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ARTICLES

Only Bilateral Agreements Can Stop Wildfires: Why Diplomacy
Through The U.S.–Canada Air Quality Agreement (AQA) Is A
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**ONLY BILATERAL AGREEMENTS CAN STOP WILDFIRES: WHY
DIPLOMACY THROUGH THE U.S.–CANADA AIR QUALITY AGREEMENT
(AQA) IS A SOLUTION FOR WILDFIRE RELATED TRANSBOUNDARY
POLLUTION**

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I. INTRODUCTION

Air pollutants know no borders. They can traverse any geopolitical or internationally-recognized boundary without consequence. The physical environment, atmosphere, human health, and relationships between nations face detrimental ramifications. International customary law is the vessel for assigning the responsibility of damage one country causes to another regarding transboundary pollution.¹ For example, black carbon (in the form of smoke from wildfires) is crossing between the U.S. and Canada's border, causing environmental damage in the other's jurisdiction.² Wildfires may not be a new emission source, but recently they are a rising concern because they are starting at an "unprecedented" rate.³ Hundreds of thousands of acres of land have burned in both the U.S. and Canada, costing both countries billions of dollars annually in damages.⁴ Wildfires damage the physical land, air quality, and human health. Additionally, latent environmental damage occurs when wildfires release black carbon into the atmosphere, which can travel at high speeds for long distances into another country.⁵

The U.S. and Canada have historically been able to amicably create solutions to divide the responsibility of air and water resources and the responsibility of damage caused to those resources.⁶ For example, U.S. and Canadian citizens advocated for their governments to address acid rain.⁷ Both

1. See *Customary International Law*, CORNELL L. SCH., https://www.law.cornell.edu/wex/customary_international_law (last visited July 31, 2022) (defining "customary international law").

2. See *infra* note 16 ("[r]ecognizing the existence of possible adverse effects, in the short and long term, of air pollution including transboundary air pollution").

3. See Jonathon Lash & Fred Wellington, *Competitive Advantage on a Warming Planet*, HARVARD BUS. REV., Mar. 2007, at 1, 2–3 (describing wildfire's growing threat to the physical environment).

4. *Id.* at 2

5. See *infra* note 9 (defining and discussing black carbon).

6. See *infra* Part III (discussing the U.S. and Canada Air Quality Agreement).

7. See MICHAEL I. JEFFREY, *Transboundary Pollution and Cross-Border Remedies*, 18 CAN.-U.S. L. J. 173, 175 (1992).

nations entered into the U.S. and Canada Air Quality Agreement (AQA) to address the issue of transboundary acid rain pollution.⁸ Pollutants released from one location travel long distances affecting air quality many miles away from the original source.⁹ The President of the Canadian Association of Fire Chiefs (CAFC) stated in July 2021 that Canada surpassed “what we would have the whole wildfire season, so it’s quite daunting right now.”¹⁰ On the other side of the border, the U.S. is dealing with the same problem. The Canadian Government investigated the impacts of climate-change-driven wildfires, which revealed that people across the country are breathing in more wildfire smoke than before.¹¹ The investigation also found a significant increase in the number of days people are exposed to wildfire smoke.¹² The dangerous black carbon from these fires can travel and affect people more than 3,000 miles away.¹³ Yet, the real issue is more profound than just wildfires. The AQA must be a vessel to extinguish the cause of wildfires: poor land use planning and forest management.

Part I in this note explains why poor land use planning and forest management cause significant transboundary wildfire pollution. Part II establishes: background on transboundary pollution’s definition and history; impact on geopolitics and the environment; and distinguishes between different forest types concerning their deposition and climate. Next, Part II explains the extensive issues with current land-use practices and forest mismanagement in the U.S. and Canada. Lastly, Part II details the natural and anthropogenic causes of wildfires and their significant contribution to air pollution. Part III analyzes the U.S. and Canada AQA as a mechanism for addressing transboundary pollution. Then, Part III goes into the Agreement’s procedures, using acid rain as an example. Next, Part III mirrors acid rain’s journey through the Agreement with a theoretical investigation into wildfires as a transboundary pollutant. Finally, within this examination, Part III suggests policies, practices, and regulated and unregulated activities that the International Joint Commission (IJC) could implement to solve transboundary wildfire pollution.

8. See *infra* Part III (discussing the U.S. and Canada Air Quality Agreement).

9. *U.S.-Canada Air Quality Agreement*, U.S. ENV’T. PROT. AGENCY, <https://www.epa.gov/airmarkets/us-canada-air-quality-agreement> (last visited Mar. 17, 2022).

10. Saba Aziz, *A look at Canada’s Wildfires in Numbers and Graphics Over the Decades*, GLOB. NEWS (July 21, 2021), <https://globalnews.ca/news/8045796/canada-wildfires-yearly-trends/>.

11. See Alison Saldanha et al., *Dangerous Air: As California Burns, America Breathes Toxic Smoke*, INSIDE CLIMATE NEWS, Sept. 28, 2021 (stating “Americans across the country are breathing more wildfire smoke—and the harmful particles it carries—than they did 10 years ago, and their health is suffering the consequences.”)

12. *Id.* at 2.

13. CAMP FIRE AIR QUALITY DATA ANALYSIS, ii (Cal. Air Res. Bd. Jul. 2021).

II. BACKGROUND

A. Defining Transboundary Pollution and its Impacts on Geopolitics and the Environment.

Polluted air particles do not stop at an invisible line for border patrol.¹⁴ Transboundary pollution is not a recent development nor a simple policy problem for neighboring countries. The EPA defines transboundary pollution as “pollution [which] neither recognizes nor respects territorial boundaries.”¹⁵ Typically, anthropogenic means are a common cause of pollution that traverses geopolitical borders.¹⁶ Such pollution could taint the shared air, public and private waters, and groundwaters between two or more nations.¹⁷ “Transboundary air pollution occurs when a pollution source in one country creates a pollutant that crosses into the territory of another country.”¹⁸ Transboundary air pollution has become an increasing issue between North American countries, especially in light of the intense wildfires in the U.S. and Canada.¹⁹ Air pollution, such as Clean Air Act (CAA) regulated greenhouse gasses (GHGs) or National Ambient Air Quality Standards (NAAQS) regulated black carbon particles,²⁰ can travel hundreds of miles away from the emission’s source.²¹ Consequently, transboundary air pollution poses an increasing threat to international legal systems protecting multiple nations’ sovereignty, health, and environment.²²

In a geopolitical sense, transboundary pollution is difficult to regulate and strains the legal and political relationships between countries. For example, a country with a pollutant source may be reluctant to impose legal directives over relevant, pollution-causing industries (i.e., the land use

14. *Transboundary Air Pollution*, U.S. ENV’T. PROT. AGENCY, <https://www.epa.gov/international-cooperation/transboundary-air-pollution> (last visited Mar. 17, 2022).

15. Michael I. Jeffrey, *Transboundary Pollution and Cross-Border Remedies*, 18 CAN.-U.S. L. J. 173, 173 (1992).

16. See Geneva Convention on Long-Range Transboundary Air Pollution art. 1, Jun. 6, 1981, 6 U.S.T. 0129 (defining air pollution and long-range transboundary air pollution).

17. *Id.*

18. Jeffrey L. Roelofs, *United States-Canada Air Quality Agreement: A Framework for Addressing Transboundary Air Pollution Problems*, 26 CORNELL INT’L L.J. 421, 421 (1993); see also *Canada-United States Air Quality Agreement*, INT’L JOINT COMM. § 1 <https://ijc.org/en/mission/air-quality-agreement> (last visited Jan. 23, 2022) (defining “air pollution” as, “the introduction by man, directly or indirectly, of substances into the air resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems and material property and impair or interfere with amenities and other legitimate uses of the environment”).

19. *Transboundary Air Pollution*, *supra* note 14.

20. NAAQS TABLE, U.S. ENV’T. PROT. AGENCY <https://www.epa.gov/criteria-air-pollutants/naaqs-table> (last visited Mar. 17, 2022).

21. Ophelia Eglene, *Transboundary Air Pollution: Regulatory Schemes & Interstate Cooperation*, 7 ALB. L. ENV’T. L. OUTLOOK, 131 (2002).

22. See Elena M. McCarthy, *International Regulation of Transboundary Pollutants: The Emerging Challenge of Ocean Noise*, 6 OCEAN & COASTAL L.J. 257, 257 (2001).

industry and forest management industry). Unfortunately, regulation can be expensive, making it unattractive for some source countries (countries with a transboundary pollutant source). Yet, the country on the receiving end of the pollution cannot obtain jurisdiction over the source country.²³ This phenomenon occurs even when parties are unable to pin down the source. Leading to strained political relationships and countries playing the “blame game.”²⁴

Looking towards the science, air pollutants may travel farther when they develop from their precursor compounds (i.e., smoke, black carbon, smog, or acid rain) over an extended period.²⁵ For example, sulfur dioxide (SO₂) emissions from burning coal and fuel can cause transboundary acid rain pollution.²⁶ Forty years ago, the U.S. and Canada were reporting “dead lakes,” meaning lakes that had become too acidic for fish eggs to evolve or for fish to survive.²⁷ Studies show that winds between the U.S. and Canada carried high concentrations of SO₂ from coal plants, over long distances.²⁸ During this time, the SO₂ transformed into acids that precipitated over lakes and the land (which is an example of air pollutants being developed from their precursor compound, coal).²⁹ Anthropogenic and natural sources emit pollutants into the atmosphere, traveling several hundreds of meters to thousands of miles.³⁰ When these airborne pollutants cross “geopolitical boundaries”—physical boundaries defined and created by governments—

23. The international legal systems surrounding the issue of transboundary pollution is customary. Countries make small adjudications, declarations, and unofficial comments. Transboundary pollution puts a strain on these relationships because it has proven difficult for countries to take responsibility for pollution sources. *See* Thomas Merrill, *Golden Rules for Transboundary Pollution*, DUKE L.J., 931–1020, 940 (Mar. 1997) (noting that transboundary pollution is an interstate externality and provides strong economic justification for federal intervention by any affected party).

24. *See generally* Helena Varkkey, *Transboundary Pollution*, OXFORD BIBLIOGRAPHIES (last modified Nov. 26, 2019), <https://www.oxfordbibliographies.com/view/document/obo-9780199756223/obo-9780199756223-0290.xml> (explaining how transboundary pollution does not remain within political boundaries and is thus challenging for environmental governance).

25. Franco DiGiovanni & Philip Fellin, *Transboundary Air Pollution*, 1 ENV'T MONITORING § 1–3 (2019).

26. *See id.* at § 4.1 (explaining that with SO₂ and NO_x are released into the atmosphere they oxidize to produce both sulfuric and nitric acid).

27. *See id.* at 1.1, *see also* Michigan Sea Grant, *Dead Zones*, MICH. SEA GRANT, <https://www.michiganseagrant.org/lessons/lessons/by-broad-concept/physical-science/dead-zones/#:~:text=Technically%2C%20a%20dead%20zone%20is,bottom%20waters%20do%20not%20mix>. (last visited Aug. 13, 2022) (explaining that dead zones are areas without enough dissolved oxygen to support fish etc.).

28. *See* DiGiovanni, *supra* note 25 at § 4.2 (estimating that between 3.5–4.2 millions of tons per year of SO₂ flows from the U.S. to Canada).

29. *Id.* at 4.1.

30. “Micro-scale” is used when discussing that the pollutant merely traveling meters and “macro-scale” refers to when the pollutant travels hundreds or thousands of kilometers. Both are important to determine where the source of the pollutant. Again, it is difficult to distinguish air pollutant sources and looking through various lenses is a tool that climate scientists use to distinguish where pollutants are emitted. *Id.* at § 1.1.

they become transboundary pollution.³¹ The EPA considers GHGs (carbon dioxide (CO₂), methane, nitrous oxide, and fluorinated gases) to be transboundary pollutants.³² Additionally, the Air Quality Index (AQI) measures the air quality in a given area and shows scientists specific air pollutants.³³

Determining which pollutants are regulated by the CAA and NAAQS is critical because this determination allows for collective legal action for parties to identify pollutant sources. To a greater extent, customary international law allows affected parties (i.e., the U.S. and Canada) to impose procedural duties before or after damages.³⁴ This is a predominately proactive approach.

One principle of customary international law requires a conscious effort from parties to avoid transboundary pollution. *Sic utere tuo ut alienum non laedas's* (*sic utere*) translates to the idea that “one must use one’s property not to injure another.”³⁵ The U.S. and Canada may use *sic utere* to establish that the CAA and NAAQS pollutants are threats to property, then make agreements to remove pollutant sources proactively and procedurally. *Sic utere* gives both countries the international customary authority and precedent to address new transboundary pollution threats.³⁶

The landmark *sic utere* principle case is the Trail Smelter case of 1941.³⁷ In this case, the United States claimed Canada emitted fumes from a smelter

31. Pollutants are still designated transboundary even if they only meander a short distance to cross internationally recognized boundaries. Distance is not a critical element to distinguish what is and what is not transboundary pollution. If it crosses a geopolitical border, it is transboundary pollution. *Id.*

32. *Overview of Greenhouse Gases*, U.S. ENV’T. PROT. AGENCY <https://www.epa.gov/ghgemissions/overview-greenhouse-gases> (last visited Jan. 24, 2022).

33. *See generally Air Quality Index (AQI) Basics*, AIRNOW, <https://www.airnow.gov/aqi/aqi-basics/> (last visited Mar. 17, 2022) (discussing what AQI is and how it works).

34. International environmental law takes three basic forms: customary international law, international agreements, and non-binding soft law. *See generally* Brian Popiel, *From Customary Law to Environmental Damage Between Canada and the United States*, 22 B.C. ENV’T. L. REV. 447, 461 (1995) (describing customary international law’s importance when assessing and mitigating damages).

35. This international customary legal principle arose once more between the U.S. and Canada during the Gut Dam arbitration of 1968. Canada constructed a dam which spanned the international boundary of the St. Lawrence River and caused flooding and property damage on the U.S.’ side of the river. The two Parties agreed to codify the *sic utere* principle and impose responsibility on Canada. *Sic utere* is an essential principle for transboundary pollution—especially between the U.S. and Canada because both countries have agreed that the concept has legal merit. *Sic utere* is the exact principle that bolsters the AQA. *See* Canada-United States Settlement of Gut Dam Claims, 8 INT’L L.M. 118 (1969) (detailing that that Canada agrees to pay the U.S. a settlement for harm done); *see generally Developments in the Law—International Environmental Law*, 104 HARV. L. REV. 1484, 1493 (1991) (explaining the background and providing the Latin translation of the *sic utere* principle).

36. *Developments in the Law*, *supra* note 35, at 1496.

37. *McCarthy*, *supra* note 22, at 258. *See* Trail Smelter Arbitration (U.S. v. Can), 3 U.N. Rep. Awards 1905, 1965 (1941), *reprinted in* 35 AMJ. INT’L L. 684, 716 (1941) [hereinafter Trail Smelter or (final decision)]. (In which the court found the Government of Canada responsible for the damage caused by their smelter. The Government of Canada deposited \$350,000 into the United States Treasury as payment for all damage that occurred in the United States).

located merely seven miles away from the State of Washington, causing damage to the environment in the form of noxious fumes and odor.³⁸ The smelter released up to seventy tons of SO₂ per day over twenty years.³⁹ Throughout the smelter's operation, this release caused thirty miles of the surrounding Canadian–U.S. forests to deteriorate.⁴⁰ Arbitration determined that the Canadian Government holds responsibility for any environmental damage it creates, even if that damage goes beyond its border or territorial limit.⁴¹ Trail Smelter is significant because it highlights that “ecological effects” do not stop at geopolitical borders and provides one of the first instances of addressing an “amorphous type” of transboundary pollution.⁴² The case also introduced and relied on the international customary law principle of *sic utere*.⁴³

Ecological effects (i.e., black carbon, smog, acid rain) can create negative externalities on an international scale.⁴⁴ The Trail Smelter case set a precedent in international law that a country is responsible for the environmental damage it causes to a neighboring country.⁴⁵ This case opened the door for North American countries to address their air pollution grievances with neighboring nations, making confronting new transboundary pollutants both relevant and possible.⁴⁶ Neighboring states or nations must show collective and corrective efforts to remedy air pollution breaches across

38. *Id.* at 684

39. *Id.*

40. *See id.* at 691 (explaining that the agriculture industry, groundwater, and air quality in general also suffered from the smelter fumes).

41. McCarthy, *supra* note 22, at 258.

42. *See id.* (asserting that the Trail Smelter case is the only international adjudication about air pollution).

43. *See* Trail Smelter Arbitral Tribunal (United States v. Can.), 33 AM. J. INT'L L. 182 (1939) [hereinafter Trail Smelter (initial decision) or (Initial Decision)] (initial decision) (explaining the questions presented for Trail Smelter); *see also* Trail Smelter (final decision) *supra* note 37, at 684 (accounting for the further proceedings and final decision in the Trail Smelter Arbitration).

44. DiGiovanni, *supra* note 25 at § 1.1.

45. *Id.*

46. *See generally* Her Majesty the Queen in Right of Ontario v. U.S. EPA, 912 F.2d 1525 (D.C. Cir. 1990). In a more historical case, *Her Majesty the Queen*, the court found that when allocating responsibility for air pollution, “[t]he dispute. . . is whether the EPA has a present obligation, under section 115, to promulgate endangerment and reciprocity findings as proposed rules with respect to U.S. emissions that allegedly result in harmful levels of acid deposition in Canada.” Under § 115 of the Clean Air Act, a remedy is only applicable to “a foreign country [where] the Administer determines has given the [U.S.] essentially the same rights with respect to the prevention or control of air pollution occurring in that country as is given that country by this section” (also known as a “Reciprocity Finding”); *see* 42 U.S.C. §§ 7401-7431 (codifying air quality and emissions limitations across political boundaries; a Reciprocity Finding, made by the EPA Administrator, requires the U.S. to act in accordance with other nations and negotiations, and vice versa); *see also* Michael Burger et al., *Legal Pathways to Reducing Greenhouse Gas Emissions under Section 115 of the Clean Air Act*, 28 GEORGETOWN ENV'T L. REV. 359, 387 (2016) (using the Trail Smelter case as one of the defensible bases for with the EPA has to create reciprocity agreements with other countries).

geopolitical boundaries.⁴⁷ Otherwise, the efforts of a single state or nation may be ineffective.⁴⁸

B. Distinguishing Between Boreal and Temperate Forests: Climate, Land Use Practices Generally, Forest Management Generally, and How Wildfires Start and Spread.

There are different types of forests in the U.S. and Canada that all vary in structure and climate. Additionally, respective countries have varying land use and forest management practices depending on the forest type. There are many issues regarding these practices that scientists have concluded contribute to the exponentially worsening wildfire phenomenon. Therefore, poor land use practices and forest management are the primary culprits to transboundary wildfire pollution.

1. Boreal versus Temperate Forest Structure and Climate.

Boreal forests have adapted to withstand frigid temperatures and are home to caribou and other animals that migrate long distances every winter. These forests predominately cover Canada and reach into the northern U.S.⁴⁹ A belt of boreal forests encircles the northern hemisphere through North America.⁵⁰ Evergreen temperate forests are less common in most of the U.S., but typical in Alaska, New England, Michigan, and Minnesota. Most other U.S. forests are temperate forests.⁵¹ These forests are made up of evergreen trees with year-round leaves and cycle through all four seasons. Deciduous and coniferous forests are frequently mixed within temperate forests. Various animals and plants call these forests home, and many of the animals hibernate or migrate during the winter months.⁵² The seasons of both forest types are divided into “short, moist, and moderately warm summers and long, cold, and dry winters.”⁵³ The U.S. and Canadian logging industry relies on these forests, and the forest product industry generates just under \$300 billion per

47. Eglene, *supra* note 21 at 142.

48. *Id.*

49. Lorin Hancock, *What’s a boreal forest? And the three other types of forests around the world*, WORLD WILDLIFE FOUND. (Mar. 21, 2019), <https://www.worldwildlife.org/stories/what-s-a-boreal-forest-and-the-three-other-types-of-forests-around-the-world>.

50. *Id.*

51. *Id.*

52. *See The Forest Biome*, UNIV. CAL. BERKELEY, <https://ucmp.berkeley.edu/exhibits/biomes/forests.php#:~:text=Seasons%20are%20divided%20into%20short,%2C%2040%2D100%20cm%20annually> (last visited Mar. 17, 2022) (explaining that deer, songbirds, bears, wolves, squirrels, and a multitude of plant life reside in both boreal and temperate forests).

53. *Id.*

year.⁵⁴ The reality is that these beautiful forests permit land use and require forest management to maintain their good nature.

