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Local Government Environmental Policy Innovation: Emerging Regulation of GHG Emissions in the Transportation-for-Hire Industry

Austin Zwick [1], Mischa Young [2,*], Zachary Spicer [3] and Karina Freeland [1]

[1] Maxwell School of Citizenship and Public Affairs, Syracuse University, Syracuse, NY 13244, USA; alzwick@syr.edu (A.Z.); kfreeland@syr.gov (K.F.)
[2] Urban Environments Studies and Research Center, Université de l'Ontario Français, Toronto, ON M5E 0C3, Canada
[3] School of Public Policy and Administration, York University, Toronto, ON M3J 1P3, Canada; zspicer@yorku.ca
* Correspondence: mischa.young@uontario.ca

Abstract: Given that most environmental regulation is performed on the international and national scale and that municipal powers are often limited, what are the necessary conditions for local government to take on leadership and policy innovation in this space? The transportation-for-hire industry provides an interesting case study as municipalities around the world recently updated their local regulatory frameworks because of the disruption caused by the advent of ridehailing. Over time, policy learning resulted in policy convergence of major components, including license requirements, vehicle standards, and rate standardization, across the industry. However, overlooked from these initial regulations, but now gaining traction is the regulation of greenhouse gas (GHG) emissions of ridehailing vehicles and the transportation-for-hire industry more generally. Because of how many transportation-for-hire vehicles are in use, activists argue that environmental fleet standards ought to be tougher than that for personal-use vehicles. This paper investigates the emerging regulatory frameworks for GHG emissions by examining four case studies of the first-mover cities (London, Amsterdam, Mexico City, and New York City) in this emerging policy space, untangling the complex web of multi-level regulatory governance to tease our policy learning outcomes. Through the innovative lens of examining multi-level governance for policy learning, we conclude that GHG emissions in the transportation industry at the local level only occurred after international and national frameworks were set, giving "permission" to local leaders to demonstrate innovation and leadership on how to achieve targets set by higher-order governments. Cities, assisted with policy-learning transfer through international not-for-profit organizations, acted via local government powers to fill in the gaps of international and national frameworks with policies implemented at higher orders of government in other places. These local environmental transportation-for-hire bylaws took a three-pronged form: (a) vehicle permit standards; (b) regulations of public space and infrastructure; and (c) public–private partnerships to assist in the transition to electric vehicles.

Keywords: transportation-for-hire; GHG emissions; Paris Climate Agreement; intergovernmental relations; policy learning; C40

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1. Introduction

Most environmental regulation is shaped on the international stage, requiring individual countries to implement national laws to achieve global standards (i.e., CFCs, ozone layer, ocean waste, etc.). In order to hit emission targets, set out by the Paris Climate Agreement, developed countries are mandated to submit plans to achieve their Nationally Determined Commitment (NDC) while it remains encouraged for developing countries. As a part of these plans, countries are making requests and passing laws for their subnational governments (i.e., municipalities) to do their part in alignment with their policy-space responsibilities. Unlike countries, cities have much more limited policy scope and governance powers, but this has not stopped them from experimenting with new regulations (i.e., by-laws) to achieve their goals. Given that most environmental regulation is performed on the international and national scale and that municipal powers are often limited, our primary research question is as follows: what are the necessary conditions for local government to take on leadership and policy innovation in this space?

To research this topic, our study needed to identify a policy area that intersects with sustainability while falling under the local government policy-making space. We chose the transportation-for-hire industry (different countries and the academic literature refer to analogous concepts by different names. For the purposes of this paper, we used a standardized set of terms even if legal or technical definitions may vary. Ridehailing is also called ridesharing or transportation-networks services (TNCs). Transportation-for-hire refers to all private-vehicle-for-hire services, including taxis, ridehailing, limousines, etc. We use the term electronic vehicles (EVs) to refer to all vehicles that have stringent environmental standards and have some degree of electrification, including hybrid electronic vehicles (HEVs), low-emission vehicles (LEVs), low-carbon vehicle (LCV), zero-emission vehicle (ZEV), and more. Low-emission zones (LEZ) are geographically bounded areas that only EVs can drive-in, are also referred to as ultra-low-emission zones (ULEZ), low-carbon zones (LCZs), or zero-carbon zones (ZCZs)) (more colloquially known as taxis) as they have historically been regulated almost exclusively on the local level. With the advent of ridehailing, the industry faced significant disruption when over concerns of labor equity [1] and rider safety [2] led municipalities to respond to this disruptive industry with regulatory action [3]. Over time, policy learning resulted in policy convergence of major components, including license requirements, vehicle standards, and rate standardization, across the industry, but the regulation of greenhouse gas (GHG) emissions was often overlooked [4].

This policy space is at a unique nexus of interaction between international, national, and subnational (i.e., city) government levels, both between countries and within them, becoming the ideal case study for studying multi-level government sustainability policy. Furthermore, international not-for-profit climate advocacy organizations (i.e., C40, Bloomberg Philanthropies, Climate Action Network) worked closely with multiple levels of government to enable policy-learning and policy-transfer. Our literature review establishes that GHG emissions from transportation-for-hire vehicles remain an ongoing concern, and we found a hole in the policy learning literature as it does not consider multi-level governance, particularly on international issues. No research has asked what local government is undertaking to address GHG emissions, and where their policy proposals originate.

We started our research by identifying which cities have already enacted policies in the transportation-for-hire policy space through a media search of major cities. Though we came across many cities that either are publicly debating action (i.e., Boston) or have passed subnational legislation that will require future regulation (i.e., California), the only four cities around the world that have already enacted specific regulations on the transportation-for-hire industry on GHG emissions as of May 2023 are Amsterdam, Mexico City, New York City, and London. (Other cities not included in the study have some degree of ridehailing regulation too; this is not intended to be an exhaustive list. As all EU cities are operating under the same international framework, we chose to focus on Amsterdam as it has the most developed transportation-for-hire policy framework even though we found some information about additional European cities (e.g., Paris, Lisbon, and Madrid). We found secondary source information about Chinese cities (Guangzhou, Zhengzhou, Wuhan, and Xi'an) requiring electrification of their transportation-for-hire fleets but could not locate the primary source information. We believe this is due to language access). We then located the primary and secondary sources to understand their transportation frameworks with regard to environmental regulation, and then the interaction between international, national, and subnational policies in order to untangle the complicated web of multi-level governance of sustainability of the transportation-for-hire subsector within the wider transportation regulation sector. Finally, we examined the transportation-for-hire policies of the case study cities to uncover similarities and differences). The innovative part of this research is exhibiting that intergovernmental and intragovernmental policy learning are co-occurring in multiple countries concurrently.

