPA, 2022)
Attendance at Cumberland County public interest meeting	250 people	McFarland
Likelihood of hydrogen sulfide exposure associated with living proximate to landfill	1.03	(Mataloni et al., 2016)
Likelihood of mortality associated with hydrogen sulfide exposure	1.1	(Mataloni et al., 2016)
Value of statistical life	$ 9,890,000	(US EPA, 2014)

Appendix B: Cost-Effectiveness Analysis

Alternative #1: State-Wide Tipping Fee

Year		1	2	3	4	5
Category						
Costs						
Personnel						
	Regulatory – VDEQ	$ 26,180.00	$ 22,575.80	$ 16,787.66	$ 10,764.92	$ 5,952.58
	Administrative – VDEQ	$ 13,090.00	$ 11,287.90	$ 8,393.83	$ 5,382.46	$ 2,976.29
	Administrative – VDT	$ 34,737.98	$ 29,955.61	$ 22,275.38	$ 14,283.87	$ 7,898.42
Technology						
	Computer	$ 300.00				
Effectiveness						
Out-of-State Waste						
	Maryland	1,217,195	1,217,195	1,217,195	1,217,195	1,217,195
	New York	476,108	476,108	476,108	476,108	476,108
	New Jersey	469,270	469,270	469,270	469,270	469,270

Assumptions

% reduction in out of state waste with tipping fee	70%
# hours regulatory – VDEQ per year	1000
# hours administrative – VDEQ per year	500
# hours administrative – VDT per year	1500
Net Discount Rate	16%
Discount Rate	3%
Inflation Rate	11%

Totals

Present Value of Costs (5 Years)	$	232,842.71
Reduction in Municipal Solid Waste Tonnage (5 years)		10,812,861

Effectiveness-Cost Ratio (tonnage reduced per $)	**46.43847806**

Alternative #2: Incentivize Localities to Adopt a State-Set Tipping Fee

Year		1	2	3	4	5
Category						
Costs						
Personnel						
	Regulatory - VDEQ	$ 26,180.00	$ 22,575.80	$ 16,787.66	$ 10,764.92	$ 5,952.58
	Administrative - VDEQ	$ 13,090.00	$ 11,287.90	$ 8,393.83	$ 5,382.46	$ 2,976.29
	Administrative - VDT	$ 34,737.98	$ 29,955.61	$ 22,275.38	$ 14,283.87	$ 7,898.42
	Administrative - VDHCD	$ 53,138.46	$ 45,822.89	$ 34,074.51	$ 21,849.94	$ 12,082.16
Tech						
	Computer	$ 600.00				
Grant						
	VDHCD Grant	$ 10,000,000.00	$ 10,000,000.00	$ 10,000,000.00	$ 10,000,000.00	$ 10,000,000.00
Effectiveness						
Out-of-State Waste						
	Maryland	608,597	608,597	608,597	608,597	608,597
	New York	238,054	238,054	238,054	238,054	238,054
	New Jersey	234,635	234,635	234,635	234,635	234,635

Assumptions

% reduction in out of state waste with tipping fee	70%
% locality take-up into program	50%
# hours regulatory - VDEQ per year	1000
# hours administrative - VDEQ per year	500
# hours administrative - VDT per year	1500
# hours administrative - VDHCD per year	2000
Net Discount Rate	16%
Discount Rate	3%
Inflation Rate	11%

Totals

Present Value of Costs (5 Years)	$	50,400,110.67
Reduction in Municipal Solid Waste Tonnage (5 years)		5,406,430

Effectiveness-Cost Ratio (tonnage reduced per $)	**0.10727021**

Alternative #3: Empower SWPUs to Impose Regional Tipping Fees

Year		1	2	3	4	5
Category						
Costs						
Personnel						
	Administrative - VDEQ	$ 10,472.00	$ 9,030.32	$ 6,715.07	$ 4,305.97	$ 2,381.03
	Administrative - SWPU	$ 36,960.00	$ 31,871.72	$ 23,700.23	$ 15,197.54	$ 8,403.64
Effectiveness						
Out-of-State Waste						
	Maryland	486,878	486,878	486,878	486,878	486,878
	New York	190,443	190,443	190,443	190,443	190,443
	New Jersey	187,708	187,708	187,708	187,708	187,708

Assumptions

% reduction in out of state waste with tipping fee	70%
% SWPU take-up	40%
# hours administrative - VDEQ per year	400
# administrators at the SWPU level	21
# hours administrative at each SWPU per year	200
Net Discount Rate	16%
Discount Rate	3%
Inflation Rate	11%

Totals

Present Value of Costs (5 Years)	$	149,037.52
Reduction in Municipal Solid Waste Tonnage (5 years)		4,325,144

Effectiveness-Cost Ratio (tonnage reduced per $)	**29.02050751**

Calculation Inputs

Input	Value	Source
DEQ Personnel Hourly Rate	$26.18	(GovSalaries, 2020b)
VDT Personnel Hourly Rate	$23.16	(GovSalaries, 2020c)
VDHCD Personnel Hourly Rate	$26.57	(GovSalaries, 2020a)
VDHCH Annual Block Grant	$ 10,000,000.00	(Virginia DHCD, 2020)
% out of state waste from MD	43%	(Virginia DEQ, 2021)
% out of state waste from NY	17%	(Virginia DEQ, 2021)
% out of state waste from NJ	16%	(Virginia DEQ, 2021)
Total out of state waste in 2020 (tons)	4070341	(Virginia DEQ, 2021)
New Dell Computer	$300.00	(Dell Technologies, 2022)
% rural counties in Virginia	38%	(Office of Management and Budget, 2005)
Inflation Rate	11.2%	(Mid-Atlantic Information Office, 2022)
PDC Personnel Hourly Rate	$22.00	(*Richmond Regional Planning District Commission Salaries*, 2020)
Effectiveness Reducing Out-of-State Waste with Tipping Fee	70%	(Katers et al., 2009)

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