Lessons Learned for Designing Programs to Charge for Road Use, Congestion, and Emissions

Alan Jenn
Institute of Transportation Studies, University of California, Davis

December 2019

POLICY BRIEF

Issue

Driving is associated with a series of costs to society, or externalities. These include road damages, traffic congestion, and vehicle emissions (of both local pollutants and greenhouse gases). A fuel tax has been used in the United States to account for some of these costs, particularly road damage. However, other methods of pricing may be more effective and able to cover a variety of externalities. While several successful programs have been implemented in other countries, very few have been attempted in the United States.

To inform the optimal design of programs to price road use/damage, emissions, and congestion, researchers at UC Davis reviewed published studies, examined existing programs, and investigated potential design choices for such programs.

Key Research Findings

Vehicle pricing programs have been successfully implemented around the world. Mileage-based fees, congestion pricing, and emission fees are already being implemented in various cities and countries, and studies show that almost all of them have been effective in achieving their goals. A brief overview of unique features of each pricing mechanism is below (Figure 1).

Policymakers can base pricing on different types of data and data collection technologies. In designing a program to price a certain externality or set of externalities, fundamental choices must be made. These include: (1) what type(s) of data will be used as the basis of the price (e.g., miles travelled, fuel consumed, time of day, location, etc.); (2) how the data will be collected (e.g., odometer, fuel
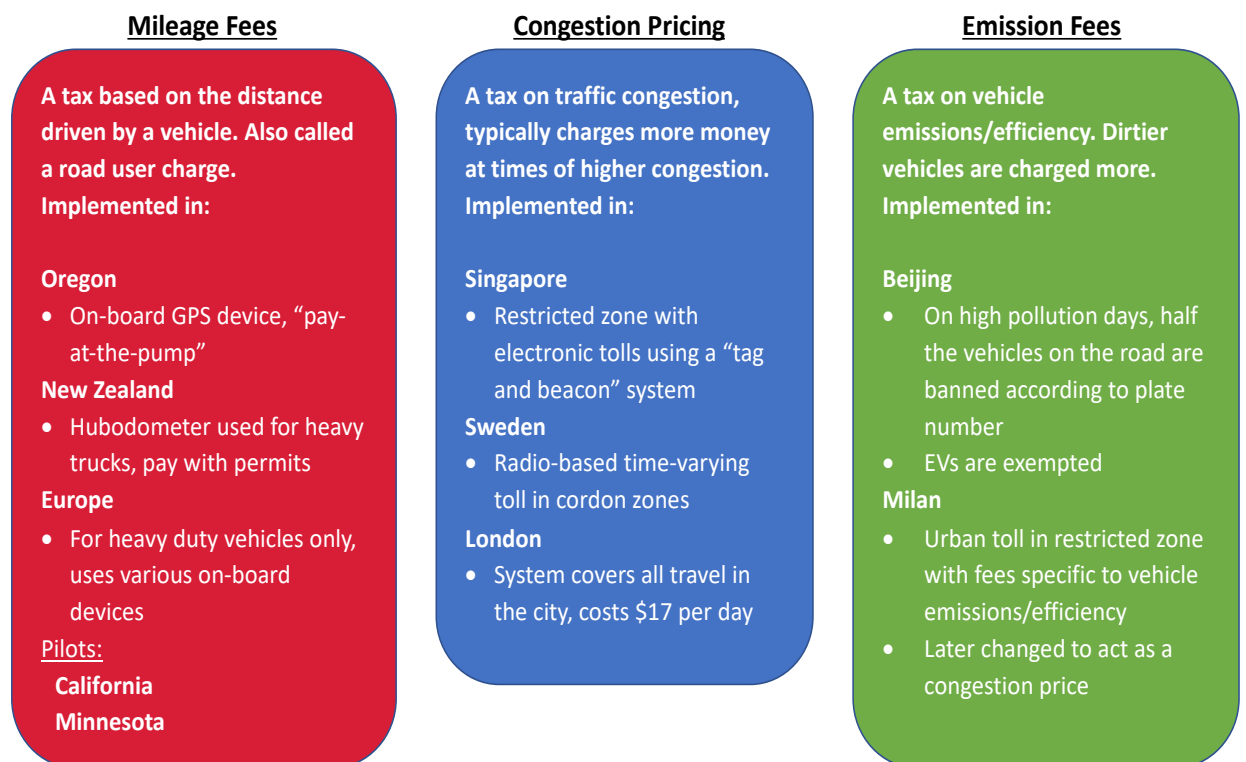
Mileage Fees

A tax based on the distance driven by a vehicle. Also called a road user charge.
Implemented in:

Oregon
- On-board GPS device, "pay-at-the-pump"

New Zealand
- Hubodometer used for heavy trucks, pay with permits

Europe
- For heavy duty vehicles only, uses various on-board devices

Pilots:
  California
  Minnesota

Congestion Pricing

A tax on traffic congestion, typically charges more money at times of higher congestion.
Implemented in:

Singapore
- Restricted zone with electronic tolls using a "tag and beacon" system

Sweden
- Radio-based time-varying toll in cordon zones

London
- System covers all travel in the city, costs $17 per day

Emission Fees

A tax on vehicle emissions/efficiency. Dirtier vehicles are charged more.
Implemented in:

Beijing
- On high pollution days, half the vehicles on the road are banned according to plate number
- EVs are exempted

Milan
- Urban toll in restricted zone with fees specific to vehicle emissions/efficiency
- Later changed to act as a congestion price

Figure 1. Summary of some existing pricing programs.

dispenser, GPS device, etc.); (3) how the data will be transmitted to the administrative entity; and (4) how the fees will be paid. As described below, careful choices for each of these elements (1-4) can serve multiple pricing programs at once, allowing for significant cost savings.