2. Literature Review

2.1. Ridehailing Regulatory History

Policy and regulatory systems are prone to change over time. Like many policy systems, municipal policy and regulatory systems are sensitive to external events that demand response from local decision-makers [5,6]. Often these types of events come from senior orders of government or other national or international actors, but a common dimension is scale, the limited scale of municipal jurisdiction, and the expanded scale of external actors. Policy learning is an adopted method of overcoming externally imposed risk, which takes place when policymakers experience common problems and examine the response of comparable jurisdictions [7]. It is rare that one government will experience a challenge that another has not. As a result, government decisions are often informed by the experiences of others. Decision-makers often engage in a learning process to better understand why a policy was implemented, what impact the policy had, what contextual factors exist that led to the policy's failure or success, and what could be gained by adopting the approach of another jurisdiction on their own [8]. This learning can take several forms, including both deliberate efforts to account for both policy success and failure and a more passive socialization approach which gradually allows for consensus on certain policy ideas [9]. Policy learning often leads to policy convergence, where several jurisdictions come towards a similar policy or regulatory position [10]. As more governments experience a common policy challenge, a consensus policy approach emerges and it is likely to be emulated. This creates a convergence point where other governments gravitate, creating a degree of homogeneity in policy response.

Cities have long regulated their transportation-for-hire sectors (i.e., taxis, limousines). The advent of ridehailing presented a moment of disruption to local regulation, adding a new industry to the mix. As ridehailing became more popular, municipalities were subjected to an external disturbance to their regulatory environment, albeit at different times as ridehailing firms did not enter every market simultaneously. Past research has demonstrated that there was a regular learning experience present with ridehailing, where decision-makers converged upon a common regulatory approach over time [2,4]. During the early entry of several ridehailing firms, regulators were unsure of how to approach the companies and drivers. These firms argued that they should not be classified as existing taxi services; instead, they were operating a digital platform that connected drivers and passengers. Even as municipalities insisted that ridehailing firms like Uber were, in fact, engaging in transportation-for-hire services, firms continued to refuse to abide by existing transportation-for-hire policies. This refusal ushered in an environment of policy uncertainty, leading to a scattered response from municipalities, with some taking a hard enforcement approach to ridehailing firms and others adopting a laissez-faire approach in the absence of new regulation. Whichever response was selected, firms like Uber continued to operate, forcing municipalities to adopt a complete and enforceable approach that attempted to balance consumer demand with community protection. As a regulatory path emerged, uncertain actors adopted common regulatory elements. Much of this can be attributed to Uber's continual lobbying efforts [11], which highlighted the approach of comparable jurisdictions that had accepted a position favorable to the company [12]. Once this convergence point was reached, change became incremental. This convergence point has been experienced in several aspects of ridehailing regulation.

However, to date, GHG emissions and sustainability have been low on the policy agenda of most municipalities, despite a rise among the academic and scientific community and increased focus on climate action and sustainability among municipalities, and therefore, were left out of this initial round of policy convergence on ridehailing.

2.2. Ridehailing's GHG Impact

Following their introduction just over a decade ago, ridehailing services have grown to account for a sizeable share of the urban transportation market [13,14]. This in turn has raised questions about their effect on congestion, vehicle kilometers driven, and air pollutant emissions. While the overwhelming majority of research concludes that the ridehailing industry has increased transport-related greenhouse gas emissions, some argue that its effect may be more convoluted given its potential to enhance a carless lifestyle and the presence of pooled ridehailing services. To better understand the industry's overall effect on emissions, it is helpful to breakdown its effects on mode choice, trip generation, and vehicle kilometers driven.

2.2.1. Ridehailing's Effect on Mode Choice

Given their convenience and relative low costs, it is no wonder ridehailing services such as Uber, Lyft, and Didi Chuxing, have been able to attract such high ridership and capture a sizeable share of the urban transport market. Early research on ridehailing [13,15] found their userbase to be primarily comprised unsatisfied taxi users looking for a cheaper and more convenient alternative. But the assertion that ridehailing was replacing taxis, particularly in neighborhoods ignored by taxi services, while often reiterated by Uber's spokespeople [16] does not reveal the full picture. Indeed, given their multi-billion dollar valuation, some rightfully argued that ridehailing companies could not simply content themselves with the market historically occupied by the taxi and limousine industry, and would also need to capture new users from other modes as well [17].

Public transit users were the obvious targeted group, as constant delays, service cuts, and safety concerns provided a massive base of disgruntled potential users willing to at least consider the use of viable alternatives, such as ridehailing. While ridehailing was never going to be as cheap as public transportation, the initial deluge of discounts supplied in hopes of capturing and retaining sufficient market share rendered these services at least comparable to transit in terms of costs, especially when sharing the price of a ride with other passengers. The constant injection of subsidies, coupled with the unmatched level of convenience provided by ridehailing, pushed many towards these services and may ultimately have led to the decline in transit ridership observed in many cities across North America in the 2010s [18]. Numerous studies confirm that riders are substituting away from transit in favor of ridehailing [19–23] and warn against the longer-term effect this may have on the quality and level of transit services as agencies' budgets decline at a rapid pace [24]. This negative depiction of ridehailing does not mesh with the image these companies are trying to portray of themselves, as they rather emphasize ridehailing's potential as a first- or last-mile solution to connect with existing transit networks and accentuate its ability to complement overcrowded transit routes [25]. And while studies that have examined its potential to serve as a first- or last-mile solution only find that 5% of ridehailing trips are used to connect with other modes, including public transit [23,26], this has led some to conclude that depending on the time, location, and context of ridehailing trips, they may both serve as a substitute and complement to public transit [27–30].