2. Boreal versus Temperate Land Use Practices and Forest Management Generally.

Land use is simply the human use of land.⁵⁵ Land use encompasses all economic and cultural activities (e.g., agriculture, residential, industrial, and recreational) that occur in a given area.⁵⁶ Land in boreal and temperate forests have different uses, even if it does not appear that way. For example, land used for timber production and forested land designated for wilderness will appear as forest-covered land, despite having various uses. Wildfires are a significant threat to land use and a naturally occurring forest systems process.⁵⁷ To curb the increasing risk of wildfires near residential areas, land must be used more intentionally.⁵⁸ These escalating residential losses have had significant economic and ecological consequences.⁵⁹

Economically, people, organizations, and agencies are losing millions of dollars every year from wildfire damages. Further, over 35,000 structures were destroyed or damaged by wildfire in 2017-2018 alone.⁶⁰ This is a recurring cost because structures will be rebuilt and then re-burned because many homes, structures, and buildings are placed in the most hazardous parts of the landscape, for instance, within areas of woody fuel types and higher fuel loads.⁶¹ Yet, the conversation has steered clear from discussing how land use planning could ease wildfire risk. The arrangement and location of structures strongly affect their susceptibility to wildfire, making it essential for law and policymakers to consider future land use practices.

54. U.S. FOREST SERV., *Forest Products Research Actives*, <https://www.fs.fed.us/research/forest-products/> (last visited Mar. 17, 2022).

55. See Van Butsic et al., *Land Use and Wildfire: A Review of Local Interactions and Teleconnections*, 4 LAND 140,141 (2015) (reviewing and exploring the concept of land use).

56. See *id.* (discussing that land use changes are driven by economic and other local conditions).

57. *Id.*

58. *Land Use Planning Can Reduce Wildfire Risk to Homes and Communities*, HEADWATERS ECON., <https://headwaterseconomics.org/natural-hazards/land-use-planning-wildfire/> (last visited Mar. 17, 2022) (stating that “In areas with high wildfire hazard, land use planning can reduce wildfire risks to homes and communities by requiring new developments to comply with wildfire-resistant design and building techniques.”).

59. *Id.*

60. Christopher C. French, *America on Fire: Climate Change, Wildfires & Insuring Natural Catastrophes*, 54 UC DAVIS L. REV. 817, 817 (2020) (stating that: “Despite spending approximately \$3.7 billion annually on fire suppression, more than 35,000 structures were lost to wildfires in 2017 and 2018, approximately \$32 billion in property losses occurred and more than 100 people were killed”).

61. See Stephanie Pincetle et al., *It's the Land Use, Not the Fuels: Fires and Land Development in Southern California*, 37 REAL EST. REV. 25, 25–43 (2008) (explaining that woody fuels encompass shrubbery and trees which make up boreal forests).

Ecologically, land use affects the resilience of forests against wildfires. New land use practices should focus on reducing fuel loads. In Canada, fuel reduction treatments in their boreal zone are used mainly for residential protection.⁶² The Canadian government focuses on reducing fuel loads and thereby reducing wildfire risk. Fuel reduction treatments aim to impede the spread of fast-spreading, high-intensity wildfires to susceptible boreal forest ecosystems.⁶³ The U.S. does not focus on reducing fuel loads and instead defers to excluding and suppressing fires the minute they start.⁶⁴ High fuel loads are a paramount issue because the smoke emitted from wildfires in the U.S. is still making its way into Canada; even though Canada is intentionally reducing their fuel loads, with hopes of reducing black carbon pollution. The land use policies in the U.S. still have a transboundary effect on Canada and implementing policies via the AQA can remedy this issue.

Turning to forest management, the U.S. Forest Service is editing its wildfire policies per new understandings of wildfire's ecological services.⁶⁵ For decades, the agency's standard response to wildfires was immediate suppression by attempting to stifle the fires right when they form.⁶⁶ The U.S. can effectively suppress fresh wildfires because the U.S. government solely focuses on the short-term risks of wildfires. Or, more likely, the possibility of property damage.⁶⁷ The U.S. Forest Service's research has changed the way agencies view and manage wildfires by forcing the transition to a method of igniting prescribed fires—the controlled application of fire by a team of fire experts—to restore the health of stressed overcrowded forests.⁶⁸ Improving forest management approaches is an additional means of limiting wildfire pollution. Management methods include thinning overcrowded forests (too dense with dead foliage) with hopes of restoring them to what forests typically have been: meadows, shrublands, and woodlands.⁶⁹ Thinning is the removal of some trees from a stand to give other trees more

62. Jennifer L. Beverly, *Stand-Level Fuel Reduction Treatments and Fire Behaviour in Canadian Boreal Conifer Forests*, MDPI J. 1 (July 27, 2020) (discussing the aim of their fuel treatments is to minimize fast-spreading, high-intensity crown fires).

63. *Id.*

64. *Science and Technology*, U.S. FOREST SER., <https://www.fs.usda.gov/science-technology/fire> (last visited Mar. 17, 2022).

65. *Id.*

66. *Id.*

67. *See id.* (explaining how U.S. policies place more of a focus on property damage than environmental effects).

68. *Id.*; *see also* Nathan Rott, *Fire Ecologists say more fires should be left to burn. So why aren't they?* NPR <https://www.npr.org/2018/09/27/649649316/fire-ecologists-say-more-fires-should-be-left-to-burn-so-why-arent-they> (Sep. 27, 2018) (asserting that immediately smothering a wildfire is problematic because it is both short-sighted and dangerous. This is because forest overgrowth is the largest contributor to the kinds of huge, catastrophic, and extremely hot fires that are becoming more common.).

69. *See* John Punches, *Thinning: An Important Forest Management Tool*, OR. STATE UNIV., (Sept. 2004), <https://extension.oregonstate.edu/forests/health-managment/thinning-important-forest-management-tool> (explaining the process of thinning a forest).

space.⁷⁰ Right now, the conversation on thinning is mainly economic-based.⁷¹ Landowners see thinning as a tool for improving timber value and making forest sites more productive.

Not only is forest management flawed, but wildfire legislation has been a contributor to net black carbon emissions.⁷² For example, there have been legislative proposals in California, both to improve “wildfire surveillance and warning systems” and to require private property owners to clear brush and dead trees near residential areas.⁷³ Lawmakers are skeptical about passing the proposed legislation because intentionally lighting fires to halt wildfires seems counterintuitive. Lawmakers want to protect homes and businesses and the lawmakers see wildfires as a threat to that goal. Due to wildfire’s potential for impacting the health and safety of humans and the environment (in both countries), current policies surrounding wildfire management predominately focus on the method of excluding.⁷⁴ Exclusion (also known as suppression) is the act of extinguishing or fighting fires.⁷⁵ Additionally, exclusion is the de facto policy of attempting to eliminate fires versus letting them burn.⁷⁶ Common sense would say that immediately extinguishing wildfires is the safe, wise, and correct choice. Although well-intentioned, Canada’s utilization of a de facto exclusion policy is misguided because excluding wildfires increases the fuel loads and alters the forest’s composition and structure.⁷⁷ The de facto policies are leading to hotter and larger fires.⁷⁸ Hotter and larger fires return to the same landscape under this traditional method,⁷⁹ meaning more emissions of black carbon will traverse the U.S. and Canada border. Altering fire management from exclusion to new

70. *Id.*

71. See French, *supra* note 60 (explaining the economic costs of wildfires).

72. Chuck DeVore, *Wildfires Caused by bad environmental policy are causing California Forests to be Net CO2 emitters*, FORBES (Feb. 25, 2019), <https://www.forbes.com/sites/chuckdevore/2019/02/25/wildfires-caused-by-bad-environmental-policy-are-causing-california-forests-to-be-net-co2-emitters/?sh=216704475e30>.

73. A common theme with the U.S. regarding wildfire management is real estate and property protection. As discussed *supra*, and *infra*, the U.S. will immediately extinguish fires (or try to) once identified. The hope is to prevent homes, businesses, and other structures from going up in flames. This method will only make fires burn hotter, wilder, faster, and larger as exclusion remains the go to method. California is a perfect example of this phenomenon. Every year during “wildfire season,” fires rage across the state through residential areas causing millions of dollars in damages. *Id.*

74. *Fire Exclusion and Changing Patterns of Fire Behavior*, KARUK CLIMATE CHANGE PROJECTS (last visited July 28, 2022), <https://karuktribeclimatechangeprojects.com/chapter-2-fire-exclusion-and-changing-patterns-of-fire-behavior/>.

75. *Id.*

76. Sean C.P. Coogan & Mike D. Flannigan, *Scientists’ warning on wildfire—a Canadian Perspective*, NRC RES. PRESS 1015, 1019 (May 30, 2019), <https://cdnsiencepub.com/doi/pdf/10.1139/cjfr-2019-0094>.

77. *Id.*

78. *Id.*

79. Jennifer Sherry et al., *Rethinking the maps: a case study of knowledge incorporation in Canadian wildfire risk management and planning*, J. ENV’T. MANAGE. 494, 494 (2019).

methods proven to be effective must be in the International Joint Commission's (IJC's) wildfire regulation conversation.

Reducing air pollution is overlooked during wildfire legislation creation. Exclusion may aid in protecting property during the short term. Still, this archaic method ultimately creates more significant property damage from more unwieldy fires and air pollution from those fires. Fire suppression does nothing to reduce fuel loads and wildfire likelihood and instead is an aggravative method. Wildfire management must change to mitigate and alleviate transboundary pollution, and the AQA could be a vessel for that change.⁸⁰

3. How Wildfires Start and Spread: On Land and in the Air.

The U.S. and Canada must address wildfires as a growing threat to air quality. For example, in 2021, jurisdictions along the northern U.S.-Canada border—New York City, New York; Detroit, Michigan; Cleveland, Ohio; parts of Idaho and Montana; and the Canadian provinces of Manitoba and Ontario—hit the “unhealthy air quality zone,” reaching above 150 on the AQI.⁸¹ This past year, in New York City, a gray haze shrouded the city while the AQI for delicate particulate matter reached 170 and lasted over three weeks.⁸² Surprisingly, Canadian wildfires were partly to blame for the U.S.’ poor air quality. Black carbon diffused from Canadian wildfires drifted across the geopolitical border into the U.S.⁸³ At the same time, the AQI in U.S. cities (Detroit, Michigan and Cleveland, Ohio) reached above 125, which was “considered unhealthy for sensitive individuals” and continued to

80. See generally *Salvage Logging*, SIERRA FOREST LEGACY (last visited Mar. 17, 2022), https://www.sierraforestlegacy.org/FC_FireForestEcology/FFE_SalvageLoggingScience.php (describing salvage logging and its intricacies, along with its controversial issues) (Salvage logging could be another useful forest management tool. Although controversial, salvage logging is a long-practiced method of forest management. Theoretically, it aids with forest restoration following wildfires. Salvage logging involves the Forest Service or private companies salvaging trees post-fire. Although promising, salvage logging is scientifically unsupported and would likely not be able to be implemented via the AQA.).

81. Peter Szekely & Steve Gorman, *Western wildfire smoke causes cross-country air pollution*, REUTERS (July 21, 2021), <https://www.reuters.com/world/us/smoke-us-west-wildfires-leaves-easterners-gasping-2021-07-20/> (defining AQI, which measures the quality of the air. AQI works similarly to that of a thermometer. AQI gives the quality of the air a numerical value from 0 to 500 which shows the changes in the amount of pollution in the air. For example: 0–50 is good air quality and at 150 it trends into unhealthy air quality. Five major air pollutants include: ground level ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, airborne particles/aerosols.); See also Popiel, *supra* note 34, at 447. (discussing the imminent threat to transboundary pollution Canadian's face because of their proximity to the U.S.-Canada border. Notably, 90% of Canadians live within 100 miles of the U.S. border. The proximity to the U.S. has allowed for effective and friendly dispute management, but also puts Canadians at a higher risk for negative effects of air pollution.).

82. Szekely & Gorman, *supra* note 81.

83. *Id.*

worsen.⁸⁴ Wildfire smoke has prompted widespread government air quality warnings from the U.S. and Canada.⁸⁵ The biomass that burns from these fires is an “important intermittent source” of black carbon.⁸⁶ Wildfires also emit large amounts of “light-absorbing carbon” particles into the atmosphere.⁸⁷ Wildfires (and the resulting pollution) are expected to increase in frequency and intensity as climate change advances.⁸⁸ Light-absorbing particles cause extreme climate impacts by burdening the atmosphere, reducing snow albedo, increasing solar radiation absorption, and accelerating ice melting.⁸⁹ This cycle continues to pollute the atmosphere and, in turn, pollute the human environment.⁹⁰

Concerning climate change, absent a global climate policy average temperatures in the western U.S. are projected to increase by another 7–12 degrees Fahrenheit by 2100 from their previous increase of 2.34 degrees Fahrenheit since 1895.⁹¹ This shows that wildfires are increasing in temperature and intensity.⁹² Climate change will catalyze wildfires to burn with more intensity and frequency.⁹³ Climate-change-exacerbating wildfires

84. *Id.*

85. *Id.*

86. S.E. MARTENIES, ASSESSING THE IMPACT OF WILDFIRES ON THE USE OF BLACK CARBON AS AN INDICATOR OF TRAFFIC EXPOSURES IN ENVIRONMENTAL EPIDEMIOLOGY STUDIES 2 (L. Hoskovec, A. Wilson eds., 2021).

87. See Dantong Liu, et al., *Lifecycle of light-absorbing carbonaceous aerosols in the atmosphere*, 40 CLIMATE ATMOSPHERIC SCI. 1, 2–3 (2020) <https://www.nature.com/articles/s41612-020-00145-8> (explaining that the term light-absorbing carbonaceous aerosols (LACs) is a broad term that includes black carbon and light absorbing carbon. LACs contribute to heating the atmosphere, dimming the Earth’s surface, and reducing snow/ice albedo (whiteness of the surface of the snow/ice).).

88. MARTENIES, *supra* note 86, at 2.

89. See Liu, et al., *supra* note 87, at 3 (describing how LACs emit into the atmosphere, then evolve into further deposition).

90. MARTENIES, *supra* note 86, at 1.

91. See generally French, *supra* note 60, at 826 (summarizing the affect climate change has had on the average temperature of North America and stating that there has been an increase of 2.34 degrees Fahrenheit in the U.S. since 1895); See also INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Climate Change 2022: Impacts, Adaptation, and Vulnerability Summary for Policymakers Report*, UNEP at 11. (Climate change has caused “widespread, pervasive impacts to ecosystems, people, settlements, and infrastructure have resulted from observed increases in the frequency and intensity of climate and weather extremes, including hot extremes on land and in the ocean, heavy precipitation events, drought and fire weather (*high confidence*).”); See also *Climate Change Indicators: U.S. and Global Temperature*, U.S. ENV’T. PROT. AGENCY, <https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature#:~:text=Since%201901%2C%20the%20average%20surface,F%20per%20decade%20since%201979> (last visited Mar. 17, 2022) (The EPA published a report stipulating that since 1901, the average surface and air temperature across the contiguous 48 states has risen at a rate of 0.16 degrees Fahrenheit per decade. Additionally, this rise has grown exponentially as 2016 was the warmest year on record and 2020 was the second warmest.).

92. MARTENIES, *supra* note 86, at 2.

93. French, *supra* note 60, at 823.

are a longstanding issue.⁹⁴ Dating back to 2002, wildfires burning in Quebec, Canada resulted in a smoke plume that could be shown in satellite images that blanketed the U.S. East Coast.⁹⁵ This led to enhanced “CO mixing ratios . . . seen in the [U.S.] from Maine down to northern Virginia.”⁹⁶ Wildfires needlessly and violently ravage both the U.S. and Canada.⁹⁷ As wildfires continue to destroy parts of North America, health experts and scientists are warning the public about the dangerous levels of air pollution and its adverse effects.⁹⁸ While contributing to the climate crisis and exacerbating transboundary pollution, wildfires are emitting black carbon at an exponential rate. This puts humans and the environment (physical and atmospherically) at risk.

Additionally, black carbon is a major player in climate change.⁹⁹ A recent study found that black carbon is the second-largest contributor to climate change after CO₂ because it traps heat.¹⁰⁰ When fossil fuels or wood incompletely combust, soot forms—this is known as black carbon.¹⁰¹ Black carbon can be produced naturally or by human activity and exists in high concentrations in areas where trees are burning.¹⁰² Black carbon particles strongly absorb sunlight, which makes the soot appear black.¹⁰³ The EPA deems this pollutant “a global environmental problem that has negative

94. *Smoke from Canadian Fires Blankets Eastern U.S.*, NASA, <https://earthobservatory.nasa.gov/images/2596/smoke-from-canadian-fires-blankets-eastern-us> (July 9, 2002).

95. *Id.*

96. J. William Munger, *A Major Regional Air Pollution Event in the Northeastern United States Caused by Extensive Forest Fires in Quebec, Canada*, 109 J. GEOPHYSICAL RSCH. 1, 8 (2004).

97. Elizabeth Gamillo, *Plumes of Smoke From Fires in the North American West Stretch Across the Continent*, SMITHSONIAN MAG., (July 27, 2021), <https://www.smithsonianmag.com/smart-news/plumes-smoke-north-american-wildfires-are-stretching-across-continent-180978288/>.

98. *Black Carbon Research and Future Strategies: Reducing Emissions, Improving Human Health, and Taking Action on Climate Change*, U.S. ENV'T. PROT. AGENCY (Oct. 2011) https://www.epa.gov/sites/default/files/2013-12/documents/black-carbon-fact-sheet_0.pdf.

99. Black carbon is not one of the GHG chemicals regulated under the CAA despite petitions from the EPA. Instead, it is a fine particulate subject to regulation under the NAAQS.

100. See T.C. Bond & S.J. Doherty, *Bounding the role of black carbon in the climate system: A scientific assessment*, J. GEOPHYSICAL RSCH.: ATMOSPHERES 5380, 5381 (2013), <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/jgrd.50171> (sharing the results of a four-year research collaboration by 31 scientists, that analyzed and synthesized what is known about black carbon's contributions to climate change); Brooke Jarvis, *Black Carbon: A Golden Opportunity to Fight Climate Change?*, ENSIA (Jul. 15, 2013), <https://ensia.com/features/black-carbon-golden-climate-change/> (stating that black carbon traps even more heat than methane).

101. Black Carbon, CLIMATE & CLEAN AIR COAL., <https://www.ccacoalition.org/en/sleps/black-carbon> (last visited Dec. 10, 2021).

102. *Id.*

103. *Black Carbon and Climate Change: What is Black Carbon?* CEN. CLIMATE ENERGY SOLUTIONS 1 (Apr. 2010) (last visited Dec. 10, 2021), <https://www.c2es.org/document/what-is-black-carbon/>.

implications for human health and our climate.”¹⁰⁴ One can infer that the EPA acknowledges that black carbon is a significant contributor to climate change. Black carbon has imminent health and environmental effects and accelerates glacial and ice sheet melting—increasing the rate of global warming. The direct-warming effect comes from the particulate matter absorbing atmospheric solar radiation and converting it to heat radiation.¹⁰⁵ The indirect effect stems from black carbon reducing the reflectivity of snow and ice in the arctic.¹⁰⁶ Climate scientists recognize black carbon as a considerable contributor to the overarching issue of climate change¹⁰⁷ and, more specifically, transboundary pollution.

III. ANALYSIS

A. The U.S. and Canada Air Quality Agreement: Overview and Procedural Aspects.

1. Overview of the AQA’s history and purpose

In 1991, after years of protests in Canada and near the boundary waters of the U.S., former President George H. W. Bush and former Prime Minister Brian Mulroney signed the bilateral Air Quality Agreement (AQA).¹⁰⁸ The bilateral accord was then integrated into the U.S. Clean Air Act of 1990 (CAA) and the Canadian Acid Rain Program of 1985.¹⁰⁹ AQA is one of the most successful bilateral agreements tackling transboundary air pollution.¹¹⁰ After receiving political and social pushback to reduce acid deposition and acid rain levels,¹¹¹ both countries agreed to sign the AQA.¹¹² Acid rain caused

104. *Black Carbon Research and Future Strategies: Reducing Emissions, Improving Human Health, and Taking Action on Climate Change*, U.S. ENV’T. PROT. AGENCY (Oct. 2011) https://www.epa.gov/sites/default/files/2013-12/documents/black-carbon-fact-sheet_0.pdf.

105. *Black Carbon*, SCIENCE DIRECT, <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/black-carbon> (last visited Dec. 10, 2021).

106. *Id.*

107. *Id.*

108. Brian Mulroney, *Acid Rain: A case study in Canada-US relations*, POL’Y OPTIONS (Apr. 12, 2012) <https://policyoptions.irpp.org/magazines/harpers-foreign-policy/acid-rain-a-case-study-in-canada-us-relations/>.

109. *Id.*

110. *See generally* Roelofs, *supra* note 18, at 421 (concluding that the AQA is one of the most successful transboundary air pollution agreements).

111. *See generally* Don Munton, *Acid Rain and Transboundary Air Quality in Canadian-American Relations*, 27 AM. R. CAN. STUD. (stating that acid rain was a major environmental issues during the 1980s).

112. *Canada-United States Air Quality Agreement: Overview*, GOV’T CAN., <https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/transboundary/canada-united-states-air-quality-agreement-overview.html> (last visited Oct. 29, 2021).

adverse effects on human and environmental health in both countries; at the time, there was no remedial legal or diplomatic instrument.¹¹³ Thus, the AQA was born. The AQA successfully mitigates acid rain sources and causes from both countries.¹¹⁴ Yet, the diplomatic potential expands beyond acid rain.

