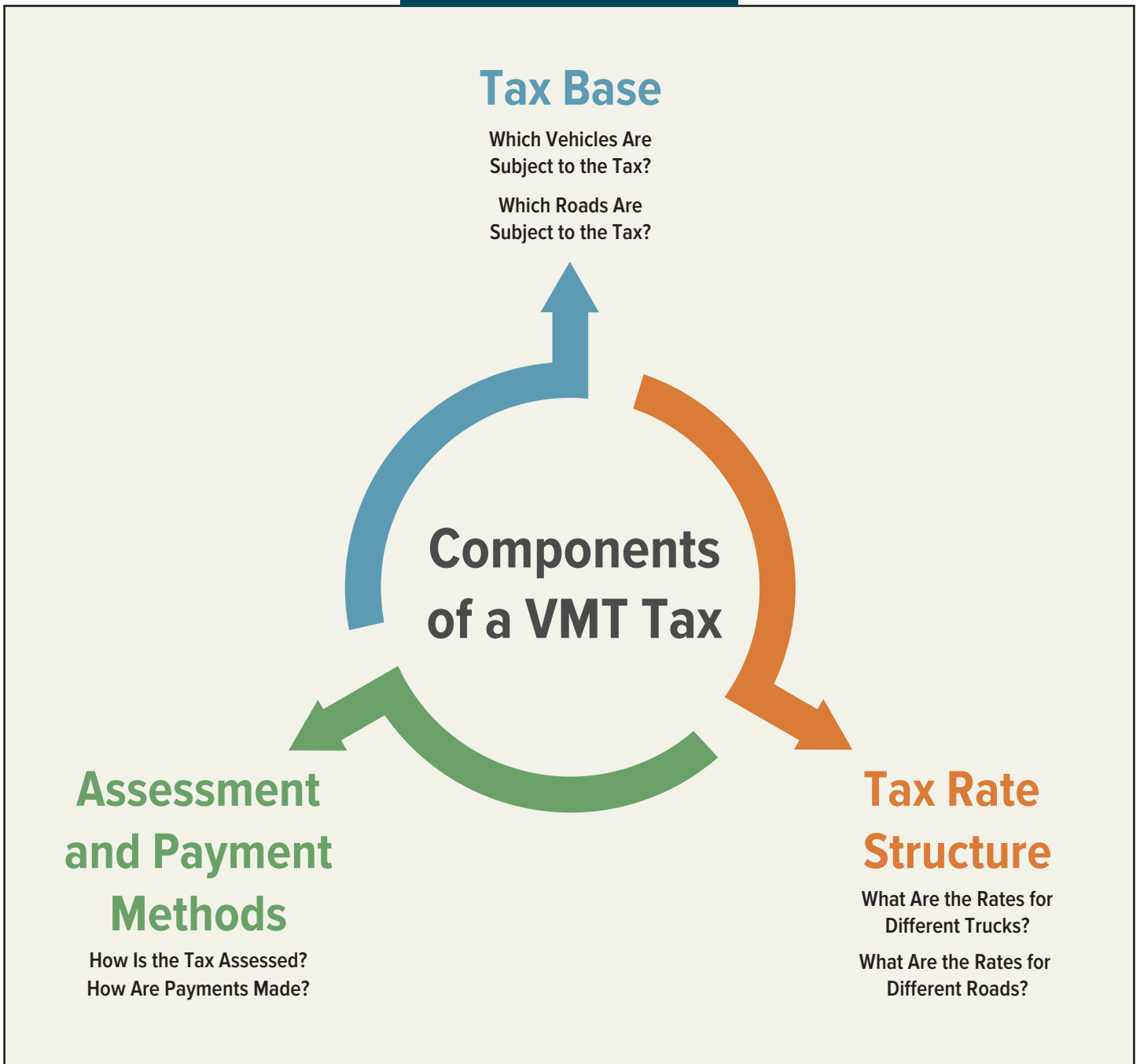


CBO

Issues and Options for a Tax on Vehicle Miles Traveled by Commercial Trucks



OCTOBER 2019

At a Glance

Since 2001, spending from the Highway Trust Fund for highway and transit programs has consistently exceeded revenues from taxes on highway users. The Congressional Budget Office projects that without additional revenues or reductions in spending, the fund will be exhausted by 2022.

This report examines one option for reducing the trust fund's imbalances: a tax on vehicle miles traveled (VMT) by commercial trucks. Kentucky, New Mexico, New York, and Oregon already levy such taxes at the state level. To implement a federal tax, lawmakers would need to determine:

- The tax base—which trucks would be taxed and on which roads the tax would apply;
- The rate structure—whether the tax would be uniformly applied to all trucks or would vary by trucks' configuration, weight, or location; and
- Implementation methods—whether to assess taxes using odometer readings, radio-frequency identification readers (like those in use on many toll roads), or onboard devices such as electronic logging devices.

CBO estimates that in 2017, a tax of 1 cent per mile on all roads would have raised about \$2.6 billion for the trust fund if imposed on all commercial trucks and about \$1.6 billion if imposed only on those with one or more trailers. Revenues would have increased almost proportionally for higher tax rates.

The costs to the government of implementing a VMT tax on trucks are uncertain but would be higher than the costs of the existing tax on diesel fuel. The distributional effects of a VMT tax would be essentially the same as those of the diesel tax, however.



Contents

Summary	1
What Choices Would the Congress Face in Establishing a VMT Tax on Trucks?	1
How Might a Truck VMT Tax Affect the Federal Budget?	3
Would the Distributional Effects of a Truck VMT Tax Differ From Those of the Diesel Tax?	4
Sources of Revenues for the Highway Trust Fund	4
Taxes on Vehicle Miles Traveled by Trucks	5
Examples of Existing Road-User Charges	5
Advantages and Disadvantages of a Federal VMT Tax	7
Design Choices and Their Implications	7
Tax Base	7
Rate Structure	8
Implementation	10
BOX 1. ALLOCATION OF FEDERAL HIGHWAY COSTS TO TRUCKS	12
Implications of the Choices	14
BOX 2. HOURS-OF-SERVICE REQUIREMENTS FOR ELECTRONIC LOGGING DEVICES	15
Illustrative Estimates of Budgetary Effects for 2017	18
The Basis of the Revenue and Tax Rate Estimates	19
Estimated Revenues and Tax Rates	19
Other Budgetary Effects	22
Distributional Effects of Diesel and VMT Taxes for Commercial Trucks	24
Appendix A: Road-User Charges on Commercial Trucks in the United States	27
Appendix B: Road-User Charges on Commercial Trucks in Selected Foreign Countries	31
Appendix C: Modeling Behavioral Responses to Changes in Taxes on Trucks	37
List of Tables and Figures	38
About This Document	39

Notes

Years referred to in discussions of federal revenues and spending are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end.

Numbers in the text, tables, and figures may not add up to totals because of rounding.