Others argue that by providing a viable alternative to the personal automobile, ridehailing services may facilitate a carless lifestyle and enable some urban residents to give up or forgo the purchase of a personal vehicle, which if combined with the use of more sustainable modes such as walking, cycling, and transit may help reduce emissions. To support this, another study [31] points towards the small, yet consequential, portion of ridehailing users that have, or plan to give up their personal vehicle because of ridehailing. This behavior is especially found to resonate with younger individuals who appear to be purchasing vehicles and obtaining their driver's licenses at a later age [32]. Nevertheless, the projected decline in car ownership rates ensuing from the arrival of ridehailing has yet to materialize, which in turn has led some to believe that a portion of drivers may also now be justifying the purchase of a new vehicle by becoming part-time ridehailing drivers [33].

Despite potentially enabling a carless lifestyle and at times serving as a complement to transit, when considering its overall effect on mode share, ridehailing does appear to have increased levels of transport-related air pollution within our cities, as it is shown to cannibalize a sizeable share of users from more sustainable modes of travel such as public transit.

2.2.2. Ridehailing's Trip Generating Potential

The arrival of ridehailing affected the way people move within cities and in some cases enabled individuals to participate in trips that would otherwise not have taken place. Often referred to as induced demand, these trips most often occurred in areas or at times where viable travel alternatives were not present and where the trip itself would not have occurred were ridehailing not available. Recent studies estimate that these suppressed trips account for as much as 5% to 12% of all ridehailing trips [26,34] and may be responsible for an increase in transport-related greenhouse gas emissions. While arguably beneficial from an equity perspective, especially given the growing body of literature linking transport access to employment opportunities and related socioeconomic outcomes [35,36], these additional trips do contribute to ridehailing's emission levels and must be considered when attempting to regulate the industry's greenhouse gas emissions.

2.2.3. Ridehailing's Effect on Vehicle Kilometers Travel (VKT)

Contrary to personal vehicles which mostly contribute to pollution when transporting passengers from their origin to destination, ridehailing services also produce emissions before the passenger has even entered the vehicle. This is referred to as deadheading and encompasses all the kilometers required to arrive at the passenger's initial pick-up location. Previous studies have shown this to be a non-trivial amount, and accounts for as much as 20% to 50% of the trip distance itself [37]. The detour distance required to pick up additional passengers during successfully matched pooled ridehailing trips falls into a similar category and also adds kilometers and emissions to a segment of ridehailing trips. While these detours have been shown to vary quite substantially in terms of distance and duration, depending on the surrounding demand for shared ridehailing, a recent study using data from over 12 million ridehailing trips in Toronto estimates an average detour time penalty associated with pooling trips took on average of 3.6 min longer than their non-shared counterparts [38]. On the other hand, if performed right, the ability to share trips and pick up additional passengers along the way may also reduce the number of overall vehicle kilometers traveled as a portion of the pooled trip is replacing two trips that would otherwise have been conducted separately. That said, the above-mentioned study also finds that of the 15% of ridehailing trips that were pooled, only 52% were actually successfully matched, which begs the question as to the merits of pooled ridehailing's ability to reduce emissions. This is especially true given that these pooled services were suspended during the COVID-19 pandemic and have yet to return to their pre-pandemic levels [39].

Another reason why people often use ridehailing is to avoid the search for parking [31]. In dense urban areas, the hunt for parking can be very time consuming and has even been shown to account for as much as 30% of downtown traffic [40]. By dropping passengers off at their destination and eliminating much of the wasteful driving required to search for parking, some argue that ridehailing services may help reduce congestion and consequently taper tailpipe emissions [41].

There is also an increasing body of research that focuses on ridehailing driver behaviors and early results suggest that drivers may be incurring additional vehicle kilometers traveled (VKTs), referred to as relocation travel, to return to favorable pick-up locations [42]. Given the uncertainty surrounding the proportion of drivers that undergo relocation travel, and other driver behaviors such as the distance they initially commute to arrive at where they pick up passengers, it is difficult to determine with any degree of certainty what the overall effect of ridehailing driver behavior on VKTs will be. That said, most studies [26,43] agree that deadheading likely outweighs the benefits of no longer having to search for parking and that the overall effect of ridehailing is an increase in VKTs and therefore, this mode appears to have increased levels of transport-related air pollution.

Table 1 provides a summary of the above discussed effects of ridehailing and their associated outcome on greenhouse gas emissions.

Table 1. Description of ridehailing's effects and their associated outcome on emissions.

Category	Effect	Description	Outcome
Mode choice	Substitute taxi	Trips previously undertaken by taxis	No Effect
	Substitute public transit	Trips previously undertaken by public transit	Increase GHG
	Supplement and complement public transit	Provide first- or last-miles solution to connect with transit network and complement existing overcrowded transit networks	Decrease GHG
	Encourage a carless lifestyle	Provide a viable alternative to the personal vehicle, which may enable some urban residents to give up or forgo the purchase of a personal vehicle	Decrease GHG
Trip generation	Induced demand	Enabled individuals to participate in trips that would elsewise not have taken place	Increase GHG
Vehicle kilometers traveled (VKT)	Deadheading	Kilometers required to arrive at the passenger's pick-up location	Increase GHG
	Relocation travel	Kilometers required to return to favorable pick-up locations	Increase GHG
	Pooled trips	Ability to pick up additional passenger along the way and reduce the number of overall vehicle kilometers traveled (may incur detour kilometers to reach additional passenger)	Unknown
	Search for parking	By dropping passengers off at their destination much of the wasteful driving require to search for parking is eliminated	Decrease GHG

Finally, while more research is needed to identify the full impact of ridehailing in terms of greenhouse gas emissions, it has increasingly become apparent that the industry as a whole is responsible for an increase in transport-related emissions and that government intervention is therefore not only warranted but necessary to ensure existing climate emergency targets will be achieved and to offset emission increases already produced by the ridehailing industry.