The initial purpose of the AQA was to serve only as the Acid Rain Accord.¹¹⁵ But, as Prime Minister Mulroney noted, the AQA's impact and purpose can, and should, expand beyond tackling transboundary acid rain.¹¹⁶ Mulroney mentioned, "it could well serve as a template for a bilateral accord on climate change, as it has on other cross-border air issues."¹¹⁷ Initially, the Agreement's goal was to lower SO₂ emissions by 50% by 1994.¹¹⁸ The Agreement was so successful that the goal of reducing SO₂ was met early in 1993.¹¹⁹ The U.S. and Canada have an active, successful agreement, and both countries continue to use this channel to mitigate transboundary air pollution.

Scientists found that an estimated three to four times as much SO₂ travels up to Canada from the U.S. versus the other way around.¹²⁰ Typically, most transboundary pollution disproportionately affects one country due to natural causes, such as prevailing winds, and anthropogenic means (i.e. improper land-use practices and forest management).¹²¹ The AQA has led to significant progress between Canada and the U.S. in reducing acid rain sources.¹²² As of 2017, SO₂ emissions decreased by 69% and 88% from their initial levels in 1990 in Canada and the U.S., respectively.¹²³ Additionally, nitrogen dioxide emissions decreased by 59% and 61% in Canada and the U.S., respectively.¹²⁴ Impressively, both countries continue to meet their commitments as established in the original Agreement.¹²⁵

113. Carol Garland, *Acid Rain Over the United States and Canada: The D.C. Circuit Fails to Provide Shelter Under Section 115 of the Clean Air Act While State Action Provides a Temporary Umbrella*, 16 BOS. COLL. ENV'T AFFS. L.R. 1, 1-2 (1988).

114. *See generally* Agreement Between the Government of the United States of America and the Government of Canada on Air Quality, U.S.-Can., Mar. 13, 1991, T.I.A.S. 11783 [henceforth Air Quality Agreement] (establishing an international framework to address acid rain).

115. Mulroney, *supra* note 108.

116. *Id.*

117. *Id.*

118. *Id.*

119. *Id.*

120. Roelofs, *supra* note 18, at 423.

121. Increased wind speeds tend to mean that there is a higher dispersion of air pollutant particles. This phenomenon results in lower air pollution concentrations in areas with stronger and faster winds. Further, when the ground heats up during the day, the air becomes more turbulent which causes air pollutant particles to disseminate in the air. Essentially, pollutants will disperse at a higher rate where the air is warmer. *Transboundary Air Overview*, GOV'T CAN. (last visited Aug. 13, 2022), <https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/transboundary/overview.html>.

122. GOV'T CAN., *supra* note 121.

123. *Id.*

124. *Id.*

125. *Id.*

Each year, both countries hold the New England Governors and Eastern Canadian Premiers (NES/ECP) conference. The NES/ECP has stressed “the need for appropriate controls on sources outside the region that pose an environmental threat.”¹²⁶ This conference complements the AQA. In 1999, the NES/ECP created a resolution “calling upon the [EPA] and Environment Canada [the Canadian counterpart to the U.S. EPA] to pursue additional reduction strategies for those sources outside the region that significantly contribute to air quality problems in New England and eastern Canada.”¹²⁷ Thus, the neighboring countries created a platform for discussing environmental threats. Both countries formed the International Joint Commission (IJC) (an independent binational commission) to administer new bilateral agreements (including transboundary air pollution-focused agreements)¹²⁸ and revisit active agreements—such as the AQA.¹²⁹ To upkeep the AQA, the bilateral Air Quality Committee must issue a progress report every two years.¹³⁰ Each report spotlights each country’s progress on the commitments included in the AQA and reports each country’s continued efforts to address transboundary air pollution.¹³¹ The motivation behind the annual NES/ECP conference is to pinpoint new and recurring sources that cause adverse effects across the geopolitical U.S. and Canada border.¹³²

To summarize the motivation behind the AQA’s creation: the Canadian Government realized that, because of the disproportionate effect of acid rain, it would be unable to slow down the problem absent a bilateral effort.¹³³ Likewise, transboundary pollution from wildfires requires similar

126. Eglene, *supra* note 21, at 144.

127. *Id.*; see also Bradley C. Karkkainen, *The Great Lakes Water Resources Compact and Agreement: A model for Transboundary Governance at Subnational Scales*, 9 SEA GRANT L. & POL’Y J. 37, 40 (2018) (noting that the U.S. and Canada have coordinated an agreement for the purpose of managing the “world’s largest freshwater system.” The Boundary Waters Treaty was created over 100 years ago and is still a strong piece of legislation. Its purpose is to guarantee full freedom of navigation and commerce on the great lakes and other boundary waters, to maintain the natural flow of the waters, and ensure that the boundary waters and great lakes are healthy.); see Trail Smelter *supra* note 37, at 716 (mentioning that the IJC recommended remedial measures and a formula for payments to compensate for damages).

128. Air Quality Agreement, *supra* note 114 at 7.

129. *Id.*

130. *Id.* at 6.

131. *Canada-United States Air Quality Agreement: Overview*, <https://www.canada.ca/en/environment-climate-change/services/air-pollution/issues/transboundary/canada-united-states-air-quality-agreement-overview.html> GOV’T CAN. (Last visited Oct 29, 2021).

132. See *generally id.* (stating that the purpose of the agreement was to reduce emissions of SO₂ and NO_x, and that the bilateral committee issues reports highlighting progress on these commitments).

133. James C. Brockmann, *Acid Rain: Corroding United States-Canadian Relations*, 6 J. ENERGY L. & POL’Y 357, 366 (1985); see also Air Quality Agreement, *supra* note 114, at 4, 19 (stipulating the specific objectives for emissions limitations or reductions of sulfur dioxide and nitrogen oxides).

collaboration. Article V of the AQA is the catalyst for incorporating new measures and new transboundary pollution threats—like wildfires.¹³⁴

2. The AQA's Procedures

The AQA is structured to be a set of five prescribed provisions that, if the U.S. and Canada follow, will maintain the original objective of the AQA. The five provisions are: (1) establish objectives and then implement programs to meet these objectives;¹³⁵ (2) undertake environmental assessments, notify the counterparty, and enact mitigation measures;¹³⁶ (3) carry out cooperative and coordinated scientific and technological activities while also conducting economic research;¹³⁷ (4) exchange pertinent information;¹³⁸ and (5) review, assess, consult, address rising concerns, and settle disputes.¹³⁹ The AQA has a very systematic and thorough roadmap. The document intends to “keep up” with the changing climate by identifying every new (and old) transboundary pollutant and then going through the AQA's provided steps to eliminate those pollutants. For the AQA to consider an activity, the IJC must determine whether such activity causes “significant transboundary air pollution.”¹⁴⁰ Following SO₂'s journey through these steps is helpful to fully understand the effectiveness and particulars of the AQA's provisions.

First, both Parties must establish objectives and then implement programs in their respective country to meet these objectives.¹⁴¹ Annex 1 of the AQA contains both Parties' objectives for emission limitations of SO₂. The U.S. followed this provision by implementing an SO₂ control program.¹⁴² At the same time, Canada committed itself to a permanent cap on SO₂ emissions.¹⁴³ Right off the bat, both countries have shown commitments to

134. Air Quality Agreement, *supra* note 114, at 5. The Agreement goes way beyond addressing acid rain and hopes to control every type of transboundary air pollution except for those which have a global effect (i.e., ozone depletion). The reason for exempting global transboundary air pollution is not stated within the text of the Agreement itself. The Agreement's reach, and purpose is to remain narrow and only involve the U.S. and Canada and the AQA is not the document to expand beyond that scope. Other larger and broader multilateral treaties are better suited for global transboundary pollution (such as the Paris Climate Accord). *See id* at 3 (stating that transboundary air pollution in the AQA only includes “air pollution whose physical origin is situated wholly or in part within the area under the jurisdiction of one Party and which has adverse effects, *other than effects of a global nature*, in the area under the jurisdiction of the other Party” (emphasis added)).

135. Air Quality Agreement, *supra* note 114, at 3.

136. *Id.* at 4.

137. *Id.*

138. *Id.*

139. *Id.*

140. *Id.* at 5.

141. *Id.* at 3.

142. The SO₂ Control program was established under the 1990 CAA Amendments. *Id.* at 19.

143. *Id.*

each other that they are taking SO₂ seriously through implementing programs and are making concrete remedial steps to alleviate SO₂ within these programs. Three joint projects were completed under the AQA strategy: the Great Lakes Basin Airshed Management Framework,¹⁴⁴ Maintaining Air Quality in a Transboundary Air Basin,¹⁴⁵ and A Study on the Feasibility of Emissions Cap and Trading for Nitrogen Oxides (NO_x) and SO₂.¹⁴⁶ According to both countries' objectives and commitments, all of these projects aid in the overall decrease in SO₂ and NO_x emissions (and their existence in the atmosphere).¹⁴⁷

Second, each Party must conduct an environmental assessment, notify its counterparty, and enact mitigation measures.¹⁴⁸ Both Parties are specifically required to assess any proposed activity or project within the country's jurisdiction that "would be likely to cause significant transboundary air pollution."¹⁴⁹ Parties must then notify the other of the assessment results and include mitigation propositions.¹⁵⁰

Third and fourth, both Parties must carry out cooperative and coordinated scientific and technological activities while also conducting economic research and exchanging that information.¹⁵¹ Canada and the U.S. both agreed to coordinate their monitoring activities through the:

coordination of existing networks[,] . . . additions of monitoring tasks of existing networks[,] . . . addition of stations or networks where no existing monitoring facility can perform [the] necessary function[,] . . . the use of compatible data management procedures,

144. See generally Canada–United States Air Quality Agreement, *Great Lakes Basin Airshed Management Framework Pilot Program*, U.S. ENV'T. PROT. AGENCY (2005) https://www.epa.gov/sites/default/files/2015-07/documents/great_lakes_basin_airshed_management_framework.pdf (detailing a pilot program to address air quality issues in the Great Lakes Basin).

145. See generally *Maintaining Air Quality in a Transboundary Air Basin: Georgia Basin-Puget Sound*, U.S. ENV'T. PROT. AGENCY (2005) https://www.epa.gov/sites/default/files/2015-07/documents/maintaining_air_quality_in_a_transboundary_air_basin_georgia_basin_-_puget_sound.pdf (reporting on the pilot program to establish the Georgia Basin-Puget Sound International Airshed Strategy).

146. See generally *United States–Canada Emissions Cap and Trading Feasibility Study*, U.S. ENV'T. PROT. AGENCY (2005) https://www.epa.gov/sites/default/files/2015-07/documents/emissions_cap_and_trading_feasibility_study.pdf (reporting on a cross-border cap and trade program for sulfur dioxide and nitrogen oxides emissions).

147. Air Quality Agreement, *supra* note 114, at 19.

148. *Id.* at 5.

149. *Id.* See Roelofs, *supra* note 18 at 446 (stating that consultations must begin "as soon as practicable, but in any event not later than thirty days from the date of receipt of the request for consultation, unless otherwise agreed by the Parties").

150. Air Quality Agreement, *supra* note 114 at 5.

151. *Id.* at 4.

formats and methods[,] . . . [and] the exchange of monitoring information.¹⁵²

The specifics of monitoring activities are not necessarily mentioned in the AQA's text, but one can infer that the intent was to include coordinated activities that will better understand SO₂ transboundary pollution. Further, Annex 2 of the AQA lays out the specifics for coordinating all air pollutant monitoring activities.¹⁵³ From this step of the AQA, Environment Canada produced the Canadian Air and Precipitation Monitoring Network (CAPMoN).¹⁵⁴ Article VI of the AQA was a channel for connecting CAPMoN to the U.S.. After IJC discussions regarding cooperative scientific and technological activities, the U.S. now contributes information to the CAPMoN system.¹⁵⁵ This allows for both Parties to assess the impact of SO₂ emission decreases on a broad scale while exchanging pertinent SO₂ transboundary pollution in real-time and adjusting as needed per Articles X through XIII.¹⁵⁶

Finally, even after following all the AQA's steps for eliminating pollution, both Parties recognize that the AQA is not static. Articles X–XIII are instruments for reviewing, assessing, consulting, and addressing concerns.¹⁵⁷ In 1996, both Parties agreed, after reviewing their respective and joint programs and policies, that the “control of transboundary air pollution has not occurred to the extent necessary to protect the environment” regarding SO₂ emissions fully.¹⁵⁸ The IJC enacted remedial measures after

152. *Id.* at 26.

153. *Id.* The details of SO₂ monitoring activities are not written as an additional clause or amendment in the AQA itself. Again, the AQA is a process.

154. 135 Environment Canada is a federal agency comparable to the EPA. CAPMoN is comparable to the Canadian Wildland Fire Information System (CWFIS), the Wildfire Threat Rating System (WTRS), and the Canadian Fire Effects Model (CanFIRE). The latter three programs deal with monitoring wildfires, fuel loads, and wildfire threats whereas CAPMoN measures SO₂ air pollutant deposits. The difference with CAPMoN is that the United States contributes to its measuring system through well-established networks created by Article VI of the AQA. The same can, and should, be done with CWFIS, WTRS, and CanFIRE. All are programs that could benefit from cooperative monitoring, which is the purpose behind Article VI. *Canadian Air and Precipitation Monitoring System*, GOV'T CAN., <https://www.canada.ca/en/environment-climate-change/services/air-pollution/monitoring-networks-data/canadian-air-precipitation.html> (last visited Jul. 20, 2022).

155. EPA's AIRNOW program measures the air quality in real time. Through AQA discussions and negotiations, AIRNOW expanded to include data and develop maps of Canada. This is another example of Article VI successfully allowing for collaboration and coordination regarding technology and scientific programs. AIRNOW could and should be utilized for measuring air quality during and after wildfires. AIRNOW, *supra* note 33 (showing the current AQA in every city and zip code).

156. *See* Air Quality Agreement, *supra* note 114, at 7–8 (explain that both parties must assess and adjust their SO₂ impact).

157. *Id.*

158. INT'L JOINT COMM'N, *U.S.–Canada Air Quality Agreement: 2002 Progress Report* 41, U.S. ENV'T. PROT. AGENCY (2002) https://www.epa.gov/sites/default/files/2015-07/documents/2002_u.s.-canada_progress_report.pdf.

this review, and Canadian Prime Minister Jean Chrétien and U.S. President William “Bill” Clinton committed to developing a Joint Plan of Action.¹⁵⁹ AQA’s first review ended with both Parties recognizing the value of expanding the Agreement to address concerns of other and or new transboundary pollution. Overall, the AQA is a successful bilateral agreement. The Joint Plan of Agreement purports that the AQA is valuable beyond thwarting transboundary SO₂ pollution. The AQA is an ideal instrument for diminishing transboundary wildfire pollution because wildfire pollution constitutes “significant transboundary air pollution.”¹⁶⁰

B. Diplomacy Through the AQA is a Solution for Wildfire Related Transboundary Pollution.

Article II of the AQA prescribes a simple purpose: “to establish, by this Agreement, a practical and effective instrument to address shared concerns regarding transboundary air pollution.”¹⁶¹ The IJC should, and must, use this instrument to suppress transboundary wildfire pollution.

1. Step zero: proving that poor land use and forest management are activities that likely cause significant transboundary pollution.

Before anything, if both Countries want to bring wildfires through the AQA’s process, they must assess which activities or projects “would be likely to cause significant transboundary air pollution.”¹⁶² Informing the IJC of the U.S.’ exclusion and suppression practices, residential planning, and high fuel loads will be the cause for imposing the AQA. As previously discussed, the U.S.’ poor land use and forest management practices have been the initial cause of wildfires and have exacerbated raging fires. SO₂’s journey through its AQA application required both governments to receive tremendous pushback from their respective citizens.¹⁶³ Public outrage and engagement are the sparks this movement demands.

159. The Joint Plan of Action sets in motion that a bilateral negotiation addressing ground-level ozone would benefit air quality health in both the U.S. and Canada. To solidify their commitments to each other, both Parties included an “ozone Annex” in the AQA. The Joint Plan of Action is a quintessential example of both Parties recognizing the need to review their own programs continuously and periodically. *See generally* Air Quality Agreement, *supra* note 114, 19–25 (setting objectives that are not always met by the initial programs to curb transboundary pollution).

160. *Id.* (stipulating that the AQA’s scope is narrow in that it only considers pollution that is considered by both Parties to be “significant transboundary air pollution”).

161. *Id.* at 3.

162. *Id.* at 5.

163. This starts with educating the public on the gravity of wildfire pollutions. The public was impossible to ignore during the acid rain discussions. *See generally* *Trail Smelter*, *supra* note 37 (showing how both the U.S. and Canada were forced by their citizens to address the significant transboundary pollution that was coming from these wildfires).

Canada and the U.S.’ success with curbing acid rain has shown the value of using the AQA’s provisions for tackling significant transboundary pollution. In addition, there is potential and precedent for extending that success to suppress wildfires because wildfires are a significant transboundary pollutant.¹⁶⁴ Wildfires often result from acts like leaving campfires unattended, burning debris, malfunctioning equipment,¹⁶⁵ discarding cigarettes, and arson.¹⁶⁶ Wildfires have significantly impacted human health and exacerbated climate change—the most significant threat to

164. Not referring to pollutants in the CAA, but instead the NAAQS. *Treatment of Air Quality Data Influenced by Exceptional Events* (Homepage for Exceptional Events), U.S. ENV’T. PROT. AGENCY, <https://www.epa.gov/air-quality-analysis/treatment-air-quality-data-influenced-exceptional-events-homepage-exceptional>. *Wildfire Causes and Evaluations*, NAT’L PARK SERV. <https://www.nps.gov/articles/wildfire-causes-and-evaluation.htm> (last visited Jan. 20, 2022). See also Water Science School, *Acid Rain and Water*, USGS 9 <https://www.usgs.gov/special-topics/water-science-school/science/acid-rain-and-water#overview> (last visited Dec. 10, 2021) (distinguishing acid rain precipitation sources such as volcanoes and human activities (emissions of sulfur dioxide and nitrogen oxides over long periods of time) which is, in some ways, similar to anthropogenic black carbon sources). This technology may be useful and could potentially be used during future AQA discussions to show that it is possible to anticipate black carbon breakouts (wildfires). See also *Distinguishing Black Carbon Sources*, ANSTO (Jul. 22, 2019), <https://www.ansto.gov.au/news/distinguishing-black-carbon-sources> (describing new technology created for the purpose of distinguishing sources of black carbon. “Experts in the monitoring of fine particle pollution have developed a research instrument to measure the concentration of black carbon in the atmosphere and determine its source.”).

165. Pacific Gas & Electric Co.’s downed power lines have caused more than 1,500 wildfires since 2012. One of which was the deadliest wildfire in California’s history, killing 85 people and destroying more than 19,000 structures. Morgan McFall-Johnsen, *Over 1,500 California fires in the past 6 years—including the deadliest ever—were caused by one company*, INSIDER (Nov. 3, 2019) <https://www.businessinsider.com/pge-caused-california-wildfires-safety-measures-2019-10>.

166. The AQA was created to curb acid rain sources, damages, and externalities. Comparing the process of locating acid rain sources to that of wildfire sources may prove useful for the IJC during wildfire discussions. Finding wildfire sources is difficult, but not impossible, and lawmakers/policymakers should look to the new technology that assists in predicting when or where wildfires will start. *Human vs. Naturally Occurring Wildfires*, U.S. DEP’T INT. INDIAN AFF. (last visited Dec. 10, 2021) <https://www.bia.gov/bia/ots/dfwfm/bwfm/wildfire-prevention-and-education/home-bureau-indian-affairs-bia-trust-services-division-forestry-and-wildland-fire-management-branch>; *id.* (highlighting the difficulty for firefighters to find and distinguish wildfire sources). Acid rain emitters and emission sources are easier for scientists to distinguish and locate. See GOV’T CAN., *supra* note 121 (identifying primary emission sources for acid rain and addressing those issues). SO₂ consistently emits from acid rain sources over a longer period of time in comparison to wildfires. Wildfires have a “shorter lifespan” in that they do not last years at a time; It is difficult to ascertain how removing a source of sulfur emissions in the U.S. would have a positive effect on sulfur deposits or acid rain in Canada—it is hard to track how one specific emission source affects a specific part of a country. Thus, like regional SO₂ evaluations, the IJC would have to discuss at a regional level how and what their plans are for curbing wildfires. See generally INT’L JOINT COMM. UNITED STATES-CANADA AIR QUALITY AGREEMENT PROGRESS REPORT 2004, https://www.epa.gov/sites/default/files/2015-07/documents/2004_u.s.-canada_progress_report.pdf (asserting that scientists cannot guarantee that a 50% reduction in, for example, a sulfur emission reduction in the Midwest, would assure a 50% reduction in the Northeast). Additionally, it is important to note that climate scientists believe acid rain sources originate in urban areas whereas black carbon emissions are found in rural locations. See generally *The Rural Fire Problem in the United States*, FED. EMERGENCY MGMT. AGENCY U.S. FIRE ADMIN. 7 (Aug. 1997) (touching on the phenomenon of urban acid rain sources and rural wildfire sources).

living creatures, resources, and ecosystems.¹⁶⁷ Many wildfires are human-caused through small, negligent actions.¹⁶⁸ Yet, as previously discussed, poor land use practices and forest management are to blame for both starting and exacerbating wildfires.¹⁶⁹ Wildfires are a significant transboundary pollutant and will exponentially magnify as fuel loads from poor forest management increase and people continue to construct residential areas near large fuel loads.