Issues and Options for a Tax on Vehicle Miles Traveled by Commercial Trucks

Summary

Historically, most of the funding for U.S. highway programs has come from the Highway Trust Fund (HTF), which is credited with revenues from federal taxes on highway users, including fuel taxes. In almost every year since 2001, spending from the HTF has exceeded those revenues—in 2017, for example, the fund had about \$41 billion in revenues and \$54 billion in outlays. To help cover those shortfalls, the fund has received \$144 billion in transfers, primarily from the Treasury's general fund. The Congressional Budget Office projects that under current law, the HTF will be exhausted by 2022. Sustaining it will require continued transfers from the general fund, reduced spending on highways and transit programs, increases in existing taxes on highway users, new taxes credited to the fund, or some combination of those approaches.

In this report, CBO focuses on one example of a potential new tax: a federal tax on vehicle miles traveled (VMT) by trucks. Kentucky, New Mexico, New York, and Oregon already levy such taxes at the state level. A federal VMT tax on trucks could provide additional revenues to the HTF; it could also substitute for existing taxes on trucks that are credited to the HTF. However, implementing a VMT tax would impose greater costs on the federal government and trucking companies than increasing existing taxes.

What Choices Would the Congress Face in Establishing a VMT Tax on Trucks?

To establish a truck VMT tax, lawmakers would have to consider the tax base, the structure of the tax rates, and how the tax would be implemented. CBO used data on truck traffic in 2017 to analyze how differences in those factors would have affected the revenues generated by a truck VMT tax in that year.

Tax Base. Two key choices about the tax base would be the set of trucks subject to the tax and the set of roads on which travel would be taxed. For illustrative purposes,

CBO analyzed taxes on combination trucks (those with one or more trailers) and on all commercial trucks (defined here as combination trucks and single-unit trucks with six or more tires or an operating capacity—consisting of the vehicle's weight plus its maximum load—exceeding 10,000 pounds). Combination trucks represented 28 percent of commercial trucks in 2017 but accounted for more than 60 percent of the miles traveled by such trucks.

CBO also considered three choices of the road network: all public roads, Interstate highways and other arterial roads, and Interstate highways only. In 2017, travel on Interstates accounted for 41 percent of the miles traveled by all trucks and more than half of the miles traveled by combination trucks.

Structure of the Tax Rates. A uniform tax rate could be applied to all travel by all trucks included in the tax base. Alternatively, the miles traveled by trucks could be taxed at different rates on the basis of one or more factors: vehicle type or configuration (such as single-unit versus combination truck), vehicle weight or weight per axle, and location or location and time of travel.

The structure of the tax rates would affect commercial trucking companies' incentives to use roads efficiently. Rates differentiated by trucks' total weight or weight per axle could potentially help reduce pavement damage; rates differentiated by where (or where and when) travel occurred could potentially help reduce traffic congestion.

Implementation Methods. A key question about a truck VMT tax is how the taxable mileage would be assessed. There are three main options:

- Odometer reading,
- Radio-frequency identification (RFID) readers, or
- Onboard devices.

Table 1.

Characteristics of Assessment Methods for VMT Taxes on Trucks

Assessment Method	Compatible Payment Methods	Potential Road Coverage	Significant Sources of Capital Costs	Relative Enforcement Costs	Compatible With Location-Based Tax Rates?	Current Usage
Periodic odometer reporting	By mail or online	All roads	None	High	No	Used in state VMT tax programs and the IFTA program ^a
Radio-frequency identification readers on road gantries, posts, or collection booths	Through onboard transponder, by mail, or online	Only roads equipped with readers	Purchase and installation of readers and related equipment	Low	Yes	Used in the E-ZPass system and other tolling systems, including Rhode Island's program of tolls for combination trucks; used primarily on bridges, tunnels, and road segments with few access points
Electronic logging devices and other onboard devices	By mail, online, or through the device itself	All roads	Purchase of new or upgraded devices where necessary	Intermediate	Only if devices have high spatial resolution	Widely used by larger carriers to manage fleets; required in most trucks used in Interstate commerce and an estimated one-quarter of all trucks under federal or state hours-of-service rules; increasingly used in the IFTA program ^{a,b}

Source: Congressional Budget Office.

Assessment methods may be used in combination.

IFTA = International Fuel Tax Agreement; VMT = vehicle miles traveled.

a. Under IFTA, fuel taxes paid during trucks' operations in the 48 contiguous U.S. states and 10 Canadian provinces are reallocated among those jurisdictions on the basis of the fuel consumed in each one. Most reporting under IFTA is based on odometer readings.

b. Hours-of-service rules regulate the working hours of truck drivers.

Those options, which could be used exclusively or in various combinations, each have particular advantages and disadvantages in terms of their costs and compatibility with different tax regimes (see Table 1).

- A system based on odometer reading would require little or no capital spending—that is, spending for new equipment or facilities. However, the government's cost for enforcement, to keep evasion at an acceptable level, could be relatively high. Such a system could be used to implement a uniform tax on all miles driven on all roads; it would not allow for taxing a subset of roads or charging different rates by location or time.
- A system based on RFID readers mounted on gantries, roadside pillars, or collection booths (like those used on many toll roads) would facilitate charging different rates by location and would have low costs for enforcement. However, capital costs

would be high because accurate assessment of miles driven would require readers at each access point on taxed roads. Estimated costs for a proposed system for Interstate highways, which have comparatively few access points and represent less than 3 percent of total lane miles, are in the tens of billions of dollars. For a system that covered more roads, costs would be much higher.

- A system based on onboard devices, such as electronic logging devices (ELDs), could be compatible with location-related taxes, depending on the devices' capabilities, and enforcement costs would probably be relatively low. Capital costs would depend on the set of trucks included in the tax base. Roughly one-quarter of all commercial trucks—including most combination trucks—have or will soon have (when state compliance dates have all been reached) ELDs to comply with federal and state rules that regulate drivers' working hours. A tax system that included all

Table 2.

Illustrative Scenarios for a VMT Tax on Trucks, Covering All Public Roads, 2017

Description	All Commercial Trucks Taxed		Only Combination Trucks Taxed ^a	
	Rate (Cents per mile)	Revenues (Billions of dollars)	Rate (Cents per mile)	Revenues (Billions of dollars)
Scenarios Defined by Tax Rate (Shaded)				
1 cent per mile	1.0	2.6	1.0	1.6
5 cents per mile	5.0	12.8	5.0	8.0
Scenarios Defined by Revenue Targets (Shaded)				
Taxed trucks' share of the HTF shortfall in 2017 ^b	1.9	4.8	2.5	4.0
Taxed trucks' share of the HTF shortfall and of fuel taxes paid in 2017	5.6	14.4	7.0	11.3
Taxed trucks' share of the HTF shortfall and of all HTF taxes paid in 2017	7.5	19.4	9.9	16.1

Source: Congressional Budget Office.

HTF = Highway Trust Fund; VMT = vehicle miles traveled.

a. Combination trucks are those with one or more trailers.

b. In 2017, outlays from the trust fund exceeded the tax revenues credited to it by \$13.5 billion. Trucks' share of that shortfall is calculated by dividing the 2017 HTF taxes paid for a given set of trucks by total taxes paid for all vehicles (including passenger vehicles).

trucks would entail capital costs—borne by trucking companies, the federal government, or both—to place devices in the trucks not already using them and, potentially, to upgrade existing devices. If travel on some roads was not taxed or tax rates differed by location, the devices would need to have higher spatial resolution, which would increase those costs.