2.2.4. Multilevel Governance

Environmental and ridehailing policy making is best viewed through the lens of multilevel governance (MLG). The growing vertical and horizontal responsibility and power disruption across states and non-governmental organizations have led to the increasing importance of multilevel governance as a theoretical and practical frame [44,45]. MLG can help make sense of the policy making and responsibilities of multiple levels of government that often dot the policy landscape in most countries [46,47]. While one government may have domain over a policy space, policy delivery or production may be the responsibility of another or a private or non-profit firm, blurring accountability lines and creating confusion about the authority to act. These same governments may be subject to various domestic and international levels of authority through trade agreements or multilateral frameworks, further complicating the situation [2,48].

Multilevel governance may help to clarify this entanglement and create a sense of order among policymakers and outside observers. Transportation-for-hire illustrates this concept well. While local policymakers have traditionally had responsibility for the transportation-for-hire subsector, higher-orders of government have been responsible for policies that govern the transportation and environmental sectors more broadly. Additionally, these governments may feel compelled to enter this subsector of policy space out of self-interest or the scale of the affected firms or the breadth of the jurisdictional impact [49]. Furthermore, regulating GHG emissions may further complicate matters, as each order may be subject to international environmental agreements intended to curb emissions. Therefore, policy actors may have a much more complicated space to work within and may lack the final authority to act. In order to communicate and coordinate policy ideas and action, international climate advocacy not-for-profit organizations have played a key role in working with and convening actors throughout the world on every scale of government at no shortage of meetings, workshops, conferences, and more. The case studies below illustrate this in various ways. The authority lines are not always consistent or clear and the decision-making is muddled from a variety of factors. Our goal is to exhibit how regulating transportation-for-hire emissions is a multi-level governance process, which adds intergovernmental relations depth to our understanding of policy learning.

3. Case Studies

International agreements set the framework for municipal governments to administer policies regulating carbon emissions. Transportation emissions contribute significantly to each city's environmental health; therefore, transportation-for-hire, proven to admit greater emissions than privately owned travel, is a theorized target for regulation policy. Our research began by searching for which municipal governments around the world have already implemented emissions regulations on the transportation-for-hire industry that go above and beyond national requirements. This resulted in a very short list of four first-mover cities (Amsterdam, London, New York City, and Mexico City) that varied attempts at emission regulation in the transportation-for-hire industry. Each municipality operates under a different state and transnational framework; however, each case chose to join supranational organizations such as C40, a global network to align municipal climate action, to direct widespread efforts. Nodes of unity and contrast make each journey to municipal sustainability policy an equal point of policy learning. For each city, we identified and discussed the legislation governing their transportation sectors more generally, and their transportation-for-hire industries more specifically. We then supplement this with press releases, news articles, and promotional material from government websites. Many of the sources were from not-for-profit organizations that worked closely with local governments to introduce policy ideas and ensure their adoption.

3.1. Amsterdam

The Netherlands is a contributor to the EU's nationally determined contribution (NDC) for the Paris Agreement of reducing greenhouse gas emissions by at least 55% in 2030 compared to 1990 levels [49]. The EU has taken two routes to reduce their GHG emissions: one set of regulations that affects all states equally and another that leaves the mechanics of adherence to the states' discretion. This framework serves as a catalyst for regulations on all sectors, including transportation, such as the requirement of vehicle manufacturers to provide emissions reports of vehicle sales because longer vehicle combinations (LVCs) contribute 12% of the EU's GHG emissions [50]. This regulation was placed with the goal of exclusively selling electric vehicles in the EU by 2035 [51]. Other than regulations on manufacturers, the EU has left the journey of GHG emission reduction to the discretion of each state [52].

The Netherlands has established itself as an environmental leader, motivated by the fact that most of the country is beneath sea level and will bear the heavy cost of rising sea levels [53]. The Netherlands aims to submit an NDC to reduce greenhouse gas emissions by 49% in 2030 compared to 1990 levels and is mainly accomplishing this through a national carbon tax of EUR 30 per metric ton in 2021. In addition to the carbon tax, the state encourages national and subnational policies targeting transportation emissions that historically contribute to 29% of all carbon consumption [54]. To support emission reduction, the state has declared all vehicle sales by 2025 to be electric vehicles (EVs) [54] and supports citizens in this transition with subsidies for 100% electric automobile purchases [55].

In 2015, Amsterdam replicated their state's environmental leadership by establishing the Amsterdam Climate Accord to reduce 95% of CO_2 emissions by 2050 compared to 1990 levels [53]. The city commits to this transition by promoting infrastructure by offering charging station installation to current and future EV owners without aqueduct infrastructure within 300 m of their residence [56]. Incentives established a green future for Amsterdam as access to charging networks supported a 20% reduction in energy use per resident between 2013 and 2020 [57]. With adequate infrastructure in place, Amsterdam has announced the banning of non-EVs by 2030 [58]. Amsterdam's 2019 commitment to the C40 Green and Healthy Streets Declaration to rid streets of fossil fuels by 2030 is demonstrated through their innovative policy leadership [59].

Amsterdam decided to target taxi operators in their efforts because taxis within the city produce 35 times more GHGs than typical low-emission vehicles (LEVs). Due to their increased emission contribution all for-hire vehicles operating within the city limits are also required to be 100% zero emission by 2025 [60]. Infrastructure and EV purchasing subsidies specific to taxi vehicles will aid in this transition [61]. Other regulations specific to transportation-for-hire operations include low-emission zones (LEZs) that fine vehicles non-compliant with current emission regulations and diesel vehicles built before 2008 trespassing the zone [56].

3.2. London

Since Brexit, the UK has continued to uphold its NDC transnational commitment of reducing GHG emission levels by 68% from the 1990 baseline by 2030 [62]. The state's public commitment to spearheading green innovation has resulted in the formation of Green Government Committees, the Green Finance Taskforce, and the Clean Growth Strategy [63], which passed a national carbon tax that increased from GBP 28 a metric ton in 2020 to GBP 85 in 2022 [64].