2. Step one: what are the necessary objectives and programs for curbing these activities?

First, the IJC must create specific objectives and programs to mitigate black carbon pollution resulting from widespread wildfires. Determining wildfire sources requires law and policymakers to make an inferential leap past a simply discarded cigarette butt. Poor land use and forest management practices are to blame for large, raging fires.¹⁷⁰ Law and policymakers should acknowledge that certain forest types—boreal and temperate—require forest management and land use practices.

These practices look like implementing prescribed fires as the “go-to” fire treatment method for forest management and straying from fire suppression. The Texas Department of Agriculture created a Prescribed Burn Program, run by the Prescribed Burning Board (PBB).¹⁷¹ The PBB regulates certified and insured prescribed burns (and the people who operate and manage such burns) that limit fuel loads to control vegetation’s health and protect residential areas.¹⁷² A nationally implemented prescribed burning program (in the critical areas previously discussed) would be an essential program that the IJC should implement through the AQA. Canada is already

167. Mulrone, *supra* note 108; see generally *Black Carbon Research and Future Strategies: Reducing Emissions, Improving Human Health, and Taking Action on Climate Change*, U.S. ENV’T. PROT. AGENCY (Oct. 2011) https://www.epa.gov/sites/default/files/2013-12/documents/black-carbon-fact-sheet_0.pdf (highlighting the human and environmental impacts from wildfires and black carbon emissions).

168. *Id.* at 167.

169. Mulrone, *supra* note 108; see generally U.S. ENV’T. PROT. AGENCY *supra* note 167.

170. French, *supra* note 60, at 828.

171. Texas has little to no boreal/temperate forests, but it is still a useful comparison. The Texas government recognizes the benefit and need for prescribed fires in their public lands. An epiphany that should come to policymakers in the IJC. Interestingly enough, 98% of Texas’ land is privately held, making having a statewide plan difficult, but the PBB is able to establish connections with private landowners. *Prescribed Burn Program*, TEXAS DEP’T AGRIC., <https://www.texasagriculture.gov/home/productionagriculture/prescribedburnprogram.aspx> (last visited Mar. 17, 2022).

172. *Id.*

funding prescribed fires nationwide.¹⁷³ Specifically, Parks Canada carefully plans prescribed fires to restore forest health and protect residential areas.¹⁷⁴ Parks Canada operates on a larger scale than Texas' PBB, but bringing both programs to the IJC's discussion will show the potential for success in both countries. Forest management is currently contributing to many black carbon emissions, which is a significant transboundary pollutant. Solving the poor forest management issues are one of the pieces for aiding transboundary wildfire pollution.

Additionally, the IJC must focus on transforming land use practices. Without specific and intentional practices, wildfires will exponentially increase in size, occurrence, and temperature, exacerbating black carbon transboundary pollution. Minimizing wildfires comes down to better land use planning. Houses and buildings are fuel too, which endangers neighborhoods. Research shows that the fuel loads in the immediately surrounding area and how the building's design and construction determines home loss. Reducing fuel loads surrounding current residential areas is critical to limit the ease with which a wildfire could start and spread. Here is where programs can mix forest management and land use goals. The IJC should create programs that distinguish dangerous areas to build homes and avoid those areas. Reducing new home development in the areas of highest risk minimizes danger to neighborhoods and reduces transboundary wildfire pollution.¹⁷⁵

3. Step two: conducting environmental assessments and enacting mitigation measures.

U.S. and Canadian lawmakers, fire management agencies, and experts will be severely challenged by growing wildfire threats and should conduct environmental assessments and mitigation measures in anticipation of these threats.¹⁷⁶ Article V of the Agreement states that each Party "as required by its laws, regulations and policies, assess those proposed actions, activities and projects within the area under its jurisdiction that, if carried out, would be likely to cause significant transboundary air pollution, including consideration of appropriate mitigation measures."¹⁷⁷ Essentially, per their

173. *Prescribed Fires*, PARKS CAN.: SCIENCE AND CONSERVATION <https://www.pc.gc.ca/en/nature/science/conservation/feu-fire/feuveg-fireveg/dirige-prescribed> (last visited Mar. 17, 2022).

174. *Id.*

175. These programs can be regulated and unregulated. *See generally* Air Quality Agreement, *supra* note 114 (explaining that the AQA has resulted in both regulated and unregulated programs).

176. Flannigan et al., *Impacts of climate change on fire activity and fire management in the circumboreal forest* 14 GLOBAL CHANGE BIOL. 1, 9 (2008).

177. Air Quality Agreement, *supra* note 114, at 5.

laws, the U.S. and Canada must conduct an environmental assessment for the appropriate proposed activities (prescribed fires and better land use planning). The EPA directed such a report in 2021.¹⁷⁸ While a “prescribed fire can reduce the overall size of future wildfires and the associated smoke emissions and smoke-related health impacts, smoke is still emitted.”¹⁷⁹ However, the benefits still greatly outweigh the costs. Although there are still smoke emissions, they are on a much smaller scale compared to wildfire emissions.¹⁸⁰ The IJC must consider this assessment (or conduct an independent assessment in each country’s respective jurisdictions) during project proposals.

As for mitigating these risks, countries should ensure that prescribed fires remain prescribed and not evolve into wildfires. The solution is hiring fire experts and funding training for those overseeing prescribed fires. Also, conducting these burns at the right time and place is critical to guarantee safety and minimize black carbon emissions.¹⁸¹ This concept extends into land use mitigation. Countries are reducing fuel loads with prescribed burns and regulating homeowners to remove dead material from around their homes.¹⁸² Overall, black carbon emissions from prescribed fires are significantly less than what is currently coming from wildfires. Therefore, the IJC should implement these mitigation strategies.

4. Step three and four: carrying out cooperative and coordinated scientific and technology programs, directing economic research, and sharing pertinent information.

Canada has already been conducting scientific and technological research that will bring essential tools to the IJC’s discussion. There has been a significant attitude shift regarding wildfire management over the past decade in Canada. Canadian researchers have expanded their government’s knowledge on how wildfires operate by providing many tools. These include the Canadian Wildland Fire Information System (CWFIS), the Wildfire

178. *EPA Releases Report Comparing Air Quality and Public Health Impacts from Prescribed Fire and Wildfire Smoke*, U.S. ENV’T. PROT. AGENCY (Sept. 30, 2021), <https://www.epa.gov/newsreleases/epa-releases-report-comparing-air-quality-and-public-health-impacts-prescribed-fire#:~:text=The%20E2%80%9CComparative%20Assessment%20of%20the,impacts%2C%20smoke%20is%20still%20emitted.>

179. *Id.*

180. *Id.*

181. *See generally id.* (stipulating what time of the year, time of day, and where exactly the safest and most effective areas are to conduct prescribed burns).

182. *See e.g., Defensible Space*, READY FOR WILDFIRE (last visited Aug. 13, 2022), <https://www.readyforwildfire.org/prepare-for-wildfire/get-ready/defensible-space/> (stating that in some zones in California, defensible spaces are mandatory).

Threat Rating System (WTRS), and the Canadian Fire Effects Model (CanFIRE).¹⁸³ All of these tools assist in furthering the overall aim of reducing fuel loads, which reduces wildfires and thereby reduces transboundary black carbon emissions. IJC negotiations and discussions should highlight the success of CWFIS, WTRS, and CanFIRE, in reducing transboundary pollution, while also suggesting the U.S. implement the same or similar resources in their fire management practices. Canada created additional resources, such as General Circulation Models,¹⁸⁴ which address the impact of climate change on weather severity. The IJC should reference this model when discussing the growing wildfire threat while also acknowledging the expansive new technology and research to mitigate wildfire damage and pollution.

Overall, the Canadian Government spent between \$800 million to \$1.4 billion annually on forest management over the past decade in preemptive attempts to mitigate wildfire damage.¹⁸⁵ Yet, the U.S. spends billions of dollars cleaning up after wildfires, and the Forest Service spends billions fighting fires—this spending is the most significant component of the Forest Service’s budget.¹⁸⁶ Unfortunately, there is little to no funding going into preemptively preventing wildfires.¹⁸⁷ Instead, billions of dollars are retroactively spent on wildfire damage. Luckily for the U.S., Canada has already fronted the expense of developing wildfire prevention tools and

183. CANADIAN WILDLAND FIRE INFORMATION SYSTEM (CWFIS), GOV’T CAN. <https://cwfis.cfs.nrcan.gc.ca/home> (last visited Jan. 24, 2022) (providing data and maps of fire danger conditions across Canadian provinces). The WTRS assesses and maps four main components of fire risk: ignition, values at risk, suppression capability and expected fire behavior. This system can generate an overall fire-threat rating that assists forest management in determining how land-use decisions are able to affect future fire threats in any given area. *See generally Wildfire Threat Rating System*, GOV’T CAN., <https://www.nrcan.gc.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/forest-fires/fire-management/13157> (last visited Jan. 24, 2022). CanFIRE is used to predict the behavior of a wildfire that is currently taking place. The CanFIRE behavior models allow firefighters to make more informed decisions on where to allocate firefighting resources. *See generally CanFIRE*, GOV’T CAN. <https://www.nrcan.gc.ca/our-natural-resources/forests/wildland-fires-insects-disturbances/forest-fires/canadian-fire-effects-model/23333> (last visited Jan. 24, 2022) (describing the CanFIRE model and how it is calculated).

184. *See* Flannigan, *supra* note 176 (explaining that “[General Circulation Models] simulate the future climate by include[ing] three-dimensional representations of the atmosphere, ocean, cryosphere and land surface. . . . Future climate scenarios are built based on the effects of various concentrations of greenhouse gases and other pollutants within the atmosphere.”).

185. Long term investments in reducing fuel loads, better forest management, and improved land use are critical steps to mitigating transboundary air pollution. *See generally* Sean C.P. Coogan & Francois-Nicolas Robinne, *Scientists’ warning on wildfire—a Canadian perspective*, 49 NRC RES. PRESS CAN J. FOR. RES. 1015, 1018 (2019).

186. *See e.g.*, FY 2022 BUDGET JUSTIFICATION, U.S. FOREST SERV. (2022), <https://www.fs.usda.gov/sites/default/files/usfs-fy-2022-budget-justification.pdf> (listing Wildfire Management budget justification spending).

187. *Id.*

models.¹⁸⁸ CWFIS, WTRS, and CanFIRE are some of Canada's many advanced practices for reducing wildfires (both the quantity and magnitude) and air pollution. The IJC must focus on encouraging the implementation of some of these tools in the U.S..¹⁸⁹ Wildfires will exponentially continue to cause more damage to the physical environment and air quality in the U.S. and Canada unless both countries collaboratively implement Canada's technologies.¹⁹⁰

5. Step five and beyond: assessing continuously.

Finally, the IJC must continue to assess each country's programs long after enactment. Every two years the IJC puts out a progress report. In the report, they invite public comments and provide a synthesis of comments to the Governments of the U.S. and Canada to assist them with implementing the AQA and its programs.¹⁹¹ The report states, "working collaboratively under the Agreement, both countries have made remarkable progress in reducing acid rain and controlling ozone in the transboundary region, improving the environment and achieving better air quality for citizens in the U.S. and Canada."¹⁹² Both countries are adamant about the AQA being a collaborative, continual, and persistent process. The bi-annual reports mirror such a statement, as SO₂ and NO_x have decreased to meet both countries' initial objectives.¹⁹³ This needs to be the case with wildfires. Incorporating the progress made from regulated and unregulated programs in the report will allow wildfire reduction to remain an open conversation.

188. An expense the U.S. will be able to avoid and a point the IJC should call attention to during transboundary air pollution discussions.

189. See Douglas Thomas et al., *The Costs and Losses of Wildfires*, Special Publ'n 1215 NAT'L INST. STANDARDS & TECH. 1, 11–13 (Nov. 2017) (giving examples of how wildfire mitigation is more cost effective) (The procedure for this implementation will be discussed further below. CWFIS, WTRS, and CanFIRE are a financial investment in the safety of the air between the border and physical landscape. The implementation of defensible space may be expensive, but the long-term benefits drastically outweigh the short-term cost).

190. In comparison to collaborative acid rain technologies. Wet deposition of sulfate and nitrate is measured by precipitation chemistry monitoring networks in Canada and the U.S., and the results are published in the bi-annual report. A similar report from each of Canada's technologies could be included in the same report. It is unknown which country founded the acid deposition technology, but both were able to collaborate and coordinate data into the same program. The same can be done with Canada's technologies. See Thomas et al., *supra* note 189, at 23 (explaining the damage that wildfires cause to humanity, the environment, and the atmosphere); see generally Air Quality Agreement, *supra* note 114 (showing how both countries collaborate and coordinate data).

191. *Canada-United States Air Quality Agreement: Progress Report: Introduction*, GOV'T CAN., (2016) <https://www.canada.ca/en/environment-climate-change/services/air-pollution/publications/canada-united-states-air-quality-report-2016/introduction.html#s1>.

192. *Id.*

193. *Id.*

IV. CONCLUSION

The AQA is an ideal mechanism for addressing significant transboundary pollutants. Historically, the AQA had shown positive results when both countries curbed SO₂ emissions and acid rain. This victory should build confidence for both countries to extend the AQA to more activities causing significant transboundary pollution. Land use planning and forest management schemes are causing this phenomenon in wildfires, thereby making wildfires emit black carbon at more intense, severe, and exponential rate. Black carbon emissions are traveling across the U.S.-Canada geopolitical border, giving rise to environmental damage outside of both countries' respective jurisdictions. The Countries could permanently curb wildfires and transboundary wildfire emissions by: following the AQA's procedures and implementing programs; stating objectives; conducting environmental assessments; enacting mitigation measures; carrying out cooperative and coordinated scientific and technological activities; and continuing to assess the progress made.

The U.S. and Canada AQA is an example of two nations with a common problem, both trying to find diplomatic solutions. The AQA is a unique agreement in that it is an ongoing process—the AQA is not static. Both Countries must continuously collaborate and communicate what activities the Countries are concerned about. Both Countries can diplomatically address activities that cause significant transboundary pollution through this international comparative legal mechanism starting with wildfire emissions. If the IJC successfully confronts wildfires through this Agreement, the AQA could open the door to tackling many other activities that cause significant transboundary pollution.

TRANSPORTATION DECARBONIZATION

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I. INTRODUCTION

In September 2020, California Governor Gavin Newsom signed Executive Order (EO) N-79-20 to ban the sale of all internal combustion engine vehicles (ICEs) by 2035.¹ In August 2022, the California Air Resources Board (CARB) will vote on the final resolution that formalizes and codifies the details of this pledge. This put California on track to set the most ambitious standard for electric vehicle adoption among states.² Soon after California's N-79-20 was announced, New Jersey,³ Virginia, Washington state, and Massachusetts⁴ pledged to join California in reaching this 2035 goal. But until August 2022, when CARB is expected to make California's targets official, these pledges are meaningless, given that the other states must choose to enact California's exact regulation with respect to the Clean Air Act (CAA) § 209 and § 177 waivers, which were revoked in 2019 by the Trump administration, and recently determined by the Biden administration to be once again legitimate. Since the U.S. Environmental Protection Agency (U.S. EPA) rescinded the waiver revocation, this opens the door for state leadership of vehicle emissions.⁵

There are dozens of options for both supply-side and demand-side approaches to reducing the carbon footprint of passenger and freight

1. Jennifer L. Hernandez et al., *California Governor Bans Internal Combustion Engines, Effective 2035, to Combat Climate Change*, HOLLAND & KNIGHT (Sept. 24, 2020), <https://www.hklaw.com/en/insights/publications/2020/09/california-governor-bans-internal-combustion-engines>.

2. Solomon Moore, *Viewpoint: California Leads National ZEV Charge*, ARGUS MEDIA (Dec. 30, 2020), <https://www.argusmedia.com/en/news/2173304-viewpoint-california-leads-national-zev-charge>.

3. Michael S. Warren, *New Jersey Eyes All-Electric Vehicle Shift by 2035*, GOV'T TECH. (Oct. 20, 2020), <https://www.govtech.com/transportation/New-Jersey-Eyes-All-Electric-Vehicle-Shift-by-2035.html>.

4. See EXEC. OFF. OF ENERGY AND ENV'T AFFAIRS & THE CADMUS GRP., MASSACHUSETTS 2050 DECARBONIZATION ROADMAP 7 (Dec. 2020) (referencing environmental commitments made by Massachusetts).

5. *Vehicle Emissions California Waivers and Authorization*, U.S. ENV'T. PROT. AGENCY, <https://www.epa.gov/state-and-local-transportation/vehicle-emissions-california-waivers-and-authorizations> (last visited Jan. 23, 2022).

movement.⁶ This paper outlines some successes and challenges to date of the Zero Emission Vehicle (ZEV) regulatory landscape at the federal and state levels. Our analysis aims to inform policymakers and practitioners at all levels. This paper begins by identifying several different “pathways” the U.S. EPA, U.S. Department of Transportation (USDOT), and other federal regulators can pursue to reduce transportation emissions. The latter part of the paper includes a deep dive on the activities of states regarding light- and heavy-duty ZEV policies. The goal of this analysis is to raise issues and consider the effectiveness of different possible options for zero-emission passenger and freight vehicles for the U.S. Federal Government, and U.S. states. This paper will focus on three broad categories of zero-emission transportation policy.

A. Recognizing Need for Equitable Decarbonization Policy

Before we begin this discussion, it is necessary to recognize that dialogue about how to reduce carbon and criteria pollutants are inherently conversations about equity. Which power plants and which tailpipes to clean first can replay historic patterns of neglect for black, indigenous, and people of color (BIPOC), as well as many low-income people, who have historically been more burdened with the health consequences brought on by the design of our transportation system, including disparities in cardiovascular health⁷ and higher traffic fatality rates.⁸

The question posed here is whether transportation decarbonization policies can contribute to correcting these injustices. For example, policies that propose to price or regulate carbon should begin with a conversation about how to ensure that emissions improvements are captured equitably by all people and communities. A University of Washington study of electric vehicle charging investments found that there was an inequitable distribution of charger access in Seattle.⁹ In San Diego, to address this issue, a partnership with a community-based organization, The Greenlining Institute, resulted in targeted installation of 1,625 charging stations.¹⁰

6. *Reducing Your Transportation Footprint*, CTR. FOR CLIMATE & ENERGY SOLS., <https://www.c2es.org/content/reducing-your-transportation-footprint/> (last visited Jan. 22, 2022).

7. Emily M. D’Agostino et al., *Longitudinal Effects of Transportation Vulnerability on the Association Between Racial/Ethnic Segregation and Youth Cardiovascular Health*, 163 J. RACIAL & ETHNIC HEALTH DISPARITIES (2020).

8. Madeline Brozen & Annaleigh Yahata Ekman, *The Need to Prioritize Black Lives in LA’s Traffic Safety Efforts* 3, LEWIS CTR. FOR REG’L STUD. (2020), <https://escholarship.org/content/qt0dm6x8k4/qt0dm6x8k4.pdf>.

9. Yohan Min & Hyun Woo Lee, *Social Equity of Clean Energy Policies in Electric-Vehicle Charging Infrastructure Systems*, CONSTR. RSCH. CONG. 2020 (2020).

10. *Clean Transportation and Mobility*, GREENLINING INST., <https://greenlining.org/our-work/environmental-equity/electric-vehicles/> (last visited Jan. 22, 2022).

Best practices for ensuring policy equity are threefold: (1) process equity should aim to meaningfully engage all community members in the policy process, (2) practice equity should test policy mechanisms to ensure no direct benefits or burdens are disproportionately distributed, and (3) outcome equity ensures long-term impacts of each policy to ensure that fairness can be captured.¹¹ All the policy recommendations included in this report should be tailored to fit the needs of the implementing community, by way of an intentional equity strategy.

II. FEDERAL ZEV POLICY LANDSCAPE

This section introduces the Federal ZEV Policy Landscape, which will dictate the boundaries of state ZEV policy efforts. Mitigating climate change is a primary goal of most ZEV policies, as well as reducing harmful pollutants, (e.g., nitrous oxides and particulate matter) especially focusing on mitigating pollution which has disproportionately harmed communities of color and low-income neighborhoods.¹²

Transportation decarbonization will require significant national and state policy actions in combination with rapid technological advances. One of the pinnacles of the ZEV policy debate rests on the CAA § 209 waiver.¹³ CAA § 209 is both the partial cause and the possible result of a states-led ZEV policy landscape and we will provide a short history of this critical policy.