How Might a Truck VMT Tax Affect the Federal Budget?

CBO estimates that in 2017, taxing travel by all commercial trucks on all public roads at a rate of 1 cent per mile, with a compliance rate of 90 percent, would have generated \$2.6 billion in revenues; taxing travel by combination trucks alone would have generated \$1.6 billion (see Table 2). (Those figures include revenues from miles traveled by trucks, such as those owned by state and local governments, that are exempt from one or more HTF taxes.) By contrast, a tax of 7.5 cents per mile on all commercial trucks would have generated \$19.4 billion. That amount would be enough to replace the \$14.6 billion in HTF taxes paid by truck owners in 2017 plus their proportional share, based on those taxes, of the \$13.5 billion shortfall between the HTF's tax revenues and outlays that year.

For any given tax rate, a VMT tax that excluded local roads would have generated 21 percent less in revenues

if all commercial trucks were taxed and 13 percent less if only combination trucks were taxed. For a tax only on Interstate highways, the corresponding reductions are 59 percent and 47 percent. Those figures do not reflect the possibility that truck owners might divert some of their traffic to untaxed roads.

In CBO's assessment, to the extent that the VMT tax increased the amount of taxes paid by truck owners (rather than substituting for current taxes), two behavioral responses would result: a reduction in overall freight shipments and a shift in some freight traffic from truck to rail. CBO estimates that for the tax rates considered here, those responses would have jointly reduced trucks' mileage in 2017 by amounts ranging from 0.4 percent to 1.6 percent. (CBO's revenue estimates account for those reductions.)

Besides generating revenues, a truck VMT tax would affect the federal budget in two ways. First, the tax would impose costs. Data from Oregon's VMT program indicate that the state's annual costs for processing payments, auditing compliance, and collecting from delinquent accounts are on the order of \$20 per truck. Nationally, that would correspond to roughly \$210 million for a tax on all commercial trucks or \$60 million for a tax on combination trucks alone. However, federal costs could differ from Oregon's because of differences in assessment

and collection methods, differences in auditing efforts, and economies of scale. Capital costs and field enforcement costs would depend on how the tax was implemented and what level of evasion was considered acceptable. As a percentage of revenues raised, implementation costs would be lower for higher tax rates.

Second, a truck VMT tax that generated new revenues would reduce receipts of income and payroll taxes. (Excise taxes like VMT taxes raise costs for businesses in the taxed industry, which must reduce their profits, cut expenses such as payroll costs, or pass the costs of the taxes on to consumers, who then have less money to spend on goods and services from other industries.) To approximate that effect, the staff of the Joint Committee on Taxation estimates an offset percentage for legislative proposals that would raise excise tax revenues. In 2017, the offset was about 26 percent. Under current tax law, it is now about 22 percent.

Would the Distributional Effects of a Truck VMT Tax Differ From Those of the Diesel Tax?

Like the current tax on diesel fuel used by commercial trucks, a VMT tax on those vehicles would affect households primarily through its effect on the prices of shipped goods. Because lower-income households tend to spend a larger share of their income on goods, that effect would be regressive. CBO estimates that if a VMT tax had yielded the same revenues as the diesel tax in 2017, it would have had similar distributional effects: In either case, the tax component of the price of goods would be about 0.06 percent of the income of households in the lowest income quintile (the bottom fifth of the distribution), compared with 0.02 percent for households in the highest income quintile. CBO also estimates that the relative burden of a truck VMT tax on rural and urban households would not be significantly different from that of the diesel tax.

Sources of Revenues for the Highway Trust Fund

The Highway Trust Fund is credited with revenues from several taxes on highway users. Most of those revenues come from two taxes on motor fuels: a tax of 18.4 cents per gallon on gasoline and gasohol (a mixture of gasoline and ethanol) and a tax of 24.4 cents per gallon on diesel fuel.¹ Three other taxes apply only to trucks and

certain other large vehicles: a sales tax of 12 percent on trucks and tractors with a maximum operating capacity (known as a gross vehicle weight rating, or GVWR) of more than 33,000 pounds and on trailers with a GVWR above 26,000 pounds; an annual heavy-vehicle use tax of \$100 to \$550 on trucks registered as operating at 55,000 pounds or more; and an excise tax on tires with a maximum load capacity above 3,500 pounds.² The trust fund has separate accounts for highway and transit programs. Both are credited with revenues from the fuel taxes; the other taxes are credited to the highway account.

Together, the gasoline and diesel taxes yielded close to 90 percent of the \$40.9 billion in revenues credited to the trust fund in fiscal year 2017. Of that amount, \$25.9 billion (64 percent) came from gasoline taxes and \$9.8 billion (24 percent) from diesel fuel taxes.³ The three taxes that apply to trucks and other large vehicles generated revenues totaling \$5.2 billion. The HTF was also credited with \$0.5 billion in interest on the balances in the fund and other revenues (see Figure 1).

Since 2001, the fund's revenues have consistently fallen short of its outlays; in 2017, the difference amounted to \$13.5 billion. That trend continues through 2029 in CBO's baseline budget projections, which incorporate the assumption that current laws will generally remain unchanged (see Figure 2). Initially, the difference between revenues and outlays was covered with funds from a substantial surplus that had accumulated in the fund during the 1980s and 1990s; in 2008, the Congress began authorizing transfers to the HTF from other sources, primarily the Treasury's general fund, to support approved spending levels. The most recent transfer was \$70 billion, authorized in 2015 by the Fixing America's Surface Transportation (FAST) Act.

Over the next decade, revenues from the gasoline tax are projected to fall as vehicles' fuel efficiency increases because of stricter fuel-economy standards, vehicle

1. Both of those tax rates include a 0.1-cent-per-gallon excise tax that is credited to the Leaking Underground Storage Tank Trust Fund, not the Highway Trust Fund.

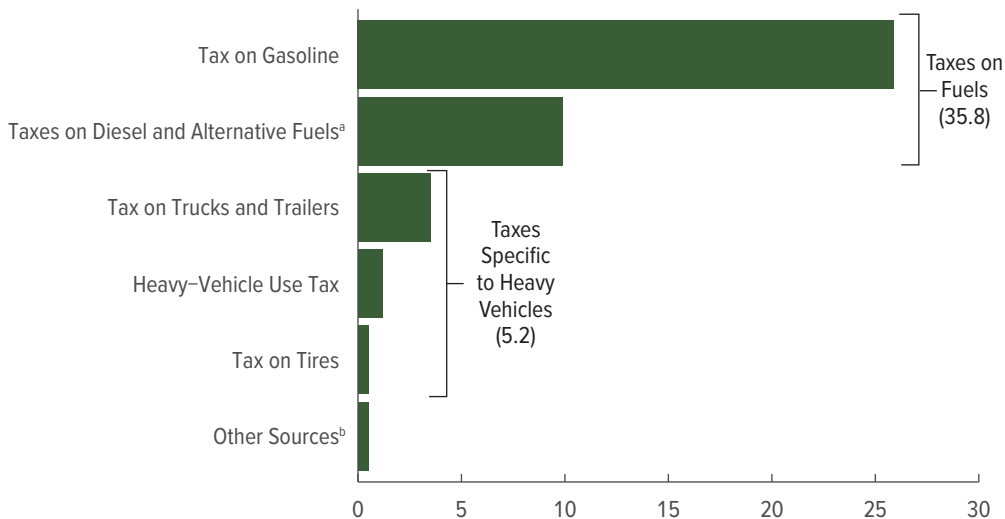
2. Tires are taxed at a rate of 9.45 cents (or 4.725 cents for bias-ply and super single tires) for each 10 pounds of maximum capacity above 3,500 pounds.