The transportation sector currently comprises 24% of the UK's overall GHG making it a target for emission reduction policy. Between 2011 and 2016, the UK invested billions in revitalizing their public transportation networks which resulted in the highest ridership since the 1920s and a 27% reduction in GHG emissions from 2009 to 2016 [63]. Such success influenced parliament to invest in subsidizing EV consumption, support a public charging network, and a Plug-in taxi Program that gives taxi drivers EV subsidies and the ability to request charging stations [65]. Furthermore, the UK will ban the sale of diesel vehicles by 2030 [66].

The current Mayor of London, Sadiq Khan, has built upon the national government's policies by making green growth a priority and becoming the Chair of the C40 Cities Alliance for Climate Change [67]. The Mayor's Transport Strategy, proposed in 2018, built upon the national government's success in emission reduction by encouraging public, pedestrian, and cycling transport to be 80% of all trips in London by 2041 [68]. The Mayor Transportation Strategy holds three key benchmarks: 80% of all trips in London to be by foot or bike by 2041; all cabs are zero carbon emission (ZCE) by 2018, alongside private-for-hire by 2023 and buses by 2025; and have full zero-emission city by 2050 [69]. Such policies build upon the existing emission reduction structure of congestion zones that bill Londoners GBP 15 for passage in high-traffic areas during rush hours within its coverage area [70].

In addition, 24/7 ultra-low-emission zones (ULEZs) were first introduced in London and have become central to London's green transportation strategy [71]. The zones fine drivers with vehicles under Euro 6 standard after each infraction [72]. Due to 82% compliance and a 92% lowering of NO_2 emission levels since the implementation of ULEZ, the Mayor declared the expansion of ULEZs as the central component of his strategy [73] as the zones will expand city-wide starting August of 2023 [72]. This amendment has forced Londoners to transition to EVs six times faster than residents of other UK municipalities [74].

Since 2012, transportation-for-hire vehicles have been increasingly forced to adhere to emission standards. Under the Mayor Air Quality Strategy of 2008, transportation-for-hire vehicles had a 10-year age limit and emission regulations checked annually through re-licensing. Transportation-for-hire vehicles are also required to provide vehicle manufacturing information (including emission per km) to receive a license which is required to operate within the city [75]. On 1 January 2023, Khan banned new licenses to any transportation-for-hire vehicle that is not zero-carbon emission capable. This announcement comes on the heels of Uber's commitment to make all their vehicles fully emission free in London by 2025, hinting at a probable partnership between the public and private sector to make sure it occurs [76].

3.3. New York City

The Biden administration broke national barriers to green implementation with The Infrastructure Investment and Jobs Act of 2021 and the Inflation Reduction Act of 2022. Their policy strategy is centered on the concept of "Build America, Buy America" by setting aggressive emission standards for vehicle manufacturers based on tailpipe emissions, size, and type of vehicles being built while encouraging domestic EV battery innovation to ignite the American green economy. Under the new Environmental Protection Agency tailpipe emission regulations, it is expected that 67% of cars sold in the United States (US) will be EVs by 2032 [77]. The Infrastructure Investment and Jobs Act aids the national implementation of EVs by committing to build public charging stations nationwide in addition to grant programs to fund subnational infrastructure [78]. The Inflation Reduction Act facilitates access to EVs by offering tax credits to offset the cost of EVs [79]. The influx of domestic policy is intended to meet 50% of sales of vehicles being EVs and reduce national GHG emissions by 50–52% by 2030.

In 2021, transportation emissions accounted for 47% of carbon emissions in New York State (NYS) (the state government in the United States is a subnational governance structure; however, for the purpose of this research they are acting in such fashion as a national government and we count their policy-space in that manner. This applies to our New York City case study and our brief mentions of California. Mexico also has state governments, but Mexico City exists independently of them as a Federal District. This layer of government does not exist in any of our other case studies and is relatively uncommon around the world) [80]. NYS committed to reducing diesel automobiles progressively from 2026 to 2035 with a final intention of only EV sales [81]. Their policy succeeded as NYS saw a 62% increase in EV sales between 2021 and 2022 [82]. New York State has also approved a congestion charge plan for downtown NYC, but it is not yet operational as of the time of publication.

New York City (NYC) is committed to green policy through membership of the C40 Alliance since 2005 [83], including a commitment to reach zero carbon emissions by 2050 [84]. NYC has accepted federal and state assistance to transition to electric, but has run into implementation challenges with EV requirements due to the lack of charging infrastructure stemming from narrow roadways and limited private parking [85]. Nonetheless, the city continues equitable implementation of charging infrastructure in all five boroughs through a private partnership with Con Edison and a fast charging hub program with New York City Department of Transportation (NYC DOT) to bring expected totals of 1000 charging points by 2025 growing to 10,000 by 2030 [86]. To offset this loss of emission reduction potential, NYC remains committed to C40 cities by attending international conferences to inspire aligned and innovative policy domestically.

It is estimated that 24% of the 7.7 million daily passages will be transportation-for-hire vehicles [87]. To reduce emissions, NYC is now issuing new transportation-for-hire vehicle licenses for electric vehicles only. NYC will mandate all current transportation-for-hire vehicles to be zero-carbon compliant by 2030 [88], which Uber and Lyft both publicly agreed to meet [89]. To aid this transition, NYS furthered increased access to electric vehicles by offering a trade-in program for licensed transportation-for-hire drivers [90].

3.4. Mexico City

In 2015 Mexico became the first developing country to submit an NDC to the UN [91]. Their commitment to contribute to the global reduction in GHG emissions has earned them international recognition [92]. Mexico instituted a national carbon tax in 2013, set at USD 3.50 per ton [93]. Mexico received a plethora of international support in the form of mentorship, green bonds, and climate grants from various international organizations [94]. National and local efforts supported by international financing have reduced GHG emissions in Mexico by 16% between 2014 and 2018 [95].

Focusing specifically on the transportation sector efforts, the federal government declared its goal to reduce transportation emissions by 28% between 2000 and 2030 [91]. To achieve these goals, the federal government set a total automobile market sale target of 35% hybrid electric vehicles (HEVs) and 10% battery electric vehicles (BEVs) by 2035 [96]. Buyers are given federal tax credits alongside subsidies and are excused from participating in maintenance inspections/paying registration fees in many municipalities, such as Mexico City when purchasing EVs. Furthermore, to ensure equitable access to eco-friendly technology the federal government has funded municipal efforts to curate charging station infrastructure in public spaces [97]. President López Obrador made it clear to all municipal and state authorities in Mexico that EVs are the future when he "announced that 50% of vehicles produced in 2030 will be zero-emission and 100% in 2040" in 2022 [98].