A. History of California Clean Air Act Waiver

Congress first granted California the freedom to lead on setting light-duty vehicle emission standards with the passage of the CAA in 1970. California has been granted approximately 100 waivers over the last 50 years, some of which have allowed the California Air Resources Board to set more stringent vehicle emissions standards than the U.S. EPA.¹⁴ This leadership has resulted in 11 states¹⁵ following suit. CAA § 177 grants any state the ability to adopt California's model year standards, as long as they are

11. Mollie D'Agostino et al., *Equitable Congestion Pricing*, INST. OF TRANSP. STUD., UNIV. OF CAL. 1 (2020), <https://escholarship.org/uc/item/17h3k4db>.

12. Hana Creger et al., *Mobile Equity Framework, How to Make Transportation Work for People*, GREENLINING INST. (Mar. 2018), https://greenlining.org/wp-content/uploads/2019/01/MobilityEquityFramework_8.5x11_v_GLI_Print_Endnotes-march-2018.pdf.

13. *See generally* 42 U.S.C. § 7543.

14. *Attorney General Becerra Files Lawsuit Challenging Trump Administration's Attempt to Trample California's Authority to Maintain Longstanding Clean Car Standards*, CAL. DEP'T. JUST. (Sept. 20, 2019), <https://oag.ca.gov/news/press-releases/attorney-general-becerra-files-lawsuit-challenging-trump-administration%E2%80%99s>.

15. Blane Erwin, *What is a ZEV Credit and how does Tesla make money with them?* (July 31, 2020), <https://www.currentautomotive.com/what-is-a-zev-credit-and-how-does-tesla-make-money-with-them/>.

“identical to the California standards for which a waiver has been granted for such model year.”¹⁶

However, in September 2019, the Trump Administration’s U.S. EPA’s Safer Affordable Fuel-Efficient (SAFE-1) action withdrew the 2013 CAA waiver and interpreted the CAA to not allow other states to adopt California’s GHG emission standards.¹⁷ Fortunately, the Biden Administration’s U.S. EPA issued a notice of decision on March 14th, 2022, finding that the actions taken as a part of SAFE-1 were decided in error and are now entirely rescinded.¹⁸ The actions by both the previous and current administrations are sobering reminders of how fragile these policy decisions can be in an increasingly polarized political climate.

B. Pathways for U.S. EPA Actions Towards Decarbonization

There are a number of options for the U.S. EPA to consider in order to pursue a climate friendly policy agenda, including:

Pathway 1—Adopt Vehicle Standards that Meet or Exceed California’s Standards: The U.S. EPA could implement new federal standards for new vehicles that exceed California’s existing standards or meet or exceed the standards set out in EO § N-79-20. This would be within the purview of the U.S. EPA for several reasons. The CAA empowers the U.S. EPA to set ever restrictive standards, because the agency is tasked with pursuing a continuous reduction strategy for emissions.¹⁹ President Biden signed executive order 14037, Strengthening American Leadership in Clean Cars and Trucks in 2021 setting a goal that 50 percent of all new passenger cars and light trucks sold in 2030 be zero-emission vehicles.²⁰ Section 6(b)–(c) of this executive order empowers the Secretary of Transportation and the U.S. EPA to implement this policy and directs the agencies to coordinate their activities with the state of California.²¹

16. 42 U.S.C § 7507.

17. The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program, 84 Fed. Reg. 188, 51329 (Sept. 27, 2019).

18. California State Motor Vehicle Pollution Control Standards; Advanced Clean Car Program; Reconsideration of a Previous Withdrawal of a Waiver of Preemption; Notice of Decision, 87 Fed. Reg. 49, 14278 (Mar. 14, 2022), <https://www.govinfo.gov/content/pkg/FR-2022-03-14/pdf/2022-05227.pdf>.

19. See Joseph Goffman & Laura Bloomer, *Disempowering the EPA: How Statutory Interpretation of the Clean Air Act Serves the Trump Administration's Deregulatory Agenda*, 70 CASE W. RES. L. REV. 929, 932–34 (2020) (outlining the EPA’s ability, and mandate, to progressively tighten restrictions).

20. Exec. Order No. 14,037, 86 Fed. Reg. 151 (2021).

21. Exec. Order No. 14,037, 86 Fed. Reg. 151 (2021).

Pathway 2—Classification of CO₂ as Criteria Pollutant: The U.S. EPA is statutorily obligated to strive for the “lowest achievable emissions rate”²² based on U.S. EPA assessments every five years identifying the “maximum achievable technology”²³ (MACT). While interpretations such as *Massachusetts v. EPA* clarified that the U.S. EPA has the authority to regulate mobile sources of greenhouse gas emissions (GHG),²⁴ they are not classified as criteria pollutants.²⁵ Vehicle emissions have been regulated under the CAA, given the criteria pollutants in tailpipe emissions (nitrogen oxides, hydrocarbons, carbon monoxide (CO), and particulate matter).²⁶ While CO₂ is not classified as a criteria pollutant under the CAA vehicle emissions, the U.S. EPA could choose to re-classify carbon dioxide as a criteria pollutant which would trigger several requirements from the administration and states.²⁷ First, U.S. EPA would have to conduct an annual National Ambient Air Quality Standards assessment to determine which states were in attainment and require states to make plans to reduce CO₂ emissions.²⁸ The extent to which this type of assessment would increase uptake of CO₂ reduction strategies in the least ambitious states is difficult to predict, but it still represents an interesting option for the U.S. EPA.

C. Notable Policy Pathways Outside of U.S. EPA Purview

Pathway 3—National Highway and Traffic Safety Administration (NHTSA) Actions: in 2022, the NHTSA finalized CAFE Standards for MYs 2024-2026; the final rule establishes standards that would require an industry-wide fleet average of approximately 49 mpg for passenger cars and light trucks in model year 2026, by increasing fuel efficiency by 8% annually for model years 2024 and 2025, and 10% annually for model year 2026.²⁹ While further claims for preemption of California’s right to set their own

22. 42 U.S.C. § 7411(j)(1)(A)(iii).

23. 42 U.S.C. § 7412(d).

24. *Massachusetts v. EPA*, 549 U.S. 497 (2007).

25. 40 C.F.R. § 50 (1971).

26. *Regulatory Information by Topic: Air*, U.S. ENV’T PROT. AGENCY (Jan. 28, 2021), <https://www.epa.gov/regulatory-information-topic/regulatory-information-topic-air>.

27. *Criteria Air Pollutants*, U.S. ENV’T PROT. AGENCY (last updated Mar. 22, 2021), <https://www.epa.gov/criteria-air-pollutants>.

28. 42 U.S.C. § 7409(d)(2)(B).

29. *Technical Support Document: Final Rulemaking for Model Years 2024-2026 Light-Duty Vehicle Corporate Average Fuel Economy Standards*, U.S. DEP’T TRANSP. (Mar. 2022), https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-04/Final-TSD_CAFE-MY-2024-2026.pdf.

fuel economy standards rests on the Energy Policy and Conservation Act (EPCA) of 1975, which according to NHTSA's interpretations, the EPA and their agency reserve sole authority for setting fuel efficiency standards.³⁰ Federal courts have thus far upheld California's authority to set fuel economy standards.³¹

Pathway 4—USDOT and USDOE Action:³² the Infrastructure Investment and Jobs Act (IIJA) established a National Electric Vehicle Infrastructure Formula Program (NEVI Formula) to provide funding to States to strategically deploy electric vehicle (EV) charging infrastructure and to establish an interconnected network to facilitate data collection, access, and reliability.³³ The NEVI Formula has a goal of developing 500,000 chargers by 2030.³⁴ The Federal Highway Administration (FHWA), under the supervision of the USDOT, is to apportion these funds proportionate to the funding states already receive from FHWA and pending approval of state developed implementation plans.³⁵

Additionally, the USDOT can also work with EPA to update the National Environmental Policy Act (NEPA) guidance or develop climate change criteria for grant programs such as The Rebuilding American Infrastructure with Sustainability and Equity program, (RAISE Discretionary Grant).³⁶ As of late 2021, the Department now asks RAISE Grant applicants to consider how their projects can address climate change.³⁷

It is also possible that USDOT can utilize its Federal Highway Administration (FHWA) authority through the Congestion Mitigation and Air Quality (CMAQ) Management Program to aid state and local agencies to

30. *Union of Concerned Scientists v. National Highway Traffic Safety Administration*, No. 20-1175 (D.C. Cir., filed Sept. 21, 2020).

31. Environmental & Energy Law Program, Harvard University, *CAFE Standards, and the Energy Policy and Conservation Act* (June 19, 2018), <https://eelp.law.harvard.edu/2018/06/california-cafe-standards-and-the-energy-policy-and-conservation-act/>.

32. *See generally* Vicki Arroyo et al., *Climate 21 Project: Transition Memo*, U.S. DEP'T OF TRANSP., https://climate21.org/documents/C21_DOT.pdf (last visited Jan. 22, 2022) (explaining budgeting requirements for different programs like BUILD).

33. *See generally*, Andrew C. Rogers, *The National Electric Vehicle Infrastructure (NEVI) Formula Program Guidance*, (Feb. 10, 2022) https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/nominations/90d_nevi_formula_program_guidance.pdf.

34. *Id.* at 1.

35. *Id.* at 9.

36. RAISE Discretionary Grants, U.S. DEP'T OF TRANSP. (Jan. 28, 2022), <https://www.transportation.gov/RAISEgrants>.

37. *Id.*

invest in charging infrastructure.³⁸ The U.S. Department of Energy (USDOE) can also utilize funding programs to provide grants for charging infrastructure projects.³⁹ However, funding for these programs would be dependent on congressional appropriations of funds.

Pathway 5—Establish a Federal Low Carbon Fuel Standard (LCFS): while this may require a legislative mandate, a Federal LCFS could model off the California system, and require that the average carbon intensity of transportation fuels decline over time, meaning the total GHG emissions they produce is reduced, from a full cradle to grave life cycle standpoint. This includes incentivizing the use of lower carbon fuel or alternative fuel sources, such as ethanol, or biodiesel, as well as electricity (depending on the grid production fuel sources).⁴⁰ In California, as of 2020, the LCFS has increased the use of alternative fuels (non-fossil fuel derived) from 7% to 16% of total fuel consumption.⁴¹

Pathway 6—Establish a Carbon Pricing System: a market-based approach that allows carbon trading on a federal level will make emitting carbon more expensive. This would emulate the cap-and-trade systems administered in the 12 U.S. states⁴² and many countries.⁴³ While these market-based strategies make the most efficient reductions possible for the economy, which explains their global popularity, there are many critics in the U.S. who would prefer a carbon pricing system that could be more equitable if it priced carbon higher in disadvantaged areas, who have historically faced the brunt of dangerous air pollution.⁴⁴

Pathway 7—Establish a Federal GHG/Passenger Mile Fee Based System: reforms to the gas tax that shift revenue generation towards pricing that favors ZEVs and higher occupancy will allow the flexibility for markets

38. Fixing America's Surface Transportation Act (FAST Act), U.S. DEP'T OF TRANSP., <https://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.cfm> (last visited Jan. 22, 2022).

39. *Guide to Federal Funding, Financing, and Technical Assistance for Plug-in Electric Vehicles and Charging Stations*, U.S. DEP'T OF ENERGY & U.S. DEP'T OF TRANSP. 1 (Jul. 2016), <https://doi.org/10.2172/1416162>.

40. *Id.*

41. Austin L. Brown et al., CARBON NEUTRALITY STUDY 1: DRIVING CALIFORNIA'S TRANSPORTATION EMISSIONS TO ZERO 109, INST. OF TRANSP. STUD., UNIV. OF CAL. (Oct. 2020).

42. *Market-Based State Policy*, CTR. FOR CLIMATE AND ENERGY SOLUTIONS, <https://www.c2es.org/content/market-based-state-policy> (last visited Jan. 22, 2022).

43. *Carbon Pricing Dashboard*, WORLD BANK (last updated Nov. 1, 2020), https://carbonpricingdashboard.worldbank.org/map_data.

44. *Ensuring Equity*, CARBON TAX CTR., <https://www.carbontax.org/ensuring-equity/> (last visited Jan. 23, 2022); see discussion *infra* Section II.B.2.

to adapt efficiently. California implemented the Clean Miles Standard⁴⁵ which will regulate emissions from transportation network companies using a GHG/Passenger miles Traveled metric. Developing such a system for privately held vehicles will have technical challenges, but this type of system would be ideal in that it would send price signals to drivers about the true impacts of their travel choices.⁴⁶ Section 13002 of the Infrastructure Investment and Jobs Act directed the U.S. Department of Transportation to establish a national motor vehicle per-mile user fee pilot program while continuing to support state-level pilots.⁴⁷ These programs will be a first major step in disincentivizing private VMTs, but they are not without their implementation challenges, which include addressing privacy issues and concerns about creating potentially unfair burdens to households displaced on the exurban fringe.

1. Non-vehicular Transportation Decarbonization Policies

While vehicles are the primary focus of this paper, it is worth mentioning that other supportive policies will also be essential in order to achieve transportation decarbonization, and both demand- and supply-side levers exist. A few will be briefly introduced in this section, which is by no means exhaustive.

2. Decarbonize the Power Sector

To fully realize the benefits of electrifying the transportation sector, power generation must be decarbonized. California has several policies targeting the decarbonization of the power sector.⁴⁸ The renewable portfolio standard (RPS) was adopted in 2002 through SB 1078, to require a minimum amount of retail electric sales to be generated from renewable sources (solar, wind, geothermal, and some hydroelectric).⁴⁹ It also required that a minimum of 20% of California's power generation come from renewable sources by

45. See discussion *infra* Section III.

46. See CARBON TAX CTR., *supra* note 44 (characterizing carbon taxes as a shift in revenue sources).

47. Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, § 13002, 135 STAT. 429, 624 (2021)

48. *California Climate Policy*, ENERGY INNOVATION POL'Y & TECH., <https://energyinnovation.org/policy-programs/california-climate-policy/> (last visited Jan. 23, 2023); Brown et al., *supra* note 41.

49. *Renewable Portfolios Standard Program*, CAL. PUB. UTIL. COMM'N (2021) <https://www.cpuc.ca.gov/rps/>.

2017.⁵⁰ The minimum target has been increased in subsequent years, to 50% by 2030 by SB 350, and increased again by SB 100 to 60% by 2030 and 100% of retail sales.⁵¹

However, the authority of the EPA to regulate greenhouse gas emissions from stationary sources, such as power plants, is currently somewhat restricted after the recent *West Virginia v. EPA* decision before the Supreme Court of the United States.⁵² In July 2022, the majority issued an opinion determining that the EPA's Clean Power Plan falls under the major question doctrine, surpassing the regulatory authority of that agency.⁵³ The *West Virginia* decision may have two possible effects on transportation decarbonization. First, a clean transportation system is contingent on a clean grid and this decision may have a chilling effect on EPA efforts to decarbonize energy grids nationwide. Second, the major questions doctrine may open regulators to legal scrutiny, which could have a broader dampening effect on emissions reduction efforts.

3. Cap-and-Trade Policy

Following the lead of European states, between 2006 and 2008 California passed and adopted the first U.S. Cap-and-Trade policy in 2006, and updated it in 2017.⁵⁴ California's carbon pricing system operates by requiring permits to an allowable cap for industries that produce CO₂ emissions, including transportation.⁵⁵ The cap declines each year, in line with California's emissions reduction goals.⁵⁶ Permits are auctioned once every quarter, and may be traded, which creates a market mechanism for emissions.⁵⁷ Some industries, like refineries, are given a set of permits to cover expected emissions, to prevent outside competition to import their product.⁵⁸ The \$19.2 billion collected from permits between 2012-2022 have been invested in a variety of programs and projects around the state, the vast majority for

50. *Id.*

51. *Id.*

52. *See generally* *West Virginia v. EPA*, 597 US. (2022).

53. *Id.*

54. *Cap-and-Trade Program*, CAL. AIR RES. BD., <https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program> (last visited Jan. 22, 2022).

55. *California's Cap-and-Trade Program Step by Step*, ENV'T DEF. FUND, <https://www.edf.org/sites/default/files/californias-cap-and-trade-program-step-by-step.pdf> (last visited Jan. 23, 2022).

56. *Cap-and-Trade Program: Allowance Distribution Factsheet*, CAL. AIR RES. BD. (2020), <https://ww2.arb.ca.gov/resources/documents/cap-and-trade-program-allowance-distribution-factsheet>.

57. *California Cap-and-Trade Program Summary of California-Quebec Joint Action Settlement Prices and Results*, CAL. AIR RES. BD. (Feb. 2021), https://ww2.arb.ca.gov/sites/default/files/2020-08/results_summary.pdf.

58. AVAILABLE AND EMERGING TECHNOLOGIES FOR REDUCING GREENHOUSE GAS EMISSIONS FROM THE PETROLEUM REFINING INDUSTRY, ENV'T PROT. AGENCY (Oct. 2010).

emissions reductions, and climate change adaptation and mitigation. Investments include incentives to consumers to purchase electric vehicles.⁵⁹ Sixty-five percent of the funds are continuously appropriated to transit, affordable housing near transit, and high speed rail construction.⁶⁰

Other states have explored implementing similar programs. For example, in 2009 the Regional Greenhouse Gas Initiative (RGGI) was implemented to reduce emissions from the power sector.⁶¹ States participating include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.⁶² The RGGI program, however, does not cover the transportation sector, but supporting clean energy in the power sector will benefit transportation electrification.⁶³ Washington state also adopted the Washington Clean Air Rule in 2016, which would reduce emissions from stationary sources and petroleum refiners, however the Washington Supreme Court ruled in early 2020 that portions of the rule are invalidated.⁶⁴

While Congress is still heavily divided on this issue, there are two bills, both still in committee, that seek to establish a national carbon cap-and-trade policy. The Save Our Future Act (S. 2085) would impose a "fee" on carbon and other pollutants to be reinvested in the clean energy transition.⁶⁵ The House's Energy Innovation and Carbon Dividend Act (H.R. 2307) would impose a "fee" of \$15/metric ton (tonne) on carbon and other pollutants. The fees would be reinvested or returned to taxpayers and would increase \$10/year until carbon reduction targets are met.⁶⁶

4. Policies that Aim to Reduce Vehicle Miles Traveled

Road- and area-pricing policies can be a very effective tool for reducing vehicle miles traveled (VMT) traffic congestion and emissions, while

59. *Id.*

60. CAL. LEGIS. ANALYST'S OFF., CAP-AND-TRADE AUCTION UPDATE AND GGRF PROJECTIONS (Dec. 2021), <https://lao.ca.gov/reports/2021/4480/cap-and-trade-120621.pdf>.

61. *Regional Greenhouse Gases Initiative (RGGI)*, CTR. FOR CLIMATE & ENERGY SOL., <https://www.c2es.org/content/regional-greenhouse-gas-initiative-rggi/> (last visited Jan. 22, 2022).

62. *Market-Based State Policy - Regional Greenhouse Gas Initiative (RGGI)*, CTR. FOR CLIMATE & ENERGY SOL., <https://www.c2es.org/content/market-based-state-policy/> (last visited Jan. 22, 2022).

63. Sarah Shemkus, *As States Look to Cut Transportation Emissions, RGGI Offers A Model – And Room to Improve*, ENERGY NEWS NETWORK (Feb. 5, 2019), <https://energynews.us/2019/02/05/as-states-look-to-cut-transportation-emissions-rggi-offers-a-model-and-room-to-improve/>.

64. *See generally Overview of the Clean Air Rule*, WASH. DEP'T OF ECOLOGY, <https://ecology.wa.gov/Regulations-Permits/Laws-rules-rulemaking/Closed-rulemaking/WAC-173-442-441-Overview> (summarizing the clean air rule); *Ass'n of Washington Bus. v. Washington Dep't of Ecology*, 455 P.3d 1126, 1138 (Wash. 2020).

65. S. 2085, 117th Cong. (2021–2022)

66. H.R. 2307, 117th Cong. (2021–2022).

generating revenue for transportation investments.⁶⁷ The most effective strategies include low-emission zones and congestion pricing, which restrict access to a given segment of a city based on vehicle engine type.⁶⁸ In order for these policies to be effective and equitable, it is critical that the revenues generated from the zones are reinvested in transit and active transport modes (e.g., walking and cycling).⁶⁹ As discussed previously, the U.S. Department of Transportation recently established a national motor vehicle per-mile user fee pilot program.

5. Role of Shared E-Bicycles and E-Scooters in Reducing Transportation Emissions

Encouraging people to use active modes of transportation, like bicycling, scooters, and walking is an important step to shift people out of single-occupancy vehicles. Improving roadways so that streets are safer for pedestrians and cyclists can result in a reduction in motorized VMT and GHG emissions, by replacing vehicle trips and providing a feeder service to transit.⁷⁰ An exemplary policy is California's Active Transportation Program in 2013 (resulting from S.B. 99).⁷¹ The goals of the program are to improve public health and make California a leader in active transportation, while supporting California's GHG reduction goals.⁷²

III. DECARBONIZING THE LIGHT-DUTY VEHICLE SECTOR

In addition to redesigning transportation to include alternate modes, decarbonizing the vehicle fleet is essential. This section dives deeper into policy strategies for decarbonizing the light-duty fleet. Cars and light trucks make up a significant share of emissions from transportation.⁷³ ZEVs include plug-in electric vehicles (PEVs) or battery electric vehicles (BEVs), and also

67. U.S. DEPT. OF TRANSP., SYNTHESIS OF CONGESTION PRICING-RELATED ENVIRONMENTAL IMPACT ANALYSES 23 (2010).

68. See generally *Applications for the Environment: Real-Time Information Synthesis (AERIS): Low Emissions Zones: Operational Concept*, U.S. DEP'T OF TRANSP., https://www.its.dot.gov/research_archives/aeris/pdf/AERIS_Capstone_ExecSummary.pdf (last visited Jan. 22, 2022).

