# Carbon Pricing Is Not Enough: Network Externalities and the Case for Green Industrial Policy

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## 1 Motivation

Economists have long viewed a price on emissions as the least-cost way to correct a pollution externality (Pigou, 1920; Baumol, 1972). This result rests on the assumption in which emissions is the only market failure and are otherwise competitive. This result may not survive in industries with large network externality, such as the electric vehicles. The transportation sector account for 23 percent of global energy-related $CO_2$ emissions (IPCC, 2022), and the decarbonation of the vehicle fleet depends on network infrastructure, namely, the charging network. Governments can encourage EV adoption through prices, by taxing gasoline or subsidizing EVs. They can also use green industrial policy to build the charging network. The industrial policy I study is direct provision of the charging network. This paper asks how a carbon price compares with public provision of fast-charging infrastructure. Preliminary results indicate that a modest public investment in the network delivers larger adoption and welfare gains than a carbon price at the levels in place or under debate in North America.

The broader question concerns the scope of climate policy. A carbon price signal the social cost of emissions, but in industries where price change may be inframarginal, as when there are large network effects, fixed entry costs, or market power, the price alone may not deliver the least-cost outcome. In those settings, instruments that target the source of the market failure can be more cost-effective at the margin. EV charging is one such industry, and I show that public provision of a charging network is more cost-effective than a carbon price. Green R&D and learning by doing, through knowledge spillovers, and freight rail and grid interconnection, through network effects and fixed costs, share the same underlying structure.

## 2 Related literature

The case for carbon pricing starts with Pigou (1920) and Baumol (1972): a tax equal to marginal damage corrects the externality. Sandmo (1975), Bovenberg and Goulder (1996), and Jacobs and de Mooij (2015) show how the optimal carbon tax changes when the government also raises revenue with distortionary taxes. Another issue is that the cost of carbon pricing are also unevenly distributed. Känzig (2026) identifies carbon policy shocks in the European carbon market and finds that a tighter carbon price raises energy prices, lowers emissions, and increases green innovation, but reduces economic activity. Poorer households bear most of the loss. They spend a larger share of their budget on energy and experience larger income losses, and these indirect effects through income and employment account for about two-thirds of the aggregate consumption response. Unequal costs of this kind are one

source of the political constraints studied in a more recent literature. Jiang et al. (2026) study how imperfect economic literacy shapes voter support for market-based environmental policies and environmental standards. They show that political constraints alone can hold a market-based instrument below the Pigouvian optimality, and that voters' imperfect understanding of pass-through and cost-effectiveness can lead a politically constrained planner to choose a less cost-effective standard. In this strand of work, distributional and political frictions keep the carbon price below its optimal level, but the emissions externality is the only market failure. I add a second market failure, a network externality, under which marginal price changes may not be the most effective policy.

A second line of work shows that market structure changes the corrective tax. Buchanan (1969) and Barnett (1980) show that the Pigouvian rule overcorrects a polluting monopolist, which already underproduces. Ryan (2012) shows that environmental regulation raised sunk entry costs in the concentrated US cement industry, and Fowlie et al. (2016) show that market power and emissions leakage change the welfare ranking of carbon pricing designs in the same industry. Miller et al. (2017) find that fuel cost pass-through in cement exceeds one and use this estimate to compute the incidence of carbon regulation. Kellogg and Reguant (2021) survey this work. My setting shares the fixed entry costs and strategic entry of Ryan (2012) and Fowlie et al. (2016), but the second distortion is a network externality across two complementary markets.

A third line of work shows that knowledge spillovers and path dependence call for instruments beyond the carbon price. Acemoglu et al. (2012) show in a model of directed technical change that optimal policy combines a carbon tax with research subsidies, and Acemoglu et al. (2016) reach the same conclusion in a model estimated on US energy-sector data. Blanchard et al. (2023) argue for a portfolio of climate instruments. Rodrik (2014) makes the case for green industrial policy, Juhász et al. (2024) review the economics of industrial policy more broadly, and Gerarden et al. (2026) review the evidence on industrial policy in renewable energy. I take the network-effects argument of Greaker and Midttømme (2016) to data and measure both the network externality and the coordination failure in one market.