Mexico City is one of the largest municipalities in Latin America and its mountainous terrain, sinking soils, and urban sprawl make it prone to climate change effects [94]. Mexico City began attempting to regulate transportation emissions, mainly to combat local air pollution, in the late 1990s with travel restrictions. The city implemented a policy that enforced driving restrictions on certain days of the week depending upon the vehicle's license plate numbers. The policy was ineffective because drivers either hailed taxis on their 'no-drive days' or purchased another vehicle in conjunction with their original to dodge the policy. After 15 years, analysis of the policy showed no decrease in mobility GHG emissions, an increase in vehicle purchases, and an increase in taxi emissions [99].

Despite setbacks, Mexico City utilized international recognition and resources to win a million-dollar technical assistance award, from C40 cities, to design a green corridor [100]. Since 2018, Mexico City has found success in reducing its transportation carbon emissions through an urban mobility plan that eliminates the need for private vehicle usage. The municipality wanted to craft a transportation plan that was accessible, equitable, and green. Mexico City has used its federal and international funding to reconstruct and expand its public transportation system [101]. In addition, Mexico City is implementing low-emission zones by 2024 to end diesel traffic by 2025 [102].

Mexico City is committed to having an all-electric fleet of transportation-for-hire options by 2040, to which Uber and VEMO have agreed to do their part [52]. In 2018, Mexico City began only giving new transportation-for-hire vehicle permits to hybrid or electric vehicles. Starting in 2020, Mexico City further restricted new transportation-for-hire vehicles to be electric only, eliminating the hybrid option. Current license holders will have 10–16 years to make the transition to EVs [103]. Mexico City asked Uber and VEMO each to bring 250 zero-carbon emission ridehailing service vehicles to the city by the first quarter of 2022 with an expected emission reduction of 5000 tons [104].

4. Analysis

We found that, before municipal governments are able to take on GHG emission regulation in the transportation sector, international agreements and national structures create and limit a local government transportation-for-hire policy space. To note, many cities (during our research process, we uncovered many cities that had discussed municipal sustainability action on the transportation-for-hire industry, but are not included in this paper because, at the time of this writing, municipal legislation was not passed on this specific sector, such as Boston, Rio de Janeiro, San Francisco, and Vancouver) choose not to pursue additional local regulations on the transportation-for-hire industry because they defaulted to higher-order government policies that apply to all vehicles. Though there may be considerable policy entrepreneurship and political risk in being an early mover in the transportation-for-hire policy space, we did not find a case where local policymakers were willing to take such regulatory risk prior to it being set as an international and national priority (i.e., prior to the signing of the Paris Climate Agreement).

We found that, once they had a framework to act, local governments did not target the transportation-for-hire industry specifically but rather it was included as one piece of a broader set of environmental actions taken by the local government. Finding that local leaders are entrepreneurial in how to achieve sustainability policy only in combination with existing international and national frameworks, creating a local government policy space. This action often takes the form of passing local bylaws that are congruent policies to other places where they were enacted at higher-order government levels. Ideas, such as helping drivers transition to electric vehicles and setting municipal targets for electrification, were heavily promoted by not-for-profit organizations like C40.

Below we draw out the policy similarities and differences (as shown in Table 2) in the international, national, and subnational framework for the transportation sector.

Table 2. Climate Policy in the Transportation Industry on 3 levels of government.

	Amsterdam	London	New York City	Mexico City
International	• EU Emission Targets • EU Carbon Border Tax • EU Manufacturer Regulations	• Emission Targets • Green Bonds (selling)	• Emission Targets	• Emission Targets • Mentorship (receiving) • Climate Grants (receiving) • Green Bonds (receiving)
National	• Carbon Tax • Electric Vehicle Consumer Subsidies • Ban on New Gasoline Vehicles by 2035	• Carbon Tax • Electric Vehicle Consumer Subsidies • Ban on New Gasoline Vehicles by 2040 • Banning new Diesel Vehicles by 2030 • Electric Vehicle Transportation-for-Hire Subsidies • Manufacturer Regulations • Transportation-for-Hire EV Subsidies • Charging Network Funding • EV battery innovation investment	• Electric Vehicle Consumer Subsidies • Manufacturer Regulations • Ban on New Gasoline Vehicles by 2030 (NYS) • Reduction in Diesel Vehicles (NYS) • EV Battery Innovation Investment • Charging Network Funding	• Carbon Tax • Electric Vehicle Consumer Subsidies • Ban on New Gasoline Vehicles by 2040 • Transportation sector Emission Targets • Charging Network Funding • Gasoline Vehicle Import Tax
Subnational/Local	• Low-Emission Zones • Public Charging Network • Active/Public Transportation Planning • Transportation-for-Hire Permit Regulation	• Low-Emission Zones • Public Charging Network • Active/Public Transportation Planning • Congestion Charges • Transportation-for-Hire Permit Regulation	• Active/Public Transportation Planning • Government Fleet Electrification • Transportation sector Emission Targets • Transportation-for-Hire Permit Regulation	• Banning diesel vehicles • Active/Public Transportation Planning • License Plate 'no-drive-days' • Green Bonds (receiving) • Transportation-for-Hire Permit Regulation