3. Another \$0.1 billion came from taxes on a set of fuels designated as "alternative" or "special," including propane, butane, and compressed or liquefied natural gas.

Figure 1.

Sources of Revenues Credited to the Highway Trust Fund, 2017

Billions of Dollars



Source: Congressional Budget Office, using data from the Internal Revenue Service and the Federal Highway Administration.

a. Includes \$0.1 billion in revenues from taxes on propane, butane, compressed natural gas, and liquefied natural gas.

b. Consists of \$0.4 billion in interest income and \$0.1 billion in other income, primarily intragovernmental transfer funds—that is, funds transferred to the Highway Trust Fund from other governmental budgetary accounts.

turnover, and greater use of hybrid and all-electric vehicles.⁴ Specifically, in CBO's projections, annual revenues credited to the HTF fall by about \$1 billion between 2019 and 2029, largely because of an 11 percent reduction in gasoline tax revenues. (By contrast, projected revenues from the diesel tax fall by 2 percent, and projected revenues from the three truck-specific taxes increase by 29 percent.) In line with statutory rules, CBO's projections incorporate the assumption that highway and transit spending from the trust fund will increase at the rate of inflation. As a result, the trust fund's annual shortfall is projected to grow from \$12 billion to \$26 billion over the next 10 years, and the trust fund is projected to be exhausted by 2022 unless it receives additional support.⁵

4. Estimates of future sales of electric vehicles (which are focused on passenger vehicles, not trucks) vary widely. For a comparison of three projections, see Jeffrey Rissman, "The Future of Electric Vehicles in the U.S." (Energy Innovation, September 2017), <https://tinyurl.com/y264c23s> (PDF, 766 KB).

5. Congressional Budget Office, "Baseline Projections for Selected Programs: Highway Trust Fund Accounts" (May 2019), www.cbo.gov/publication/51300.

Lawmakers could balance the HTF's revenues and spending by reducing spending on highway and transit programs, by continuing to authorize transfers from the general fund, or by increasing revenues credited to the fund from existing taxes on road users. Another option would be to institute a new federal tax on highway users, such as a tax on electric vehicles or on vehicle miles traveled.

Taxes on Vehicle Miles Traveled by Trucks

Proposals for a tax on vehicle miles traveled have gained increased interest in recent years. Such taxes—also called mileage-based user fees or road-user charges—are currently assessed on trucks in several states and a number of other countries. A federal VMT tax would generate funds that could be used to increase revenues to the HTF, reduce or replace current taxes, or both, and it could have other advantages as well. However, the costs of implementing a tax on miles traveled would be higher than the costs of increasing current fuel taxes.

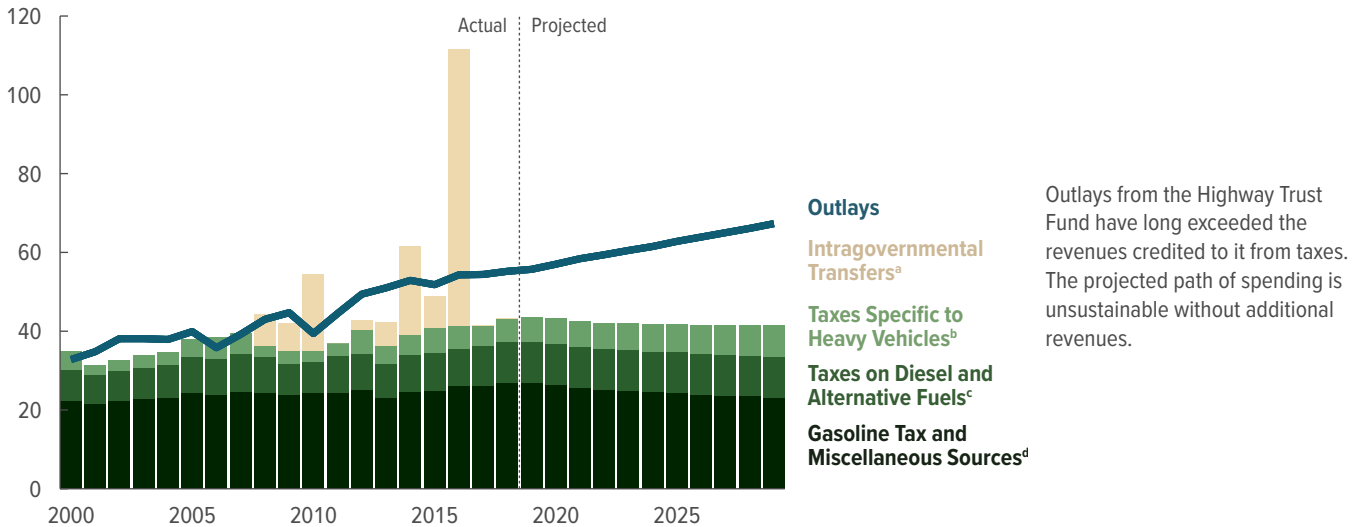
Examples of Existing Road-User Charges

Four states have mandatory VMT taxes, which apply only to commercial trucks: Kentucky, New Mexico,

Figure 2.

Revenues and Outlays of the Highway Trust Fund, 2000 Through 2029

Billions of Dollars



Source: Congressional Budget Office, using data from the Federal Highway Administration.

Projected outlays and revenues are from CBO's May 2019 baseline.

- Intragovernmental transfers are transfers of funds from other governmental budgetary accounts (primarily the Treasury's general fund) to the Highway Trust Fund. The most recent transfer, \$70 billion, was authorized by the Fixing America's Surface Transportation Act.
- Taxes specific to heavy vehicles consist of the heavy-vehicle use tax, the tax on tires, and the tax on trucks and trailers.
- Alternative fuels include propane, butane, compressed natural gas, and liquefied natural gas. Revenues from taxes on those fuels comprised less than 1 percent of the total for this category over most of the 2000–2018 period. In CBO's projections, that share increases during the 2019–2029 period but remains under 3 percent.
- Actual amounts (through 2018) include revenues from interest, fines and penalties, and other sources. Projected amounts include revenues from interest (only through 2021) and from fines and penalties (through 2029).