69. D'Agostino *supra* note 11, at 22–23.

70. See Louise Bedsworth et al., *Driving Change: Reducing Vehicle Miles Traveled in California*, PUB. POL'Y INST. OF CAL. (2011), https://www.ppic.org/content/pubs/report/R_211LBR.pdf.

71. *Active Transportation Program (ATP)*, CAL. TRANSP. COMM'N, <https://catc.ca.gov/programs/active-transportation-program> (last visited Jan. 22, 2023).

72. *Active Transportation Program Fact Sheet*, CAL. TRANSP. COMM'N (Jan. 2020), <https://dot.ca.gov/-/media/dot-media/programs/local-assistance/documents/atp/2020/atpfactsheet20202024.pdf>.

73. *Fast Facts on Transportation Greenhouse Gas Emissions*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions> (last visited Jan. 22, 2022).

include fuel cell electric vehicles (FCEVs/FCVs). While they have batteries, plug-in hybrid electric vehicles (PHEVs) are not considered to be ZEVs.⁷⁴

A. Supply-Side ZEV Policies

On the supply-side there are certain policy levers that aim to stoke the ZEV market and increase production volumes, competition, and reduce prices.⁷⁵ State or federal programs that buy out and decommission older vehicles, such as the “Cash for Clunkers” programs have high costs but have broader public appeal than punitive ICE on-road bans. A graduated approach to achieving ZEV fleet-wide adoption is more common, where a set of incremental goals are identified.⁷⁶

1. ZEV Phasing: International ZEV

ZEV goal setting can occur by executive order (EO), legislative action, or by regulatory action.⁷⁷ Codifying goals is an important guiding step that can enable regulatory authorities to take actions to meet the goals in the EO or statute and set more effective supply-side policies.⁷⁸

Norway has the world’s most ambitious timeline and plans to ban ICE car sales as well as light vans after 2025.⁷⁹ This policy is accompanied by a set of strong ZEV-supportive policies, including purchase incentives, exemption from sales taxes, exemptions from tolls on all roads, and free parking. Currently, as of 2022 65% of new sales are ZEVs. Many countries are starting by setting limits on the sales of new vehicles (which will hasten the turnover of vehicles on the road) and fewer are setting timelines for

74. See generally Josh Goldman, *Comparing Electric Vehicles*, UNION OF CONCERNED SCIENTISTS, <https://blog.ucsusa.org/josh-goldman/comparing-electric-vehicles-hybrid-vs-bev-vs-phev-vs-fcev-411> (last updated June 26, 2020).

75. Tejvan Pettinger, *Supply Side Policies*, ECON. HELP (Oct. 30, 2019), <https://www.economicshelp.org/macroeconomics/economic-growth/supply-side-policies/>.

76. Marianne Tyrrell & John C. Dernbach, *The “Cash For Clunkers” Program: A Sustainability Evaluation*, 42 U. TOL. L. REV. 467 (2011).

77. *Governor Newsom Announces California Will Phase Out Gasoline-Powered Cars & Drastically Reduce Demand for Fossil Fuel in California’s Fight Against Climate Change*, Off. of Governor Gavin Newsom, STATE OF CAL. (Sept. 23, 2020), <https://www.gov.ca.gov/2020/09/23/governor-newsom-announces-california-will-phase-out-gasoline-powered-cars-drastically-reduce-demand-for-fossil-fuel-in-californias-fight-against-climate-change/>.

78. Mollie D’Agostino et al., *Global Census of Zero Emission Vehicle Goals*, (2022), https://policyinstitute.ucdavis.edu/sites/g/files/dgvnsk9866/files/media/documents/ZEV%20Goals_2022_Formatted%20Version_2022.1.25.pdf.

79. *National Transport Plan 2018–2029*, NORWEGIAN MINISTRY OF TRANSP. & COMM’N 30, <https://www.regjeringen.no/contentassets/7c52fd2938ca42209e4286fe86bb28bd/en-gb/pdfs/stm201620170033000engpdfs.pdf> (last visited Jan. 22, 2022).

restricting road access for gas-powered vehicles.⁸⁰ Fourteen countries have set a 100% ZEV goal of 2030 (Austria, Barbados, Belgium, Cyprus, Denmark, Germany, Iceland, Ireland, Israel, Luxembourg, Malaysia, Netherlands, Slovenia, Sweden) (note some of these goals do include PHEVs).⁸¹ Many other nations are aiming for 2035 after a COP26 memorandum of understanding was circulated.⁸² China will limit auto sales to ZEVs and plug-in hybrids by 2035⁸³ (which aligns with California's goal). France, Spain, and Canada will limit sales to ZEVs by 2040.⁸⁴ The City of Paris will ban ICE vehicles from entering Paris's Low Emission Zone after 2030.⁸⁵ This approach takes ICE sales restriction goals one step further than a sales ban.

While these timelines are subject to change, there are important differences to point out regarding the scale of these markets. The U.S. is now the third largest market globally with approximately 668,000 EV sales in 2021, making up about 4% of new LDV sales for 2021. As of 2020 Europe edged out the US for the second most EVs, with Germany is the second largest EV market. China has remained the largest EV market globally, with over 1 million EVs in 2018, accounting for 56% of global EV sales and 2.58 million in 2019.⁸⁶ The Chinese auto market is a dominant force for global electrification, but availability and tastes vary considerably between Chinese markets and elsewhere.⁸⁷ U.S. consumers prefer midsize and large vehicles,

80. *Gasoline Vehicle Phaseout Advances Around the World*, COLTURA, <https://www.coltura.org/world-gasoline-phaseouts#:~:text=The%20EU%20wants%20to%20phase,countries%20have%20announced%20similar%20plans.&text=Many%20countries%20are%20planning%20for,ban%20for%20new%20car%20sales> (last visited Jan. 22, 2022).

81. Mollie D'Agostino et al., *Global Census of Zero Emission Vehicle Goals* (2022), https://policyinstitute.ucdavis.edu/sites/g/files/dgvnsk9866/files/media/documents/ZEV%20Goals_2022_Formatted%20Version_2022.1.25.pdf.

82. *COP26 Declaration on Accelerating the Transition to 100% Zero Emission Cars and Vans*, (2021), <https://www.gov.uk/government/publications/cop26-declaration-zero-emission-cars-and-vans/cop26-declaration-on-accelerating-the-transition-to-100-zero-emission-cars-and-vans>.

83. *China Explores Ambitious Goal for EV Sales 2035*, AUTOMOTIVE NEWS (Sept. 8, 2019), <https://www.autonews.com/china/china-explores-ambitious-goal-ev-sales-2035>.

84. *Zero Emission Vehicle Infrastructure Program*, GOV'T CAN., <https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-transportation/zero-emission-vehicle-infrastructure-program/21876> (last visited Jan. 22, 2022).

85. Yoann Bernard et al., *Impacts Of The Paris Low-Emission Zone and Implications For Other Cities*, INT'L COUNCIL ON CLEAN TRANSP. 6 (Mar. 2020), <https://theicct.org/publications/true-paris-low-emission-zone>.

86. *Electric Vehicles*, INT'L ENERGY AGENCY, <https://www.iea.org/reports/electric-vehicles> (last visited Jan. 22, 2022).

87. Shiqi Ou et al., *Light-Duty Plug-In Electric Vehicles in China: An Overview on the Market and its Comparisons To The United States*, 112 RENEWABLE & SUSTAINABLE ENERGY REV. 747, 750 (2019).

whereas micro-compact and compact vehicles were the most popular in China.⁸⁸

Furthermore, while ZEV goals are important, they need to be backed by strong supportive policies to facilitate a transition towards the intended goals. China's steep ZEV adoption curve was the direct result of a large set of supportive policies. In 2013 China began subsidizing the production of ZEVs, offering suppliers a subsidy that aimed to make up the cost difference between ZEV production and gas-powered vehicle production.⁸⁹ In 2013 China also set targets on the city level for ZEV adoption and provided support for meeting the targets.⁹⁰ Purchase incentives were originally mapped to sunset in 2020, with annual 10–20% reductions in incentives.⁹¹ However, in April of 2020, they announced plans to extend subsidies through 2022, and continue reducing, but not eliminating purchase incentives.⁹² Despite promising advancement in battery technology in China that will lead to price parity for electric vehicles (EVs) in the next 5 to 7 years, government intervention will still be necessary in order to hasten the pace of widespread vehicle electrification.⁹³

2. Domestic ZEV Phasing

Twenty-nine U.S. states have at least one stated or formal goal for ZEV adoption, with most of those goals emerging from inter-state agreements and compacts.⁹⁴ California recently passed an EO setting a goal for 100% of sales of passenger cars, trucks, and drayage trucks to be ZEVs by 2035.⁹⁵ The EO also stipulates that all off-road vehicles in use be electrified by 2035 and instructs CARB to begin work on a rule that would codify the goal.⁹⁶ The EO does provide a caveat for sales of heavy-duty vehicles, and these are instructed to be electrified by 2045 “everywhere feasible” (Executive Order

88. Yilei Sun & Brenda Goh, *GM Venture's Mini Car Becomes China's Most Sold EV, Surpassing Tesla's Model 3*, REUTERS (Sept. 15, 2020), <https://www.reuters.com/article/gm-electric-china/gm-ventures-mini-car-becomes-chinas-most-sold-ev-surpassing-teslas-model-3-idUSKBN25Z1E6>.

89. *Notice on Continuing to Promote and Apply New Energy Vehicles Caijian* (2013), http://www.gov.cn/zwqk/2013-09/17/content_2490108.htm.

90. *Id.*

91. *Id.*

92. Yilei Sun & Brenda Goh, *China to Cut New Energy Vehicle Subsidies by 10% this Year*, REUTERS (Apr. 23, 2020), <https://www.reuters.com/article/us-china-autos-electric-subsidies/china-to-cut-new-energy-vehicle-subsidies-by-10-this-year-idUSKCN225177>.

93. Ou et al. *supra* note 87.

94. Mollie D'Agostino et al., *Global Census of Zero Emission Vehicle Goals* (Jan. 25, 2022), https://policyinstitute.ucdavis.edu/sites/g/files/dgvnsk9866/files/media/documents/ZEV%20Goals_2022_Formatted%20Version_2022.1.25.pdf.

95. Ou et al. *supra* note 87.

96. Cal. Exec. Order No. N-79-20 (Sept. 23, 2020).

N-79-20), which is in line with the Advanced Clean Truck Rule, also finalized in 2020.⁹⁷

In taking this step California has set a precedent that other states could adopt, after the EO is codified in August 2022. In 2021, several other states pledged to adopt California's goals—Massachusetts, Washington, and Virginia have informally adopted California's ZEV targets.

B. The Fiscally Sustainable ZEV Consumer Incentives: A Feebate

There is some debate about when ZEV consumer incentives can and should sunset to ensure the ZEV market matures rapidly while ensuring sound use of public funds.⁹⁸ However, at least until the ZEV market reaches purchase cost parity with gas cars, both monetary and non-monetary ZEV incentives will encourage faster ZEV adoption than the market alone would deliver.⁹⁹

The National Conference of State Legislatures report that 47 states and the District of Columbia provide some incentives for EVs and PHEVs.¹⁰⁰ As of December 2020, California offered the largest total state incentive package (\$11,000) for low-income EV buyers,¹⁰¹ but has since reformed this incentive and as of May 2022 now offers \$9,000 in state incentives.¹⁰² These state incentives can be coupled with the Federal EV Credit (\$7,500), assuming applicants have a \$7,500 tax liability.¹⁰³

Smart fiscal policy is needed to ensure the sustainability of ZEV credits. In a 2020 review of ZEV policies UC Davis researchers, Scott Hardman and Dan Sperling, conclude that “incentives tend to decrease in value over time, as increasing sales make them more costly for governments.”¹⁰⁴ The authors warn that governments will need to identify reliable funding sources for incentives and suggest a “feebate” structure that charges high-emitting

97. *Id.*

98. PETER SLOWIK ET AL., INT'L COUNCIL ON CLEAN TRANSP., *FUNDING THE TRANSITION TO ALL-ZERO EMISSION VEHICLES* 30 (2019).

99. *Id.* at 3.

100. Kristy Hartman & Laura Shields, *State Policies Promoting Hybrid and Electric Vehicles* (2021), <https://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx>.

101. See Jameson Dow, *California Adds \$1,500 Incentive for New EVs, Total State + Fed Incentives Now Up to \$13.5K*, ELECTREK (Nov. 17, 2021), <https://electrek.co/2020/11/17/california-adds-1500-incentive-for-new-evs-total-state-fed-incentives-now-up-to-14-5k-until-end-of-year/> (listing the state and federal EV incentives available to Californians).

102. *Drive Clean CA*, CAL. AIR RES. BD., <https://driveclean.ca.gov/search-incentives> (last visited May 3, 2022).

103. *Incentives*, PLUGSTAR, <https://plugstar.zappyride.com/tools/incentives> (last visited Jan. 22, 2022).

104. *EV Uptake in the Transport Fleet: Consumer Choice, Policy Incentives and Consumer-Centric Business Models*, 122 OXFORD ENERGY F. (July 2020), <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2020/07/OEF122.pdf>.

vehicles to subsidize ZEVs as a viable solution for maintaining the long-term viability of ZEV incentives.¹⁰⁵ Such a self-funded system would ensure that there is a reliable source for ZEV incentives, and this will help in sending the right price signals to consumers.¹⁰⁶ As governments approach their ZEV goals, they could leverage the feebates to put additional pressure on the late adopters.

While the current focus of feebate mechanisms has been to incentivize both BEV and PHEV sales, certain aspects of the mechanism will need a different approach to push for a ZEV transition, while addressing equity concerns for producers and, especially, consumers.

In Europe there are many more mature examples of CO₂-based vehicle taxation that operate like a feebate.¹⁰⁷ About 23 out of 31 countries in Europe have some form of CO₂-based vehicle taxation. France has one of the most mature feebates in operation, also known as the ‘Bonus-Malus’ scheme. Over time, the French feebate has turned revenue surplus, allowing for additional funds to be utilized for other EV infrastructure investments including charging, over and above the funding for EV purchase rebates. The Netherlands taxes CO₂ by way of a circulation tax and a registration tax. More recently, since 2017, countries such as France, Germany, the UK have revised their feebates to introduce more stringent emission fees, while countries such as Sweden and Italy have introduced feebates in 2018 and 2019, respectively.¹⁰⁸

The U.K. has a circulation tax paid annually.¹⁰⁹ Cambridge Econometrics conducted an analysis in 2013 of European CO₂-based or feebate systems, demonstrating that consumers are responsive to feebate systems.¹¹⁰ Similar results from a 2012 study by Klier and Linn showed success of the feebate approach in France, Germany, and Sweden. At the same time, while the UK has revised the CO₂-based fee on LDVs, it has reduced the rebate for EVs significantly, resulting in concerns around affordability of EVs for a mass transition.¹¹¹

An example of a nascent feebate system can also be found in New Jersey.¹¹² To register a new vehicle in New Jersey buyers must pay a 0.4%

105. *Id.*

106. *Id.*

107. *The Effectiveness of CO-2 Based ‘Feebate’ Systems in the European Passenger Vehicle Market Context*, INT’L COUNCIL ON CLEAN TRANSP. (Nov. 1, 2013), <https://theicct.org/publications/effectiveness-co2-based-feebate-systems-european-passenger-vehicle-market>.

107. *Id.*

108. *Id.*

109. *Id.*

110. *Id.*

112. *New Jersey Laws and Incentives*, U.S. DEP’T OF ENERGY, <https://afdc.energy.gov/laws/all?state=NJ> (last visited Jan. 22, 2022).

fee for new vehicles that have fuel efficiency ratings below 19 mpg or are over \$45,000.¹¹³ This type of fee system represents an element of a feebate structure, although these fees are not solely responsible for funding the other consumer incentive benefits.¹¹⁴

In a detailed review of European feebates, researchers found that current feebate mechanisms incentivize a shift to both PHEVs and ZEVs, but there are key design elements that will need to be incorporated to facilitate a shift towards a higher ZEV ratio. They recommend that periodic revisions to the feebate mechanism provide a continuous signal to the market resulting in a greater shift to EVs by manufacturers and consumers. Feebates need not exist in perpetuity, and will be needed to create sufficient disincentive towards ICE purchases initially, and beyond a certain inflexion point of new EV sales becoming a significant share of total LDV sales, the feebate design can be adjusted to generate marginal revenues from non-zero emission vehicles (including PHEVs) which can be used for investments in charging infrastructure, and prioritizing other equity issues in affordability of ZEVs. More importantly, the paper finds that feebates are most effective with legislative backing, which creates a clear stream of fee revenue that can sustain rebates and other fiscal incentives for purchase of ZEVs. For the US LDV market, the authors find that over 56% of the sales in 2021 were emitting more than 300 gCO₂/mi, with average fuel efficiency ranging from 15 mpg to 28 mpg, far from the new 40.6 mpg CAFE target set by NHTSA for the 2024 Model Year. It is estimated that if a potential feebate mechanism for the US LDV market were to be implemented from 2023, the fee impact will be less than 1.5% of total revenue from LDV sales up to 2030.¹¹⁵

Monetary incentives are the most impactful type of consumer incentive. In a study of all 50 states consumer purchasing behavior is found to be most responsive to monetary purchase incentives.¹¹⁶ In a similar study, researchers surveyed California plug-in vehicle buyers between 2010 and 2017 and found that in ordered ranking the federal tax credit was rated as most important) in their decision to purchase a ZEV.¹¹⁷ Notably, at the time of the survey Federal incentives were the largest incentive, and in some cases there are more state and local incentives. Ranked as the second most important incentive was the State of California program, the Clean Vehicle Rebate Program (CVRP), which was the only available state financial incentive at the time.¹¹⁸ Ranked last was the high occupancy vehicle (HOV) lane access

113. N.J. Rev Stat § 39:3-8.4 (2013).

114. Sherilyn Wee et al., *Do Electric Vehicle Incentives Really Matter? Evidence from the 50 U.S. States*, 47 RSCH. POL'Y 1601, 1604 (2018).

115. Aditi Ramji, et al., *Vehicle Feebate Designs: Lessons Learned for a Zero Emissions Future. Institute of Transportation Studies*, U. CAL. DAVIS (DRAFT 2022).

116. *Id.*; Alan Jenn et al., *An In-Depth Examination of Electric Vehicle Incentives: Consumer Heterogeneity and Changing Response Over Time*, 132 TRANSP. RSCH. PART A: POL'Y & PRAC. 97, 108 (2020).

117. Jenn et al., *supra* note 116.

118. Alan Jenn et al., *Effectiveness of Electric Vehicle Incentives in the United States*, 119 ENERGY POL'Y 349, 351 (Feb. 2020), <https://doi.org/10.1016/j.enpol.2018.04.065>.

sticker incentives.¹¹⁹ There are many factors that will influence the effectiveness of incentives:

Cash Incentives (as of May 2022): the larger the incentives the more effective they are. UC Davis researchers found that for “every \$1000 offered as a rebate or tax credit increases average sales of electric vehicles by 2.6%.”¹²⁰

- California offers \$9,000 for low-income ZEV buyers. The incentives topped out in 2020 when state incentives had a maximum payout of \$11,000 in a combination of grants, discounts, and rebates (the max payouts are only for low-income ZEV buyers, see more on income-based incentives below).¹²¹
- Maine has a similarly tiered system, offering the largest \$8,000 incentive for Battery Electric Work Van or Cargo vans a \$7,500 incentive for battery electric vehicle purchased by a government or tribal entity (up to \$5,500 for low-income and a \$2,000 rebate for the general population).¹²²
- Colorado offers a tax credit of up to \$5,500 for light-duty trucks and \$5,000 for light-duty passenger vehicles until January 2021, after which they will reduce incentives to \$3,500 and \$2,500 respectively.¹²³
- New Jersey has instituted a maximum \$5,000 state incentive.¹²⁴ New Jersey also offers a sales tax exemption on top of the rebate, which equals an additional 6.625% savings.¹²⁵
- Vermont now offers a maximum of \$4,000 ZEV rebate. Notably Vermont, as of November 2020, had to pause their ZEV incentive

119. *Id.*

120. *Id.*; see generally *Massachusetts v. EPA*, 549 U.S. 497 (2007) (ruling that EPA has authority to regulate greenhouse gases from vehicles).

121. *Incentives*, *supra* note 103.

122. *Electric Vehicle Rebates*, EFFICIENCY MAINE, <https://www.energymaine.com/electric-vehicle-rebates/> (last visited May 3, 2022).