Work on EVs compares demand-side and supply-side instruments. Li et al. (2017) and Springel (2021) find that subsidies to charging stations raise adoption more per dollar than consumer subsidies. Cole et al. (2023) find abatement costs for charger subsidies below the social cost of carbon. Holland et al. (2016) show that the environmental value of an EV depends on the grid. Québec's grid is almost entirely hydroelectric, so an EV that replaces a gasoline vehicle removes nearly all of its emissions. Cordeau (2026) shows that public provision of fast chargers moves the Québec market out of the low-adoption equilibrium at an implied cost of $47 per ton, and that EV purchase subsidies widen the gap between the low- and high-adoption equilibria. That paper separates the effect of equilibrium selection from the effect of the network externality, but it does not consider a carbon price. None of the other papers uses the carbon price as the benchmark or isolates the effect of equilibrium selection.

# 3 Setting, data, and model

The paper builds on **?**, which estimates a spatial equilibrium model of the Québec EV market. The data combine registrations for every licensed vehicle in Québec (2011–2022), 2.7 million fast-charging sessions on the government network with battery state of charge at each session (2017–2023), and the rollout of private and Tesla stations. Consumers choose a vehicle, a destination, and a charging stop. Network quality enters vehicle choice through the expected value of the trips that a given range makes feasible. A vertically integrated firm builds a proprietary network to sell vehicles, and a fringe of station owners enters under free entry. Entry raises adoption everywhere but competes locally, so the game has multiple equilibria. I compute the Low and High equilibria by iterating best responses from the empty and the full network, and a Big Push equilibrium in which the government first builds its realized 2022 network.

The earlier paper contains the model, the estimation, and three counterfactuals: the Big Push, the EV purchase subsidy, and the removal of Tesla's network. The present paper adds the carbon price counterfactuals below. None of its results appear in the earlier paper.

# 4 Planned analysis

A carbon price $\tau$ per ton raises the present value of fuel costs of a gasoline vehicle by

$$PV(\tau) = \theta \cdot \tau \cdot e \cdot f \cdot k \cdot A(r, T),$$

where $e \approx 2.31$ kg of $CO_2$ per litre of gasoline, $f$ is fuel use per kilometre, $k$ is annual kilometres, $A(r, T)$ is the annuity factor for a vehicle life of $T$ years at discount rate $r$, and $\theta$ is the share of future fuel costs that consumers value at purchase. Because the gasoline vehicle is the outside option in the demand model, $PV(\tau)$ is equivalent to a uniform subsidy on every EV model. Unlike the observed rebate, it has no price cap. I let $\theta$ range from 0.5 to 1 to span estimates of fuel-cost undervaluation (Busse et al., 2013; Allcott and Wozny, 2014; Grigolon et al., 2018). The analysis has two parts.

1. Price schedule. For $\tau$ between \$0 and \$400 per ton, compute the Low and High equilibria and report adoption, private entry, abatement, and welfare, with carbon revenue returned lump sum.

2. Equal-outcome comparison. Find the $\tau$ that matches the adoption gain of the Big Push from the Low equilibrium. Compare this price with carbon prices in place and with a social cost of carbon of \$185 per ton (Rennert et al., 2022), and compare its cost to consumers and its deadweight loss with the \$22.4 million cost of the public network.

# 5 Preliminary evidence

Two results from the earlier paper motivate the comparison. First, the Big Push raises EV adoption by 67% relative to the Low equilibrium at a public cost of \$22.4 million, an implied \$47 per ton of $CO_2$ abated. It generates \$484 million in consumer surplus and \$88 million in

climate benefits. Second, the EV purchase subsidy in place in 2022 does not close the gap between the Low and High equilibria. It nearly doubles it.

A back-of-the-envelope calculation shows why a carbon price is unlikely to do better. A gasoline vehicle driven 15,000 km per year at 8 L/100 km emits about 2.8 tons of $CO_2$ per year. With a 15-year life, a 5% discount rate, and $\theta = 1$, each dollar per ton of carbon price is worth about \$29 per vehicle. A price of \$80 per ton, the level of Canada's federal consumer fuel charge before its removal in 2025, is worth about \$2,300 per vehicle. The combined provincial and federal rebate of \$12,000 in 2022 corresponds to a carbon price of about \$420 per ton, and more if consumers undervalue fuel costs. If a transfer of that size does not select the high-adoption equilibrium, a carbon price at conventional levels is unlikely to. The planned analysis tests this conjecture inside the model.

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