New York, and Oregon (see Appendix A). (Seven other states had truck VMT taxes in the past but repealed them—in some cases, at least partly because of evasion rates estimated at 25 percent or more.) Kentucky charges a flat rate of about 3 cents per mile; the other three states charge rates that vary by trucks' weight, ranging from about 1 cent to 29 cents per mile. (Oregon has the highest rates, but vehicles subject to the tax are generally exempt from the state's fuel tax.)

Two states have more limited programs of road-user charges for trucks. Illinois has a voluntary VMT tax program for trucks operating within the state only: Participants pay a lower annual registration fee and are charged rates ranging from about 3 cents to 28 cents for each mile in excess of a yearly allotment. Of 10,690 participants in 2018, only 1,285 (12 percent) exceeded their allotment in 2018. Rhode Island has begun a program

to collect tolls from combination trucks—those with at least one trailer or semitrailer—at 12 locations, mostly on Interstate highways; the program acts like a VMT tax for through traffic using the tolled roads.

State programs for VMT taxes on passenger vehicles are in earlier stages. Oregon has a voluntary program; participants pay 1.7 cents per mile in exchange for credits for state fuel taxes, which results in savings for drivers of vehicles that get less than 20 miles per gallon and net costs for drivers of vehicles that get more than 20 miles per gallon. Other states have experimented with pilot programs.⁶ In addition, the I-95 Corridor Coalition conducted multistate pilot programs involving small

6. For an overview of state pilot programs and studies, see Mileage-Based User Fee Alliance, "Mileage-Based User Fees by Region" (accessed April 16, 2019), www.mbufa.org/where.html.

numbers of cars and trucks; the latter investigated whether equipment and systems currently in use could support the collection of a mileage-based user fee.⁷

A number of other countries have implemented road-user charges for trucks (see Appendix B). Those charges are typically higher, on a per-mile basis, than VMT taxes in the United States. For example, the German program (the largest in terms of revenues) charges rates equivalent to 19 cents to 54 cents per mile.

Advantages and Disadvantages of a Federal VMT Tax

Beyond generating revenues for the HTE, a federal VMT tax on commercial trucks could have other potential advantages. Depending on how it was implemented, the tax could reduce pavement damage or traffic congestion by giving truck owners incentives to change what kinds of trucks they used or where or when they drove. In addition, it would provide experience with technological, administrative, and policy issues that could shed light on the feasibility of a VMT tax for passenger vehicles.

A key disadvantage of a VMT tax on trucks would be its costs, including initial setup costs and ongoing collection and enforcement costs. Whereas gasoline and diesel taxes can be administered at low cost because they are collected from a small number of firms (the taxes are assessed at roughly 1,300 fuel distribution terminals nationwide, and the number of distinct firms is smaller), a VMT tax would be collected from truck owners and thus would have a larger share of its gross revenues offset by implementation costs.⁸

A VMT tax could also have disadvantages for the trucking industry and consumers. If it increased total taxes assessed on truckers (rather than substituting for existing taxes), it would cause a shift of some freight shipments to rail and would increase the prices households paid for shipped goods. Depending on how it was implemented (for example, if drivers' travel was tracked), it could also raise privacy issues.

Design Choices and Their Implications

Imposing a federal tax on miles traveled by commercial trucks would require policymakers to make choices about which trucks would be taxed on which roads, what the structure of the tax rates would be, and how the tax would be implemented (see Figure 3). Not all of the potential choices are mutually compatible. In particular, some choices about the tax base and rate structure would rule out certain choices about implementation methods. Each choice would have implications for costs to the federal government and the trucking industry, the efficiency of trucks' road use, and truck drivers' privacy.

Tax Base

Policymakers would need to specify the set of vehicles subject to the tax and the set of roads on which their travel would be taxed. Many choices could be made on both of those dimensions; for this analysis, CBO considered the following illustrative possibilities:

- The set of vehicles subject to the tax could be all commercial trucks, defined as vehicles with six or more tires or a gross vehicle weight rating of at least 10,000 pounds, or only combination trucks (see Figure 4).⁹
- The set of roads on which travel would be taxed could be all public roads, Interstate highways and arterial roads (as classified by the Federal Highway Administration, or FHWA), or Interstate highways only.¹⁰

Revenues from a tax that did not cover all trucks on all roads would be affected by the concentration of miles traveled by taxed vehicles on taxed roads. In 2017, for example, combination trucks represented 28 percent of total commercial trucks but accounted for 63 percent of truck travel on all roads, and Interstates represented less than 3 percent of lane miles but carried 41 percent

7. The I-95 Corridor Coalition includes transportation agencies, toll authorities, and other organizations along the I-95 corridor, which runs from Maine to Florida. (For details, see i95coalition.org.)

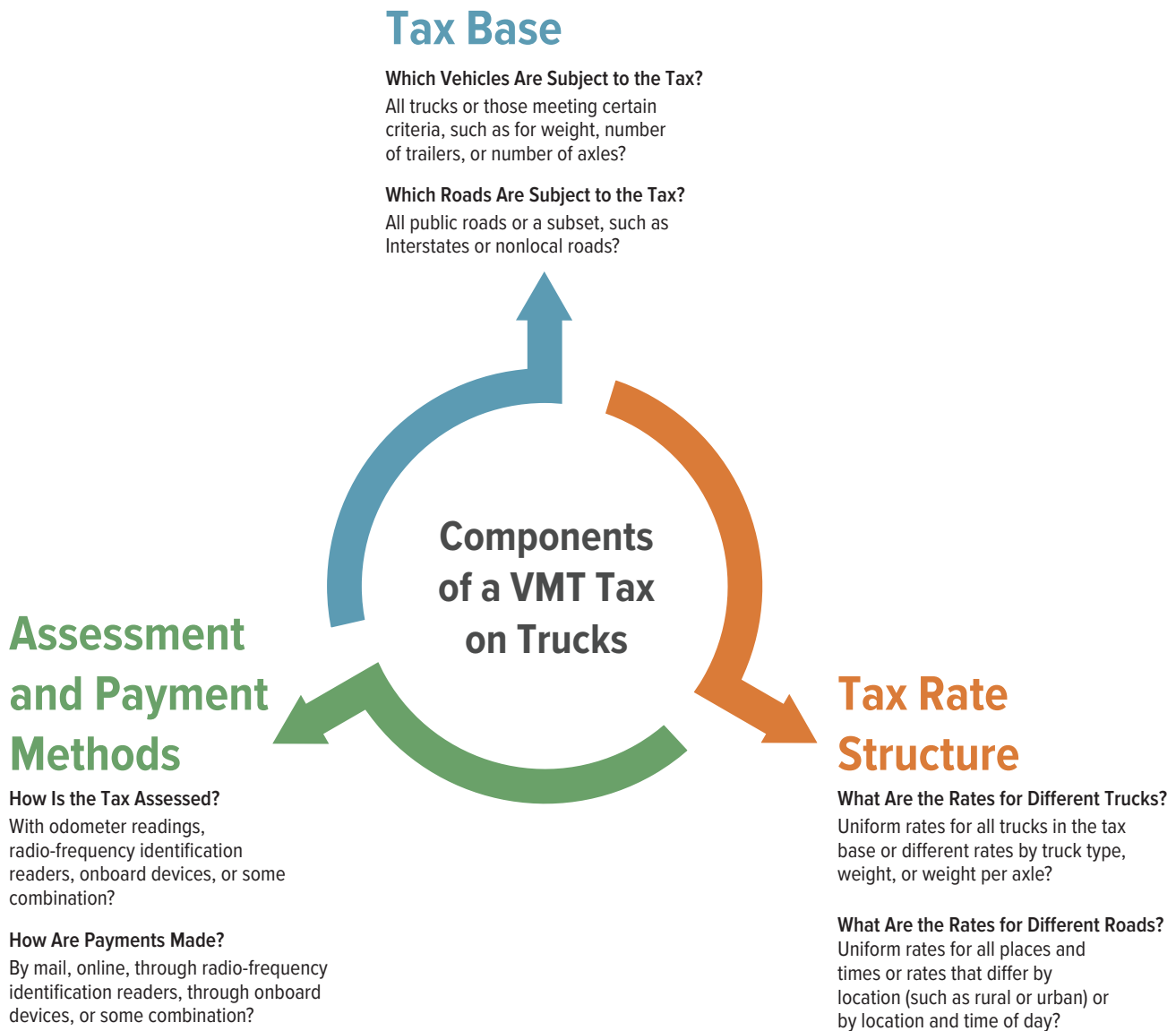
8. Internal Revenue Service, "Terminal Control Number (TCN)/ Terminal Locations Directory" (accessed September 10, 2019), <https://go.usa.gov/xV5PB>.