There are opportunities to integrate different pricing mechanisms and save implementation costs. There are substantial overlaps between the data needs of different pricing mechanisms. For example, an on-board GPS device could collect both distance and location data for both a mileage fee and a congestion fee. Choosing technologies that enable multiple pricing schemes can provide significant cost-savings when implementing separate programs (see Figure 2).

The data and data collection metric(s) used for a pricing program should be chosen to allow for as much flexibility as possible. The initial design of a pricing program can affect compatibility with other pricing programs and future innovations, and it may preclude the use of certain data collection technologies. For example, a pricing program to address road damages that is based on fuel consumption would not account for electric vehicles and may not easily integrate with other pricing programs.

Vehicle telematics is one of the few technologies that can fulfill data-collection needs in pricing road use, congestion, and emissions. Vehicle telematics is a technology system integrated in the vehicle that can store, send, and receive information through telecommunications. From a design standpoint, it is an ideal technology to implement a universal pricing program, as it can gather a wide variety of information (e.g., location, mileage, vehicle attributes, energy use). Unfortunately, leveraging vehicle telematics would require automakers to standardize the data collection and transmission system and address potential privacy concerns regarding data sharing.

More Information

This policy brief is drawn from "Lessons Learned for Designing Programs to Charge for Road Use, Congestion, and Emissions," a white paper from the National Center for Sustainable Transportation, authored by Alan Jenn of the University of California, Davis. The full paper can be found on the NCST website at https://ncst.ucdavis.edu/project/implementing-pricing-schemes-meet-variety-transportation-goals.

For more information about the findings presented in this brief, please contact Alan Jenn at ajenn@ucdavis.edu.

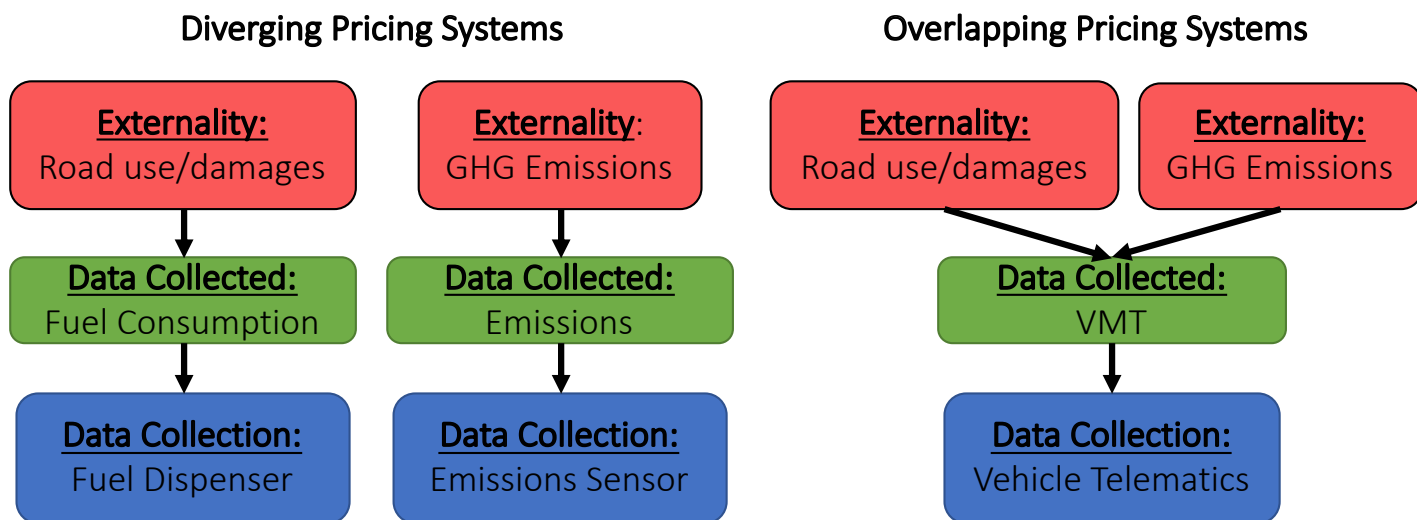## Diverging Pricing Systems
Overlapping Pricing Systems

Figure 2. Choosing a data collection technology (blue box) that is flexible (right side) can provide significant cost-savings when implementing multiple pricing programs. (Note: For calculating and pricing emissions based on VMT, recorded VMT would need to be multiplied by a factor to account for a given vehicle's known fuel efficiency.)