4.1. International Policies

There is policy convergence on the international level to set emission targets. The Paris Climate Agreement set the international stage as nearly all countries (the United States was an original signatory in 2016, but never ratified the agreement. President Trump made known his intent to withdraw from the Agreement in 2017, which was made official in 2020, and President Biden re-joined the agreement in 2021. Other countries that did not ratify the agreement include Iran, Yemen, and Libya) agreed to reduce their carbon footprint over time; however, the agreement was seen as more of a call for action than a treaty that forced reductions. Each country was asked to achieve their NDC but was left open to how (there is considerable criticism that the NDC plans that most developed countries have submitted are not adequate to meet their climate targets. Optional participation from the developing world has also lagged behind expectations). The EU responded to the Paris Climate Agreement by mandating emission targets for each country, though enforcement was lax. The EU set international policy by asking each country to implement a national carbon tax and EU-wide auto-manufacturer regulations. The EU then followed up with a carbon border tax in 2023, which taxes imports that have not already been taxed on their carbon emissions. The UK, despite leaving the EU, continued following its NDC commitments. The UK became determined to be the leader of green finance, packaging, and selling green bonds to support sustainability projects internationally. Mexico, as a developing country, was not asked by the Paris Climate Agreement to reduce its emissions in the near term; however, it voluntarily elected to submit an NDC plan. As a developing country, they took up the offer of green bonds, climate grants, and international mentoring under the Paris Climate Agreement. Though the United States did not submit an NDC plan until 2021, the Biden Administration committed to hitting its targets via executive order and made significant legislative progress towards achieving that goal since that time.

4.2. National Policies

There is policy convergence on the national level to implement carbon taxes (except in the United States), banning new gasoline vehicle sales at a future date, and offering electronic vehicle purchase subsidies to consumers. Other policies show convergence of the concept but are implemented by different levels of government. For example, the US and Mexico have subsidized a national network of public charging stations, whereas the UK and the Netherlands do so on the local level. Another example is that the UK and the US regulate vehicle manufacturing of tailpipe emissions on the national level, whereas the Netherlands does so on the international level through the EU and Mexico does not do so at all. Other policies are more unique to the national context. The US and UK have also poured money into research and development of new transportation battery innovations and technologies. The UK has created a program to subsidize transportation-for-hire drivers switching to EVs, whereas that usually occurs on the local level in other countries. Mexico is regulating greenhouse gas emissions in its own way: it charges an import tax on gasoline vehicles and has set emission targets for the transportation sector as a whole. All countries have a policy on curtailing diesel vehicles, but they vary widely on whether it is performed on the national level or local level and how ambitious they are.

4.3. Subnational/Local Policies

There is the least amount of policy convergence on transportation policy at the local level, with the notable exception of engaging in urban planning that moves more towards public and active transportation. Notably, subnational policies tend to fill in where other countries have national or international policies in place, so many of these policies have been mentioned in previous sections. London and Amsterdam have low-emission zones, where drivers have to have an EV or another qualifying vehicle to operate. Mexico City has committed to abandoning its alternate driving plates policy to adopt low-emission zones too, but it has not occurred yet. London has implemented congestion charges, which NYC is currently working on but is not operational. NYC is working on turning over its government fleet of vehicles to be solely EVs. Mexico City is the first city in Latin America to receive green bonds to achieve environmental projects. All four cities have environmental policies towards transportation-for-hire, which we will now explore in more depth.

4.4. Transportation-for-Hire Policies

We also found that cities did not regulate transportation-for-hire in a vacuum, but rather as a part of a larger sustainability effort by these local governments. As shown in Table 3, we found there are eight policy choices that local governments can take in regulating transportation-for-hire GHG emissions. In all cases, cities' scope of powers and responsibilities did not change, but policymakers used existing powers to regulate the industry in new ways to achieve its new goals.

Table 3. Local Regulations on the Transportation-for-Hire Industry.

	Amsterdam	London	New York City	Mexico City
Municipal Future Target for Fleet Electrification	✓	✓	✓	✓
No New Vehicle Permits for Gasoline Vehicles		✓	✓	✓
Phasing out of Vehicle Permits based on Vehicle Age		✓		✓
Stringent Vehicle Emission Standards for Existing Vehicle Permits		✓		
Banning Diesel Vehicles				✓
Low-Emission Zones	✓	✓		✓
Exclusive Electric Charging Ports	✓			
Public–Private Partnership to Help Drivers Transition	✓		✓	✓

The first five (colored in green) are based on cities' power to approve vehicular operating permits as a regulator of the transportation-for-hire industry. All four cities created a future date for all transportation-for-hire vehicles to be electric. Currently in 3 of the 4 cities (London, NYC, and Mexico City), new transportation-for-hire permits are being given for EVs only. London and Mexico City both have limits on how old vehicles can be to maintain transportation-for-hire permits, which naturally requires a phase-in of EVs as they are the only ones being newly permitted. London has gone even further by creating more stringent environmental standards for existing vehicle permit holders than national and international regulations for personal-use vehicles, whereas Amsterdam and Mexico City have banned diesel transportation-for-hire vehicle permits but otherwise follow EU and national standards for existing vehicle permits accordingly. New York State has more stringent vehicle standards than the United States as a whole; however, it does not have any transportation-for-hire specific regulations, and nor does New York City.

The next two (colored in blue) are based on cities' power to build infrastructure and regulate public space. Three of the four cities (Amsterdam, London, and Mexico City) have zones where only EVs (or otherwise much stricter GHG standards for internal combustion engines) can operate and/or pickup zones that are exclusively for EVs. Other cities not listed (e.g., Paris and Brussels) have followed this path. This policy creates a strong incentive for operators to switch from an internal combustion engine to an EV in order for them to be able to operate in the entire city. London and Amsterdam have both significantly expanded these zones over time, which creates a smaller geographic operating space for non-EV transportation-for-hire vehicles. Amsterdam has gone one step further by having electric charging ports exclusively for the use of transportation-for-hire vehicles, which ensures locations that they can recharge without long wait times.

The final one (colored orange) is based on its power to contract services. Cities are rightfully concerned that the cost of these new regulations will fall on those who can least afford it, the drivers themselves, and therefore, hamper regulatory efforts. Three of the four cities (Amsterdam, NYC, and Mexico City) have created some degree of public–private partnerships with the transportation-for-hire companies to help drivers make the transition to EVs, while London benefits from a national UK policy to do the same.