9. That definition includes some heavier vans and pickup trucks. Existing state VMT tax programs include both single-unit trucks and combination trucks but use higher weight thresholds—18,001 pounds (New York), 26,001 pounds (New Mexico and Oregon), and 60,001 pounds (Kentucky).

10. FHWA's main road classifications are Interstates, other arterials (including freeways and expressways), collectors (which connect local roads with arterial roads), and local roads. See Federal Highway Administration, "Highway Functional Classification Concepts, Criteria and Procedures" (accessed May 20, 2019), <https://go.usa.gov/xVgCA>.

Figure 3.

Considerations in Designing a VMT Tax on Trucks



Source: Congressional Budget Office.

VMT = vehicle miles traveled.

of all truck traffic. By itself, the combined category of Interstate miles traveled by combination trucks accounted for one-third of all truck travel on all roads (see Table 3).

Certain categories of vehicle uses and owners could be exempted from the tax. For example, state and local governments are exempt from all HTF taxes except the tax on tires, and nonprofit educational institutions are

subject only to the tire tax and the heavy-vehicle use tax. CBO did not consider such exemptions in its analysis.

Rate Structure

Policymakers could choose to tax all travel by all trucks included in the tax base at a uniform rate or to differentiate the rates in one or more of the following ways:

Figure 4.

Taxable and Exempt Trucks in CBO's Analysis

Taxed in All Scenarios



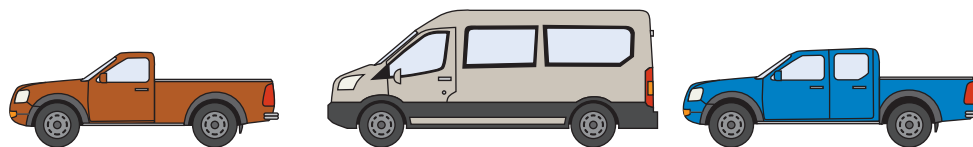
Combination (tractor-trailer) trucks with any number of axles, in any configuration

Taxed in Some Scenarios

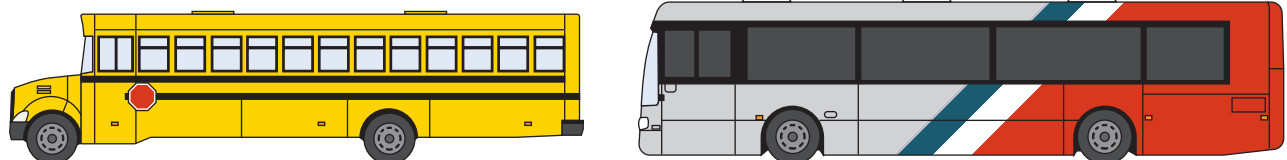


Single-unit trucks, including box and pickup trucks, above 10,000 pounds or with six or more tires

Exempt



Trucks weighing less than 10,000 pounds and with four tires, including most vans and pickup trucks



Buses, including school buses and municipal buses



Motor homes

Source: Congressional Budget Office.

Table 3.

Miles Traveled, by Type of Commercial Truck and Type of Road, 2017

	Single-Unit	Combination ^a	All
Miles Traveled (Billions)			
Interstates	24	95	120
Interstates and Arterials	71	158	228
All Roads	108	181	289
Share of All Miles Traveled (Percent)			
Interstates	8	33	41
Interstates and Arterials	24	54	79
All Roads	37	63	100

Source: Congressional Budget Office, using data from the Federal Highway Administration.

a. Combination trucks are those with one or more trailers.

- By truck type or configuration (for example, charging different rates for single-unit and combination trucks),
- By total truck weight or weight per axle, or
- By travel location (for example, distinguishing travel on rural and urban roads) or both location and time. (Leaving some roads, such as local roads or non-Interstates, out of the tax base is a form of differentiation by location, with a “tax rate” of zero on the excluded roads.)

Differentiated tax rates could potentially account for the costs imposed by different trucks on different roads. (For information about those costs, see Box 1.) As discussed below, differentiated rates could also potentially increase the efficiency of road use by providing incentives for carriers to reduce pavement damage or traffic congestion.

The four states with mandatory VMT taxes differ in the sets of trucks they tax and in their rate schedules, but the taxes have some commonalities as well. Kentucky taxes the narrowest range of trucks—only those with registered weights of more than 60,000 pounds—and it is the only state that charges a flat rate, 2.9 cents per mile. However, that rate is roughly in the middle of the range of rates charged by New Mexico and New York (see Figure 5). Oregon has the highest rates (again, it is the only state in which truck owners who pay the VMT tax generally do not pay the state fuel tax), but the effect of truck weight

on tax rates in Oregon is similar to that in New Mexico and New York. For example, in all three states, trucks with gross weights between 78,001 and 80,000 pounds are charged three to four times as much as trucks with gross weights between 26,001 and 28,000 pounds.¹¹ Oregon’s rates for trucks that weigh more than 80,000 pounds also depend on the number of axles; trucks weighing between 80,001 and 98,000 pounds with nine axles are charged roughly 25 percent to 35 percent less than trucks of the same weight with five axles, for example.¹²

Implementation

Establishing a VMT tax on trucks would require methods for assessing the miles traveled and collecting the amounts owed. There are three main options, each of which is already used in some other contexts (see Table 1 on page 2):

- Assessment via odometer reading, either self-reported by truck owners or inspected by government officials or authorized agents, coupled with payment by mail or online;
- Automated assessment via external radio-frequency identification readers mounted on gantries, roadside pillars, or collection booths, coupled with payment through onboard transponders or by mail; and
- Automated assessment through onboard devices that track and report mileage, such as electronic logging devices, coupled with payment by mail, online, or through the device itself.