123. *Income 69: Innovative Motor Vehicle and Truck Credits for Electric and Plug-in Hybrid Electric Vehicles*, COLO. DEP'T OF REVENUE (Dec. 2019) <https://www.colorado.gov/pacific/sites/default/files/Income69.pdf>.

124. *Vermont Laws and Incentives*, U.S. DEP'T OF ENERGY, <https://afdc.energy.gov/laws/all?state=VT> (last visited Jan. 22, 2022).

125. *Air Quality, Energy, & Sustainability: Incentives to Drive Green*, U.S. DEP'T OF ENV'T PROT. (Feb. 2, 2021), <https://www.drivegreen.nj.gov/dg-electric-vehicles-affordability.html>.

system, having spent the \$1.1 million in state coffers authorized for plug-in purchase incentives before the end of 2020.¹²⁶

- Delaware,¹²⁷ Massachusetts,¹²⁸ and Oregon¹²⁹ offer \$2,500 rebates. Louisiana¹³⁰ offers a \$2,500 tax credit.¹³¹
- New York offers a \$2,000 rebate.
- Connecticut offers up to a \$1,500 rebate.¹³²

Income-Based Incentives: there is an important discussion about the equitability of purchase incentives to be had. Many states including Vermont, Maine, and California have instituted income caps on their EV incentive programs to direct funds towards more cost sensitive buyers.¹³³ In 2019 Vermont passed a bill identifying income eligibility requirements for capturing purchase incentives, setting eligibility caps that are 160% of “the State’s prior five-year average Median Household Income (MHI) level.”¹³⁴ This translated to incentives for Vermonters earning under \$96,122.¹³⁵ California instituted both an income cap and an extra bonus for very low-income buyers participating in the CVRP.¹³⁶ CVRP applicants get no financial award if their incomes are greater than \$150,000 for single filers, \$204,000 for head-of-household filers, and \$300,000 for joint filers.¹³⁷ If the buyers also fall below 300% of federal poverty levels (\$78,600 for a family

126. *Purchase Incentives*, DRIVE ELECTRIC VT., <https://www.driveelectricvt.com/why-go-electric/purchase-incentives> (last visited Jan. 22, 2022).

127. *The Delaware Clean Vehicle Rebate Program*, STATE OF DEL., <https://dnrec.alpha.delaware.gov/climate-coastal-energy/clean-transportation/vehicle-rebates/> (last visited Jan. 22, 2022).

128. *Massachusetts Laws and Incentives*, U.S. DEP’T OF ENERGY, ALT. FUELS DATA CTR., <https://afdc.energy.gov/laws/all?state=MA> (last visited Jan. 22, 2022).

129. *Oregon Clean Vehicle Rebate Program, Frequently Asked Questions*, OR. DEP’T OF ENV’T QUALITY (last updated Jan. 27, 2020), <https://www.oregon.gov/deq/FilterDocs/zev-faq.pdf>.

130. *Electricity Laws and Incentives*, U.S. DEP’T OF ENERGY, <https://afdc.energy.gov/fuels/laws/ELEC?state=LA> (last visited Jan. 22, 2022).

131. LA. STAT. ANN. § 47:6035(D) (2021).

132. *Electric Vehicle & Solar Incentives*, TESLA., <https://www.tesla.com/support/incentives> (last visited Jan. 22, 2022).

133. *Id.*

134. H. 529, (Vt. 2014), <https://legislature.vermont.gov/Documents/2020/Docs/ACTS/ACT059/ACT059%20As%20Enacted.pdf>

135. *Plug-In Electric Vehicle (PEV) Incentive*, U.S. DEP’T OF ENERGY, <https://afdc.energy.gov/laws/12230> (last visited Jan. 22, 2022).

136. *Income Eligibility*, CLEAN VEHICLE REBATE PROJECT (Mar. 29, 2016), <https://cleanvehiclerebate.org/eng/income-eligibility>.

137. *Id.*

of four) they qualify for a full \$4,500 rebate, and they can apply for up to a \$5,000 grant, and a \$1,500 discount at the dealership.¹³⁸

Non-Monetary Incentives: non-monetary incentives play a complementary role to monetary incentives. Non-monetary incentives include access to high occupancy vehicle (HOV) lanes can also incent consumer interest.¹³⁹ These include lane access for peak hour commuting, charging, or parking perks, fee, or toll waivers, as well as licensing incentives.¹⁴⁰ New Jersey and California are among the states that offer non-monetary incentive options, such as lane access, toll discounts, or exemptions.¹⁴¹

Timing of Incentives: the timing of incentives is also a critical factor for influencing purchase decisions.¹⁴² Instantaneous discount options are likely the most effective, yet most state ZEV consumer incentives require customers to file for a reimbursement.¹⁴³ The CVRP offers a reimbursement approximately six weeks after the vehicle purchase paperwork is submitted.¹⁴⁴ Delaware has an eight to ten week ZEV rebate request wait time.¹⁴⁵ For example, when Colorado offers a tax credit, the timing of the credit could be delayed depending on when the purchase and tax filing occurs.¹⁴⁶ California has provided an alternative option for pre-sale grants for low-income buyers since 2018.¹⁴⁷ Recently California also opened a pilot to

138. *Id.*

139. Thomas Stephens et al., *Incentivizing Adoption of Plug-in Electric Vehicles: A Review of Global Policies and Markets*, U.S. DEP'T OF ENERGY, OFF. OF SCI. AND TECH. INFO. (Jun. 1, 2018), <https://www.osti.gov/biblio/1480507-incentivizing-adoption-plug-electric-vehicles-review-global-policies-markets>.

140. Scott Hardman, *Understanding the Impact of Reoccurring and Non-financial Incentives on Plug-in Electric Vehicle Adoption – A Review*, 132 TRANSP. RSCH. POL'Y & PRAC. 97, 10-13 (2019).

141. *Id.*

142. ZIFEI YANG ET AL., THE INT'L COUNCIL ON CLEAN TRANSP., PRINCIPLES FOR EFFECTIVE ELECTRIC VEHICLES INCENTIVE DESIGN 29 (2016).

143. See generally Kristy Hartman & Laura Shields, *State Policies Promoting Hybrid and Electric Vehicles*, NAT'L CONF. STATE LEGISLATORS (Mar. 12, 2021), <https://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx> (last visited Jan. 22, 2022).

144. *FAQs*, CLEAN VEHICLE REBATE PROGRAM, <https://cleanvehiclerebate.org/eng/faqs> (last visited Jan. 22, 2022).

145. The Delaware Clean Vehicle Rebate Program, STATE OF DEL., <https://dnrec.alpha.delaware.gov/climate-coastal-energy/clean-transportation/vehicle-rebates/> (last visited Jan. 22, 2022).

146. Tamara Chuang, *As More Electric Vehicles are on the Way, Colorado's Tax Incentives Begin to Wind Down*, COLO. SUN (Mar. 9, 2020), <https://coloradosun.com/2020/03/09/evs-electric-vehicles-tax-incentives-refund-colorado-tesla-zev/>.

147. *Choose the Vehicle that is Right For You*, CLEAN VEHICLE ASSISTANCE PROGRAM, <https://cleanvehiclegrants.org/vehicles/> (last visited Jan. 22, 2022).

expand pre-sale grants to all income groups.¹⁴⁸ The pilot program is called Rebate Now, and allows customers in San Diego County to get pre-approval that will allow them to apply their rebate as a down payment for the vehicle purchase.¹⁴⁹

Secondary Markets: California's Clean Vehicle Assistance Program offers up to \$5,000 for a new or used ZEV or PHEV.¹⁵⁰ In order to qualify, used vehicles must have less than 75,000 miles or be less than eight years old.¹⁵¹ There are several programs that are administered by California's air districts that allow for incentives for used vehicle purchases. Many local air districts are offering used vehicle incentives. For example, the South Coast Air Quality Management District has a program that offers \$5,000 to \$9,500 for used vehicles within certain qualifying areas.¹⁵²

C. State ZEV Coalitions

Another method allowing states to move forward with ZEV initiatives are coalitions. Various states have joined together producing state coalitions that have been able to leverage support between member states and make ZEV goal setting easier and more achievable.¹⁵³ The Multi-State ZEV Task force (ZEV Memorandum of Understanding; ZEV MOU), the ZEV Alliance, and the Multi-State Medium- and Heavy-Duty Zero Emissions Vehicle MOU (MHDV ZEV MOU).¹⁵⁴

Three major interstate compacts have garnered state signatories:

- Multi-State ZEV Task Force: California, Connecticut, Maine (2019), Maryland, Massachusetts, New Jersey (2018), New York, Oregon, Rhode Island, and Vermont are part of the Multi-State ZEV Task force and have the collective goal of putting 3.3 million ZEVs on the

148. *State and Federal Electric Vehicle Incentives*, CLEAN VEHICLE REBATE PROJECT, <https://cleanvehiclerebate.org/eng/ev/incentives/state-and-federal> (last visited Jan. 22, 2022).

149. *Id.*

150. *Evolving Health and Economic Crisis Impacts on the CVA Program*, CLEAN VEHICLE ASSISTANCE PROGRAM, <https://cleanvehiclegrants.org/faq/> (last visited Jan. 22, 2022).

151. *Id.*

152. *Replacement Options*, S. COAST AIR QUALITY MGMT. DIST., <https://xappprod.aqmd.gov/RZR/Home/ReplacementOptions> (last visited Jan. 22, 2022).

153. *Multi-State ZEV Action Plan*, NE. STATES FOR COORDINATED AIR USE MGMT., ZEV TASK FORCE (2018), <https://www.nescaum.org/documents/2018-zev-action-plan.pdf>.

154. *Id.*

road by 2025.¹⁵⁵ While this interstate compact was originally formed in 2013 with eight signatories, New Jersey signed on in 2018 and Maine in 2019.¹⁵⁶ Important to note, the ZEV MOU also requires states to invest in ZEV infrastructure, consider ZEV incentives, and establish state goals for public fleets.¹⁵⁷

- ZEV Alliance: California, Connecticut, Maryland, Massachusetts, New York, New Jersey (2019), Oregon, Rhode Island, Vermont, and Washington (2019) are also part of the international compact ZEV Alliance.¹⁵⁸ Their shared goal is to make all passenger vehicle sales ZEVs by 2050.¹⁵⁹ Similarly to the ZEV MOU, most states signed on in 2015, with New Jersey and Washington joining in 2019.¹⁶⁰

Thus far, these state coalitions have accomplished so much more than they would have on their own. Specifically, the Multi-State ZEV Task Force has already successfully implemented or is close to implementing many of their 2014 Action Plans recommendations. These recommendations range from enacting ZEV purchase and infrastructure incentive programs to establishing a state or dealership workgroup; to fostering collaboration with dealers; to opening up public utility commission proceedings; to considering utility and transportation electrification programs.¹⁶¹

D. Light-Duty Public and Private Fleet Electrification

Electrifying public and commercial fleets present significant opportunities. Economies of scale encourage bulk purchasers to consider the total costs of ownership more carefully, which in many cases will favor EVs.¹⁶² This will be especially true for light-duty vehicles operating with

155. *Multi-State ZEV Action Plan 2*, ZEV PROGRAM IMPLEMENTATION TASK FORCE, (May 2014) <https://www.nescaum.org/documents/multi-state-zev-action-plan.pdf> (2014).

156. *Id.*

157. *Id.* at 14, 19, 30

158. *Members*, ZEV ALLIANCE, <http://www.zevalliance.org/members/> (last visited Jan. 22, 2022).

159. *Id.*

160. *Id.*

161. *California Applauds Multi-State Coalition's Releases New Zero-Emission Vehicle Action Plan*, CAL. AIR RES. BD. (June 20, 2018), <https://ww2.arb.ca.gov/news/california-applauds-multi-state-coalitions-releases-new-zero-emission-vehicle-action-plan>.

162. Tom Gelinas, *Calculating Cost of Ownership, Especially for a Private Fleet, This is a Figure that's Important to Know, But Not One That's Easy to Calculate*, FLEET EQUIP. MAG. (Apr. 17, 2013), <https://www.fleetequipmentmag.com/calculating-cost-of-ownership/>.

VMT within the ranges of ZEVs available in the market today.¹⁶³ ZEV fleets can also be a source for increasing data collection efforts to coordinate making efficient use of different fleet vehicles to meet organizational needs and maximize energy efficiency.¹⁶⁴

Barriers to public sector fleet electrification can include procurement challenges associated with separate capital and operating budgets, which can mean that those making decisions to purchase EVs may not be the same offices tasked with charging and maintenance of the vehicles.¹⁶⁵ This is where ensuring buy-in from all stakeholders is critical to ensure the successful integration of the EV vehicles into the fleet.

Massachusetts offers public agencies, governments, colleges, and universities a per vehicle incentive of \$7,500 towards the costs of ZEV procurement.¹⁶⁶ This far exceeds the \$2,500 offered to individuals, organizations, and companies.¹⁶⁷

1. Commercial Fleets: Focus on Transportation Network Company Electrification

Transportation Network Companies (TNC) vehicles, or ride-hailing vehicles, (e.g. Uber and Lyft) represent a high-impact strategy for reducing emissions.¹⁶⁸ Under pre-pandemic market circumstances, non-pooled TNC vehicles drove more than three times more daily miles than personal vehicles and emitted 47% more GHGs per passenger mile.¹⁶⁹ While TNC vehicles made up a small percentage of overall vehicle use, the number of people who used TNCs had increased substantially over the last several years, doubling from 23% in 2015 to 46% in 2018.¹⁷⁰ TNC usage dropped by 63% in 2020 during the height of the COVID-19 pandemic, but blue collar riders were

163. ZEV PROGRAM IMPLEMENTATION TASK FORCE, *supra* note 155, at 28.

164. *Emissions Modeling, ZEV Programs, & Data Collection*, CAL. AIR RES. BOARD (May 9, 2019), <https://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442461296>.

165. TRANSPORTATION RESEARCH BOARD AND NATIONAL RESEARCH COUNCIL, *OVERCOMING BARRIERS TO DEPLOYMENT OF PLUG-IN ELECTRIC VEHICLES, CHAPTER 3: UNDERSTANDING THE CUSTOMER PURCHASE AND MARKET DEVELOPMENT PROCESS FOR PLUG-IN ELECTRIC VEHICLES* (2015).

166. *Massachusetts Laws and Incentives*, U.S. DEP'T OF ENERGY, <https://afdc.energy.gov/laws/all?state=MA> (last visited Jan. 22, 2022).

167. *Id.*

168. Alan Jenn, *Emissions Benefits of Electric Vehicles in Uber and Lyft Services*, UNIV. OF CAL, DAVIS, INST. OF TRANSP. STUD. (Aug. 2019), <https://escholarship.org/content/qt15s1h1kn/qt15s1h1kn.pdf?t=pyn867>.

169. Maria Cecilia Pinto de Moura et al., *Ride-Hailing's Climate Risks*, UNION OF CONCERNED SCIENTISTS 7 (Feb. 2020), www.ucusa.org/ride-hailing-climate-risks.

170. *Id.* at 5.

more consistently using TNCs during this time, and ridership levels among these workers dropped from 15.8% to 14.9%.¹⁷¹

The Uber third quarter earnings report in 2020 showed that mobility rides (i.e., rides with passengers) were down 50%, but delivery rides were up 135%, resulting in a 10% overall reduction in gross bookings year over year.¹⁷²

The two leading U.S. TNCs, Uber and Lyft, have both set ambitious ZEV phasing targets for their fleets, aiming for 2030.¹⁷³ In 2018 Uber pledged to make every car in their London app a ZEV by 2025.¹⁷⁴ In 2020 they expanded this goal, and pledged to convert the whole Uber platform in the U.S. and Europe to ZEVs by 2030.¹⁷⁵ Lyft also announced in 2020 that they are pledging to convert their entire U.S. passenger fleet to ZEVs by 2030.¹⁷⁶ Corporate pledges like this are common, and far from legally binding. However, these goals are worth mentioning to contextualize the corporate goals of the states and countries in which the companies are operating.

CARB has released a regulation order that set regulations to target TNC vehicle emissions.¹⁷⁷ This regulation is a result of the California legislature mandating CARB to create the Clean Miles Standard Program, after the passage of SB1014 in 2021 (Section 5431 of the Public Utilities Code).¹⁷⁸ SB1014 calls for a timeline of emissions reductions for TNCs using two metrics: (1) an EV miles traveled (eVMT) basis and (2) a GHG per passenger mile (PMT) basis.¹⁷⁹ This latter metric is notable, in that the GHGs/PMT metric allows flexibility for TNC operators to achieve emissions reductions by either reducing tailpipe emissions or by increasing occupancy per vehicle (sharing or pooling), or by generating transit trips, or making investments in bike or pedestrian infrastructure.¹⁸⁰ The regulations call for a 90% reduction

171. Grant Matson et al., *Policy Brief: Ridehailing Demand Is Resilient Among Low-Income Travelers During the COVID-19 Pandemic* (2021), <https://escholarship.org/uc/item/05z1x7m6>.

172. *Uber Announces Results for Third Quarter 2020*, UBER TECHS. (Nov. 5, 2020), <https://investor.uber.com/news-events/news/press-release-details/2020/Uber-Announces-Results-for-Third-Quarter-2020/default.aspx>.

173. Cal. Reg. Code § 2490, 2490.1, 2490.2, 2490.3, and 2490.4. (2021)

174. *The Clean Air Plan*, UBER TECHS., <https://www.uber.com/gb/en/u/ride-journey-to-electric/> (last visited Jan. 22, 2022).

175. Andrew J. Hawkins, *Uber Pledges to Shift to '100 Percent' Electric Vehicles by 2030*, THE VERGE (Sept. 8, 2020) <https://www.theverge.com/2020/9/8/21427196/uber-promise-100-percent-electric-vehicle-ev-2030>.

176. *Leading the Transition to Zero Emissions: Our Commitment to 100% Electric Vehicles by 2030*, LYFT (June 17, 2020), <https://www.lyft.com/blog/posts/leading-the-transition-to-zero-emissions>.

177. CAL. REG. CODE § 2490, 2490.1, 2490.2, 2490.3, and 2490.4. (2021).

178. CAL. PUB. UTIL. CODE § 5431 (2014).

179. *Id.*

180. *Clean Miles Standard*, CAL. CLEAN AIR RES. BD. <https://ww2.arb.ca.gov/our-work/programs/clean-miles-standard/about> (last visited Jan. 22, 2022).

in eVMT from TNCs by 2030, as well as a 0 GHG/PMT basis.¹⁸¹ Theoretically, the companies could meet both targets by bringing their fleet to 100% ZEVs, or they could bring 90% of their fleet to ZEVs and make up the remainder with other supportive credits offered within the Clean Miles Standard Program.¹⁸²

Local policymakers are also sending price signals to the TNCs to green their fleets. San Francisco passed a TNC taxation structure that requires riders to pay a 3.25% tax, except those who request a shared ride will only pay 1.5%.¹⁸³ This is incentivizing increasing the denominator of the GHG/PMT metric, and will send a price signal that reducing emissions is the preferred behavior.¹⁸⁴ Similarly the City of Phoenix began charging \$4.00 in 2019 and up to \$4.25 as of January 1, 2021 for TNC trips to the local airport (Phx Ariz., Code § 4-78(A)(1)).¹⁸⁵ These fees are discounted, “when drivers use alternative-fuel-powered or zero-emission vehicles or pick-up/drop-off passengers at PHX Sky Train stations located away from terminals.”¹⁸⁶

New York City is also sending price signals to riders regarding the full environmental costs of their TNC trips.¹⁸⁷ New York State is charging a 4% tax on gross fare trips in TNCs.¹⁸⁸ Inside Lower Manhattan there is an additional \$2.00 charge for solo-riders, and only a \$0.75 charge for riders using Lyft Share or Uber Pool.¹⁸⁹

2. TNC Charging Considerations

A significant barrier to EV adoption, especially among ride-hailing drivers, is the lack of availability for charging. Ride-hailing drivers have different driving and charging behavior than private vehicle owners.¹⁹⁰ For example, ride-hailing drivers tend to charge their vehicles at public charging

181. CAL. REG. CODE § 2490, 2490.1, 2490.2, 2490.3, and 2490.4. (2021)

182. *Id.*

183. Hannah Norman, *Uber, Lyft Agree to Proposed Ridehail Tax in San Francisco*, BUS. J. (Aug. 1, 2018), <https://www.bizjournals.com/sanfrancisco/news/2018/08/01/uber-lyft-agree-proposed-ridehail-tax-sf.html>.

184. *Traffic Congestion Mitigation Tax (TCM)*, TREASURER & TAX COLLECTOR, CITY & CNTY. OF S.F., <https://sftreasurer.org/business/taxes-fees/traffic-congestion-mitigation-tax-tcm> (last visited Jan. 22, 2022).

185. PHX. ARIZ. CODE § 4-78(A)(1) (2016).

186. PHX. ARIZ. CODE § 4-78(A)(6) (2016).

187. *New York State Assessment on Transportation Network Companies*, N.Y. DEP'T OF TAX'N & FIN. (Jun. 23, 2017) https://www.tax.ny.gov/pdf/memos/multitax/m17_1m_1s.pdf.