4.5. Discussion

There has been a vivid academic debate about the total cumulative impact of climate impact on ridehailing (summarized in Table 1). Several studies have attempted to measure ridehailing's impact on GHG emissions, and they overwhelming conclude that the industry increases emissions [43,105,106] by substituting trips that would otherwise have taken place in more sustainable forms of transportation (e.g., public transportation, cycling, and walking) [107], increasing VKT through having a driver come to your location [26], and adding to traffic congestion through induced demand [108]. Because of the rapid growth of the transportation-for-hire industry and the role it plays in our urban transportation market, some argue that vehicle and fleet standards ought to be tougher than those for personal-use vehicles.

Responding to these concerns, subnational government leaders have voiced their desire to take action. For example, noting that ridehailing can be an impediment to reaching climate emergency targets, mayors in Vancouver Metro are calling for stricter vehicle standards for ridehailing vehicles to reduce emissions to offset the increase already caused by this industry [109]. Similarly, and in line with California's larger climate goals, California passed the Clean Miles Standards which requires ridehailing firms to meet increasingly stringent GHG emission and electrification targets by 2030 [110]. However, many of these calls for local action have not yet been enacted or have passed regulation on the use of all vehicles rather than the transportation-for-hire industry specifically.

Seeing this gap between public discourse and action, our research examined under what conditions can local leaders become innovative to use municipal governance powers to enact sustainability regulation. We investigated the regulation of GHG emissions in the transportation-for-hire industry as it lies at a unique nexus of multi-level governance. We unwound the complex web of international, national, and local government regulations in four case study cities to discover that local leaders are entrepreneurial within the policy space created for them by the policy gaps created within international and national frameworks. We conclude that, since GHG regulations in the transportation area have traditionally been a policy area of higher-order governments, local government action is an entrepreneurial act that is set in motion through the adoption of international and national sustainability frameworks, but not implemented at those levels. This gave local leaders "permission", if not the outright devolution of power, to show leadership in this policy space by passing municipal legislation in order to achieve the targets set by higher-order governments. Cities answered the call, using their municipal powers, to fill in the gaps of their higher-order governments through enacting policies occurring at those higher orders in other countries.

Policy development in the transportation-for-hire industry to date has conducted a tremendous amount of learning and convergence. The early regulatory environment for ridehailing is often chaotic and regulatory action sporadic. Municipalities looked to first-movers, eventually adopting policies that appeared successful and moving towards a regulatory point that balanced the operational needs of ridehailing firms with a measure of public and consumer protection. Overlooked in early regulatory efforts was the impact of ridehailing on GHG emissions, as its total impact was unknown. Our thorough literature review shows the evolution of the debate of whether ridehailing increased or decreased total emissions, and through which mechanisms. As this debate suggests, the introduction of ridehailing in cities increases overall GHG emissions. As such, local policymakers and activists have called for explicit climate emergency legislation on this new industry.

Many cities around the world rightfully see themselves as climate actors and are taking reasonable steps towards sustainability. Given the amount of existing research demonstrating that ridehailing companies are increasing GHG emissions, it would be natural to assume the firms would be regulatory targets for municipalities. We found that the policies on the international (emission targets) and national levels (vehicle subsidies) have been standardized, while the municipal level is still seeing experimentation and policy learning. Far more convergence is seen at the international and national regulatory level, making municipalities more policy-takers than policymakers in this instance. Local regulations on the transportation-for-hire industry were performed as a part of a package of municipal environmental policies and not in isolation; nor as a part of transportation-for-hire regulatory updates that focused on consumers and driver safety. These local environmental transportation-for-hire bylaws took a three-pronged form: (a) vehicle permit standards; (b) regulations of public space and infrastructure; and (c) public–private partnerships to assist in the transition to electric vehicles.

When it comes to international municipal policy learning, innovation is occurring in the environmental regulatory space, providing some indication of where municipalities may be devoting their attention in the future. For instance, London was the first city to experiment with low-emission zones, but the idea has been copied elsewhere. London, NYC, and Mexico City are not providing new transportation-for-hire licenses for gasoline vehicles, something that Amsterdam has not adopted yet, but other cities may very well in the future given the nature of policy learning and convergence. Previous local sustainability innovation has led to some policy failures. For instance, Mexico City's experiment with 'no-drive-days' based on license plate numbers has proven to be unsuccessful. Cities have begun to phase out this idea, again demonstrating that policy learning is occurring between municipalities as poorly received ideas are not being emulated. Natural sorting occurs prior to convergence. It is likely this process of learning, emulating, and convergence will continue and soon GHG regulations for the ridehailing industry will begin to become more widely implemented throughout the world.

5. Conclusions

Our research concludes that municipal leaders are innovative when it comes to sustainability and are provided with the policy space. International and national governments set environmental targets and then provide local governments leeway in how to achieve them. Local leaders respond by, often informed by international climate advocacy not-for-profits, examining what policies are occurring at higher-order governments in other places and then using their municipal powers to implement a local version of it. Through examining the transportation-for-hire policy space through a multi-level governance lens, our research documents the first evidence of international, multi-level policy learning.

More specifically, our research shows that regulations on GHG emissions in the transportation-for-hire industry at the local level occur by local leaders filling in the gaps of existing international and national frameworks, displaying leadership and entrepreneurialism on how to achieve targets set by higher-order governments. Local regulations on the transportation-for-hire industry were conducted as a part of a package of municipal environmental policies, not in isolation, nor as a part of traditional ridehailing regulation which focused on consumers and driver safety. These local environmental transportation-for-hire bylaws took a three-pronged form: (a) vehicle permit standards; (b) regulations of public space and infrastructure; and (c) public–private partnerships to assist in the transition to electric vehicles.

Our research shows that cities and countries overlapped in their policy approaches to regulating emissions of the ridehailing industry; however, the actions taken by different levels of government within each country were dependent upon that country's structure of policy-space responsibilities. We expect to see more policy transfer of the regulations created by first-mover cities in other cities around the world as this emerging policy space continues to develop. To solidify the contribution of this paper, further research should include (1) interviews with municipal government leaders to illuminate exactly how multi-level government policy transfer occurs, (2) additional examples from other policy areas should be examined to show that multi-level policy learning can occur for issues beyond sustainability, and (3) follow-up evaluation research on the implementation impacts of these GHG emission regulations.

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