In some cases, the methods may be used in combination. For example, Oregon uses a mix of self-reported

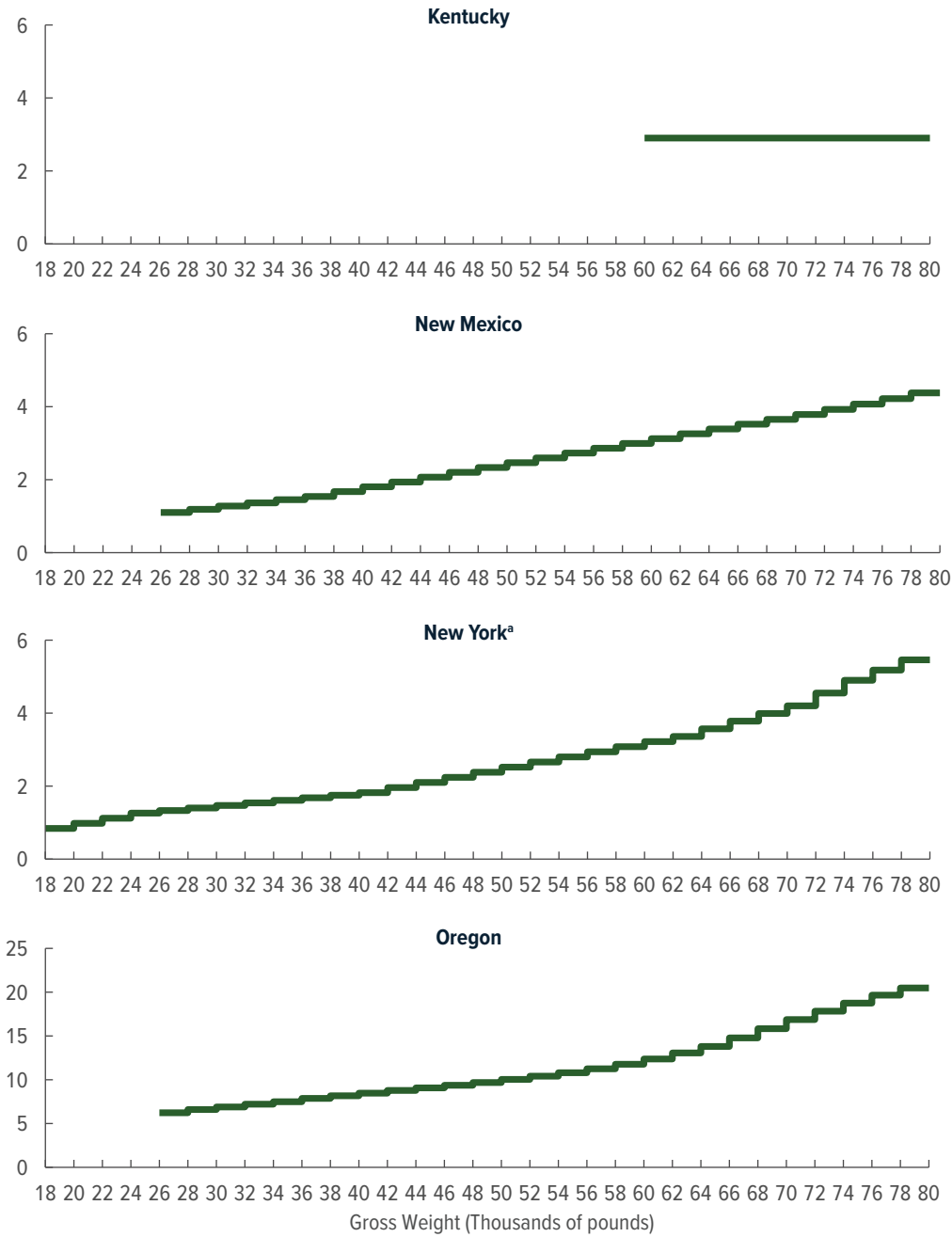
11. The weight classes are defined in terms of gross weight, which is the sum of a vehicle’s weight and the maximum load to be carried during its registration period. (By contrast, GVWR includes the maximum load a vehicle is able to carry.) States’ rate schedules may reflect estimates of the extent to which trucks operate at weights below their gross weight; for example, see Oregon Department of Economic Analysis, *Highway Cost Allocation Study: 2017–2019 Biennium* (prepared by ECONorthwest, 2017), Chapters 6 and 7, www.oregon.gov/das/oea/pages/hcas.aspx.

12. The federal gross weight limit for trucks is 80,000 pounds; however, there are state-specific exceptions. New Mexico, New York, and Oregon allow trucks to have a gross weight of up to 86,400 pounds, 143,000 pounds, and 105,500 pounds, respectively, on some roadways. See 23 C.F.R. §658, Appendix C (2019).

Figure 5.

State VMT Tax Rates for Commercial Trucks

Cents per Mile



Unlike Kentucky's flat rate, the rates in New Mexico, New York, and Oregon increase in similar proportions as trucks' weight increases—although Oregon's rates are much higher.

Source: Congressional Budget Office, using information from state taxation and transportation agencies.

Gross weight is the combined weight of truck, trailer, and the maximum load carried during the registration period.

VMT = vehicle miles traveled.

a. New York offers carriers a choice of two rate schedules. The rates shown are based on the gross weight schedule and apply to loaded miles only (unloaded miles are charged at lower rates); the other rate schedule is based only on trucks' unloaded weight, excluding the weight of any trailers.

Box 1.

Allocation of Federal Highway Costs to Trucks

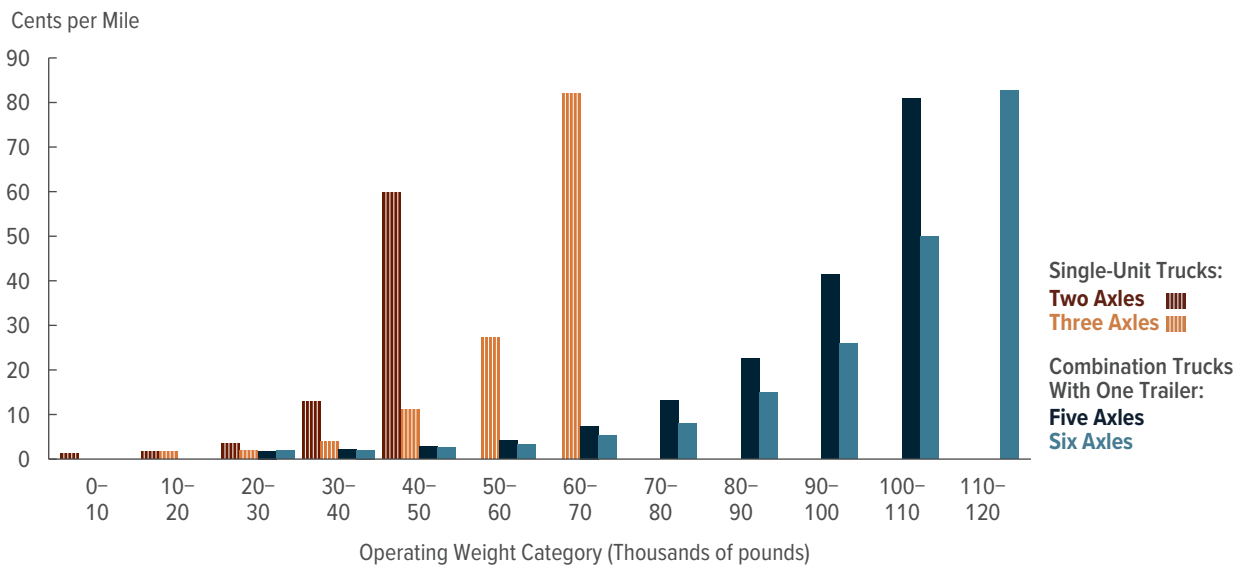
The Federal Highway Administration produced highway cost-allocation studies in 1982 and 1997 that shed light on the federal costs associated with various groups of trucks, as well as other vehicles. The 1997 study took a “cost-occasioned” approach, assigning the responsibility for all projected Highway Trust Fund spending in 2000 to different sets of road users.¹ (Most of that spending is in the form of grants to states, which carry out various highway and transit projects.)