188. *Id.*

189. Will Drickey, *No Relief in Sight for Cab Drivers on Taxi Congestion Pricing*, METRO U.S. (Jan. 17, 2019), <https://www.metro.us/no-relief-in-sight-for-cab-drivers-on-taxi-congestion-pricing/>.

190. Alan Jenn, *Emissions Benefits of Electric Vehicles in Uber and Lyft Services*, at 11–12, NAT'L CTR. FOR SUSTAINABLE TRANSP. (Aug. 2019).

stations during the day (rather than at home overnight).¹⁹¹ This could be good for the climate, given that in California the grid is cleaner during the day, due to solar energy capacity.¹⁹² More than 40% of public fast chargers were utilized by non-Tesla ride-hailing drivers, an astonishingly high number considering that less than 1% of EVs on the road are driven as TNCs.¹⁹³ In order to reach the goals set out by the Clean Miles Standard a widespread, affordable, fast charging network will need to be developed. This will likely require cooperation between TNCs, utilities, and charging companies.

IV. DECARBONIZING THE MEDIUM- AND HEAVY-DUTY VEHICLE SECTOR

While heavy-duty (HD) vehicles comprise approximately 10% of vehicles on the road in the U.S., they are responsible for 28% of GHG emissions and 45% of harmful on-road NOx emissions.¹⁹⁴ Furthermore, decarbonizing the heavy-duty sector has important equity implications. Disadvantaged communities are often disproportionately impacted by diesel and particular matter pollution. Thus, strategies that focus on the electrification of these vehicles are crucial to meet climate and electric vehicle and equity goals. The pathways discussed above can apply to light-, medium-, and heavy-duty vehicles, yet there are some strategies that are specific to the two latter categories. Because states are so distinct in character, composition, and goals, there are many different methods that can and should be considered when addressing electrification of the HD sector, ranging from planning and goal setting documents; to actual legislation or regulation; to incentives for industries, infrastructure, or directly to consumers.¹⁹⁵

A. Investments and Incentives

In the freight sector, there are many state-led ZEV programs that are targeting investments to move the industry towards electrification. In California, financial injections have been invested in multiple different sectors from infrastructure to monetary incentives for operators.¹⁹⁶

191. *Id.* at 9.

192. Sammy Roth, *California has Too Much Solar Power. That Might Be a Good Thing*, L.A. TIMES (June 5, 2019), <https://www.latimes.com/business/la-fi-solar-batteries-renewable-energy-california-20190605-story.html>.

193. Jenn, *supra* note 190, at 7.

194. Jimmy O'Dea, *Ready for Work, Now Is the Time for Heavy-Duty Electric Vehicles*, UNION OF CONCERNED SCIENTISTS (Dec. 11, 2019), <https://www.ucsusa.org/resources/ready-work>.

195. *Id.*

196. *Id.*

1. Supply-Side Investments

In California, CARB manages the Low Carbon Transportation Investments and Air Quality Improvement Program, established in 2007.¹⁹⁷ This Program leverages proceeds from cap-and-trade auctions to support the development of advanced technology and clean transportation in both the light- and heavy-duty sectors.¹⁹⁸ This program aims to fund pre-commercial demonstrations and early commercial pilots in order to improve research and development while informing the public and stakeholders of new technologies.¹⁹⁹ The goal of this program is to find mutually beneficial outcomes for society and industry.²⁰⁰

In November 2021, CARB approved \$1.5 billion dollars, the largest amount to date, to transform California's vehicle and equipment fleet to zero-emission, with \$843 million dedicated to heavy-duty and off-road equipment investments.²⁰¹ This funding will be applied to demonstrations and pilot projects, vouchers for advanced clean trucks, financing for small truck fleet transitions, and drayage trucks and transit and school buses. This mixed approach will allow the state to apply some funds to incentivize companies to research and innovate further to produce safer, more cost-effective technologies that will support the main goals for ZEV production.²⁰² By starting at the beginning of the timeline, these programs can fund feasibility assessments, research and development technologies, the pre-commercial stage, and early market entry to be involved at a grassroots level to shape and nurture the technologies that they eventually want to be widespread.²⁰³

2. Consumers Investments and Incentives

A few programs have been launched to lower the costs of obtaining and utilizing zero-emission vehicles. In 2009, California launched their Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) which lowers the capital cost of electric vehicles through vouchers directly with dealers in order to accelerate the adoption of cleaner, more efficient trucks,

197. *Low Carbon Transportation Investments and Air Quality Improvement Program*, CAL. AIR RES. BD., <https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-investments-and-air-quality-improvement-program/about> (last visited Jan. 22, 2021).

198. *Id.*

199. *The California Air Resources Board*, CAL. CLEAN AIR RES. BD. <https://ww2.arb.ca.gov/about> (last visited Jan. 22, 2022).

200. *Id.*

201. *CARB approves \$1.5 billion investment — largest to date — in clean cars, trucks, mobility options*, CAL. AIR RES. BD. (Nov. 19, 2021), <https://ww2.arb.ca.gov/news/carb-approves-15-billion-investment-largest-date-clean-cars-trucks-mobility-options>.

202. CAL. AIR RES. BD., *Heavy-Duty Investment Strategy*, at 6–8.

203. *Id.*; see discussion *infra* Section IV.2.H.

and buses.²⁰⁴ These vouchers reduce the average cost of fuel cell electric truck or bus by roughly 25%.²⁰⁵ These programs can prove effective as they consider market challenges and work to lower them for all communities.

Even with all of these seemingly robust methods of popularizing HD ZEVs and making them more accessible, it is important to consider the source of these funding opportunities as well. The biggest question, and often considered the biggest pitfall, of incentivization and electrification investments is: Where will this money come from? Federal funds are generally sought directly by local and municipal governments, whose goals vary across the state.²⁰⁶ Other sources of funds may be available on an ad hoc basis. For example, in California, the 2018 Volkswagen Mitigation Trust provides some extra resources and by consent decree, is dedicated to low-income or disadvantaged communities.²⁰⁷ It will be a challenge for regulators to consider the equity implications of these investments, while balancing the need for early market intervention.

B. Planning Documents and Tactics

California has been a leader in issuing planning documents to provide a vision that guides the zero-emission vehicle goal process.²⁰⁸ For the medium and heavy duty sector, the California Sustainable Freight Action Plan is a prime example of such visioning and this document focused on integrating several State agencies to revitalize the California freight transportation system.²⁰⁹ Prompted by an EO by Governor Brown in July 2015 the Action Plan laid out steps, goals, targets, investment opportunities, and pilot programs.²¹⁰ These were strategies to achieve the long-term 2050 goal for California's future freight transportation system to be reliable and efficient

204. *About HVIP*, CAL. HVIP, <https://californiahvip.org/about/> (last visited Jan. 22, 2022).

205. *Hybrid and Zero-Emission Truck and Bus Voucher Invention Project: Incentives for Clean Trucks and Buses*, CAL. AIR RES. BD., <https://californiahvip.org/> (last visited Jan. 22, 2022); see Alysha Webb, *California Embracing Hydrogen Fuel-Cell Buses*, WARDS AUTO (Oct. 18, 2018), <https://www.wardsauto.com/alternative-propulsion/california-embracing-hydrogen-fuel-cell-buses> (showing a \$315,000 price reduction for average cost of fuel cell bus of \$1.2 million); *Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)*, CAL. AIR RES. BD., <https://ww3.arb.ca.gov/msprog/lct/hvip.htm> (last visited Jan. 22, 2022).

206. Rebecca Lee, *Transportation Electrification*, at 7–9, CAL. PUB. UTIL. COMM'N (June 2016).

207. *Volkswagen Environmental Mitigation Trust for California*, CAL. AIR RES. BD., <https://ww2.arb.ca.gov/our-work/programs/volkswagen-environmental-mitigation-trust-california/about> (last visited Jan. 22, 2022).

208. See *California's 2017 Climate Change Scoping Plan*, CAL. AIR RES. BD., https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf.

209. *The California Sustainable Freight Action Plan*, CAL. AIR RES. BD., <https://ww2.arb.ca.gov/our-work/programs/california-sustainable-freight-action-plan/about> (last visited Jan. 22, 2022).

210. CALIFORNIA AIR RES. BD., *MOBILE SOURCE STRATEGY 26* (May 2016).

by using zero-emission equipment everywhere feasible, and near-zero emission equipment powered by clean, low-carbon renewable fuels everywhere else.

The Sustainable Freight Action Plan highlights substantial and specific goals and promises that state agencies hope to achieve. Yet, it is documents like these that, on the surface, seemingly have so much potential, but lack the enforcement and legal teeth that typically come with legislative statutes or regulations from administrative agencies. California is not bound by this Action Plan and will face no punitive measures should they not meet the goals.²¹¹

CARB made some of the strategies in the Sustainable Freight Action Plan more concrete by first establishing a Mobile Source Strategy in 2016, which laid out many environmental mandates and goals.²¹² An update in 2020 (published in 2021) focused on strategies to reduce diesel, NO_x, and GHG emissions and estimated that 77% of California's heavy-duty fleet will be electric by 2045.

The 2020 Mobile Source Strategy listed the following legislative and regulatory strategies as top priorities for the state:

- *Manufacturer requirements to foster clean technology production and sales;*
- *In-use requirements to accelerate penetration of newer technology;*
- *Incentive programs to promote and accelerate the use of advanced clean technologies;*
- *Enhanced enforcement strategies to ensure programs are achieving their anticipated benefits;*
- *Outreach and education to increase consumer awareness and acceptance of advanced vehicle and equipment technologies; and*
- *Infrastructure planning and development to support the transition to cleaner technologies.*²¹³

These planning documents are a critical step towards achieving the goals set out in California's EO N-79-20, but they are not concrete actions until

211. *See generally id.* (omitting any punitive measure for failure to meet commitment targets).

212. 2016 *Mobile Source Strategy*, CAL. AIR RES. BD., <https://ww2.arb.ca.gov/resources/documents/2016-mobile-source-strategy> (last visited Jan. 22, 2022).

213. 2020 *Mobile Source Strategy*, CAL. AIR RES. BD. (2021), https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf.

they are formally established as regulation.²¹⁴ This will occur during the forthcoming ACC II deliberation in 2022 and will enable CARB to develop regulations that will help direct the state towards these strategies.

C. Heavy Duty Electrification Regulations

Regulatory avenues are a necessary and effective pathway for decarbonizing the medium and heavy-duty sector. A seminal regulation is the Advanced Clean Truck regulation of 2020, which requires manufacturers to sell zero-emission trucks as an increasing percentage of their Annual California sales from 2024 to 2035.²¹⁵ This combined with the forthcoming ACC II policy will effectively compel industry to make necessary investments to meet the state's electric vehicle goals and provide the key drivers of the medium and heavy-duty vehicle market with more certainty and predictability.

D. Bus Electrification

California is applying what's referred to as a *beachhead strategy* to ZEV goals by targeting buses.²¹⁶ A beachhead strategy is a theory of change and technological application that drives programs as it infiltrates the market by first targeting an achievable market.²¹⁷ Transit buses, shuttle vans, and package delivery vans and trucks have been identified as the first zero-emission beachheads. These were chosen to increase volume through the electrification of large fleets which allows for more commercialization.²¹⁸ Furthermore, this would lead to lowering prices to economies of scale and to the sharing of wealth through componentry.²¹⁹ Thus, by starting ZEV transitioning with these vehicles, society is able to observe real change while industries are able to perfect and monitor the effects on types of operators, capabilities of technologies, and total costs of operations. Investments in these medium- and heavy-duty vehicles allows "research in daily vehicle use, economics, technological readiness, and the supplier base."²²⁰ Furthermore,

214. Cal. Exec. Order No. N-79-20 (Sept. 23, 2020), <https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-text.pdf>.

215. *Advanced Clean Trucks Fact Sheet*, CAL. AIR RES. BD., <https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet> (last visited Jan. 22, 2022).

216. *Global Commercial Vehicle Drive To Zero, The Program*, CALSTART, <https://globaldrivetozero.org/about/program/> (last visited Jan. 22, 2022).

217. *2016 Mobile Source Strategy*, *supra* note 212.

218. *Id.*

219. CALSTART, *supra* note 216.

220. John Boesel, *The Zero-Emissions Future for Vehicles is Coming*, MEETING OF THE MINDS (July 23, 2019), <https://meetingoftheminds.org/30731-30731>.

the beachhead strategy of choosing these vehicles allows for “technology transfer” into other similar markets such as ferries.²²¹

Researchers have concluded that considering the total cost of ownership, replacing a bus fleet of 200 with a 100% electric fleet would decrease overall costs anywhere from “\$0.1 to \$3.6 billion compared to replacing the current fleet.”²²² Specifically, electric buses are expected to have lower operating costs and lower lifetime costs as compared to conventional powertrains.²²³

E. State Coalitions

Much like for light-duty vehicles, medium- and heavy-duty coalitions can allow states to coordinate and work across borders. There is a Medium-Heavy Duty (MDHV) ZEV MOU which includes: California, Colorado, Connecticut, District of Columbia, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington.²²⁴ This MOU’s goal is to require 30% and 100% of MHDV sales to be ZEVs by 2030 and 2050, respectively.²²⁵

F. Heavy-Duty Charging Infrastructure

Medium- and heavy-duty infrastructure is an often overlooked, yet crucial part of ZEV goal making. Specifically, after California’s Advanced Clean Trucks rule was approved in June of 2020, many industry groups immediately had concerns about the costs of charging infrastructure.²²⁶ When transitioning to an electric fleet, there are many different financial factors to consider for infrastructure alone such as the site construction, equipment

221. *Guide to Federal Funding, Financing, and Technical Assistance for Plug-in Electric Vehicles and Charging Stations*, U.S. DEP’T OF ENERGY 1 (July 2016), <https://www.energy.gov/sites/prod/files/2016/07/f33/Guide%20to%20Federal%20Funding%20and%20Financing%20for%20PEVs%20and%20PEV%20Charging.pdf>.

222. Hanjiro Ambrose et al., *Exploring the Costs of Electrification for California’s Transit Agencies*, (Oct. 1, 2017), <https://escholarship.org/uc/item/0fn8s2jh>.

223. *Id.*

224. *Medium and Heavy-Duty Zero Emission Vehicle (ZEV) Deployment Support*, U.S. DEP’T OF ENERGY, ENERGY EFFICIENCY & RENEWABLE ENERGY, <https://afdc.energy.gov/laws/12460> (last visited Jan. 22, 2022).

225. *Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding*, 6–21, https://www.nescaum.org/documents/mhdv-zev-mou_12-14-2021.pdf/ (last visited Jan. 22, 2022).

226. Russ Mitchell, *California Mandates Big Increase in Zero-Emission Trucks*, L.A. TIMES (June 25, 2020), <https://www.latimes.com/business/story/2020-06-25/new-california-truck-mandate-100-000-zero-emiss>.

lifecycle and installation, back-up power supplies, and maintenance.²²⁷ Furthermore, energy consumption and cost are higher due to the fact that heavy-duty trucks require significantly more power to charge than light-duty.²²⁸

Hydrogen fuel cells are emerging as an efficient, green alternative for medium- and heavy-duty vehicles.²²⁹ Since hydrogen can offer high gravimetric energy storage density, fast recharging times, and higher vehicle utilization factors, they allow for longer driving ranges.²³⁰

Thus, there have been a few initiatives that have spurred the funding in this sector. At the federal level, the Diesel Emissions Reduction Act (DERA), which was first enacted in 2010, funds various projects across the nation with the goal of reducing harmful emissions from diesel engines.²³¹ These projects have mostly taken the form of replacement of school buses.²³²

More generally, the U.S. Department of Energy/Energy Efficiency and Renewable Energy have created the Clean Cities program which funds projects to significantly accelerate the deployment of alternative fuels and infrastructure for light-, medium- and heavy-duty vehicles.²³³ Even on a localized level, San Diego Gas and Electric has produced their Power Your Drive for Fleets program which connects fleets with resources, fleet-friendly charging rates, and financial incentives to design and install charging infrastructure to power medium- and heavy-duty electric fleets.²³⁴ Each of these programs have acknowledged the global transition to transportation electrification, acknowledged the extra difficulties and obstacles that

227. *Calculating TCO for EVs: Where to Find the Greatest Long-Term Cost Savings for Medium- and Heavy-Duty Vehicles*, ADVANCED CLEAN TECH. NEWS (Aug. 26, 2020), <https://www.act-news.com/news/calculating-tco-for-medium-and-heavy-duty-evs/>.

228. *See Level 1 vs Level 2 EV Charging Stations*, CLIPPERCREEK, <https://clippercreek.com/level-1-level-2-charging-stations/> (last visited Jan. 22, 2022) (explaining that the battery size in the electric vehicle affects the amount of energy needed to charge it).

229. *Alternative Fuels Data Center: Hydrogen Basics*, U.S. DEP'T ENERGY, https://afdc.energy.gov/fuels/hydrogen_basics.html (last visited Jan. 22, 2022).

230. Jason Marcinkoski et al., *DOE Advanced Truck Technologies: Subsection of the Electrified Powertrain Roadmap*, U.S. DEP'T ENERGY 4 (Oct. 31, 2019), https://www.hydrogen.energy.gov/pdfs/19006_hydrogen_class8_long_haul_truck_targets.pdf.

231. 42 U.S.C. § 15801.

232. *Reducing Diesel Emissions from School Buses*, U.S. ENV'T PROT. AGENCY, (July 7, 2020) <https://www.epa.gov/dera/reducing-diesel-emissions-school-buses>.

233. *Guide to Federal Funding, Financing, and Technical Assistance for Plug-in Electric Vehicles and Charging Stations*, U.S. DEP'T ENERGY (July 2016), <https://www.energy.gov/sites/prod/files/2016/07/f33/Guide%20to%20Federal%20Funding%20and%20Financing%20for%20PEVs%20and%20PEV%20Charging.pdf>.

234. *Power Your Drive For Fleets*, SAN DIEGO GAS & ELECTRIC CO., <https://www.sdge.com/business/electric-vehicles/power-your-drive-for-fleets> (last visited Jan. 22, 2022).

medium- and heavy-duty fleets face, and have chosen to fund and support a crucial step: infrastructure.²³⁵

V. CONCLUSION

A key finding of this report is that while there are dozens of potential policy options, and there are some known best practices for each of these approaches, no single strategy will be enough. A comprehensive suite of supply and demand-side policies may be necessary for both the light-duty and heavy-duty sectors.

A federal zero-emission vehicle landscape has many pathways and policy options for light-, medium-, and heavy-duty vehicles. These pathways include mandates and incentives for both consumers and manufacturers. Each of these policies should keep in mind equity and environmental justice to ensure the communities that are the most disproportionately impacted by the emissions from transportation are given access to clean transportation, while also benefiting from this transition.

State ZEV policies to decarbonize the light duty sector can be done in parallel to federal efforts and focus on phasing out internal combustion engine vehicles. A suite of supply-side and demand incentive policies will be necessary.²³⁶ For a fast turnover, public and private fleet electrification can kick-start these actions. To support all these efforts, infrastructure policies will need to be prioritized and will require coordinated cooperation between private and public stakeholders.

The medium- and heavy-duty sector is responsible for a disproportionate amount of emissions and especially given the inequitable impacts of these emissions should also be decarbonized imminently.²³⁷ These larger vehicles will be harder to electrify because of their sizes and nature, but it can be done and regulators must help target investments and incentives for infrastructure and vehicle technologies.²³⁸ Prioritizing the transition of fleets like buses and medium-duty short haul fleets, like delivery trucks, will help accelerate the overall transition. Mandates like what California has passed for bus electrification will result in innovation and operational cost savings. The

235. See, e.g., *Transportation Electrification Movement*, SAN DIEGO GAS & ELEC., <https://www.sdge.com/residential/electric-vehicles/power-your-drive> (last visited Jan. 22, 2022) (describing the infrastructure built by the Power Your Drive program).

236. *State Policies Promoting Hybrid and Electric Vehicles*, NAT'L CONF. STATE LEGISLATORS (Mar. 12, 2021), <https://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx>.

237. BUREAU OF TRANSP. STAT., *Estimated U.S. Average Vehicle Emissions Rates per Vehicle by Vehicle Type Using Gasoline and Diesel*, at table 4-43 (last visited Jan. 22, 2022).

238. Justin Gerdes, *Next Up for Electrification: Heavy-Duty Trucks and Construction Machinery*, GREENTECH MEDIA (July 13, 2020), <https://www.greentechmedia.com/articles/read/next-up-for-electrification-heavy-duty-trucks-and-construction-machinery>.

medium- and heavy-duty vehicle sector also requires unique charging capacity and locations, and federal investment in research and infrastructure is essential to support its decarbonization.

No one sector or one type of policy will work to meet the necessary emissions reductions goals that will avoid the worst impacts of climate change. For the transportation sector to achieve necessary targets a suite of policies is crucial, in the light-, medium-, and heavy-duty sectors. Carrots and sticks must all be utilized, and equity and environmental justice should be considered as each policy is developed and refined.