The study considered various categories of costs, including costs for pavement and bridges, which collectively accounted

for 65 percent of highway costs (or 57 percent of total highway and transit costs) and result in large part from vehicles with the heaviest weights per axle. For a given vehicle configuration and number of axles, total allocated costs for pavement and bridges rise sharply as operating weight increases (see the figure below). For example, moving from a range of 20,000 to 30,000 pounds to a range of 30,000 to 40,000 pounds almost quadruples the estimated costs for a single-unit truck with two axles, from 3.5 cents to 12.9 cents per mile. Moving up again to a range of 40,000 to 50,000 pounds further increases the costs by almost 5 times, to 59.9 cents (or 17 times the cost for a similar truck between 20,000 and 30,000 pounds). Conversely, increasing the number of axles reduces the costs, often dramatically. For example, adding a third axle to that 30,000- to 40,000-pound single-unit truck reduces the cost by about 70 percent, from 12.9 cents to 4.0 cents per mile.

1. Federal Highway Administration, *1997 Federal Highway Cost Allocation Study: Final Report* (August 1997), Part V, www.fhwa.dot.gov/policy/hcas/final/toc.cfm. An alternative approach, marginal-cost pricing, focuses not on allocating federal costs but on estimating the incremental, or marginal, cost to society of driving a vehicle an additional mile. For more details, see Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), www.cbo.gov/publication/22059.

Estimated Federal Costs for Pavement and Bridges Imposed by Selected Trucks, by Type of Truck, Number of Axles, and Operating Weight Category



Source: Congressional Budget Office, using data from the Federal Highway Administration.

Values in this figure are based on the Federal Highway Administration’s allocations of federal costs for new construction and rehabilitation of roads and bridges in 2000. Amounts were converted to 2017 cents using the gross domestic product price index.

Continued

Box 1.

Continued

Allocation of Federal Highway Costs to Trucks

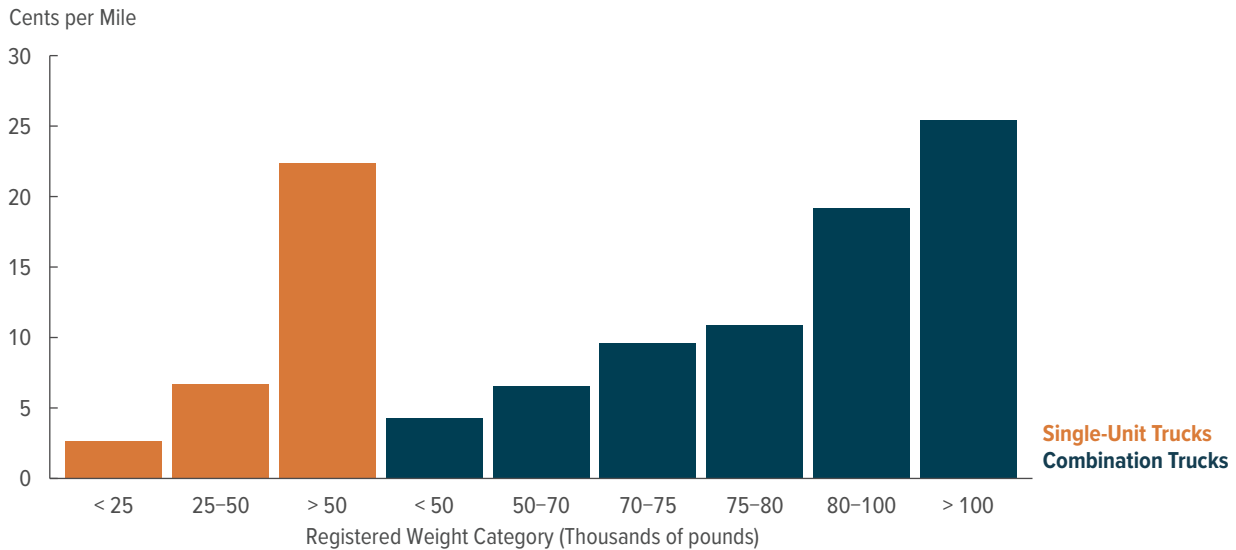
The per-mile costs shown in that figure rise more sharply with trucks’ weight than do states’ VMT tax rates (see Figure 5 on page 11). Several factors help explain why:

- The allocated federal costs are differentiated by vehicles’ number of axles. In contrast, the VMT tax rates reflect the average number of axles at each weight level, and on average, trucks that weigh more have more axles, which reduces the damage to roads.
- The VMT tax rates are based on gross weight, a figure that is provided at registration and specifies the maximum weight at which a vehicle will operate during the registration period, whereas the allocated federal costs are based on actual operating weight. A truck that does not always operate at its maximum weight does less damage than that maximum would suggest.

- Other costs that states may take into account when setting their tax rates, such as traffic management and noise abatement, are affected less by trucks’ weight.

Other estimated cost allocations from the Federal Highway Administration study are more directly comparable to the states’ tax rates in that they group all trucks as either single-unit or combination, are based on registered weight, and include all categories of spending from the Highway Trust Fund—including enhancements for safety, traffic management, and the environment (see the figure below). The estimated allocations range from 3 cents to 22 cents per mile for single-unit trucks and from 4 cents to 25 cents per mile for combination trucks. Like the state tax rates, those allocated costs are less weight-sensitive than the allocated pavement and bridge costs in the previous figure.

Estimated Total Federal Costs Imposed by Trucks, by Type of Truck and Registered Weight Category



Source: Congressional Budget Office, using data from the Federal Highway Administration.

Values in this figure are based on the Federal Highway Administration’s allocations of total federal costs—including system enhancements related to safety, environmental, or other operational objectives, transit programs, and administration—in 2000. Amounts were converted to 2017 cents using the gross domestic product price index.

odometer readings and automated ELD reports; so does the International Fuel Tax Agreement (IFTA) program, under which fuel taxes paid in the 48 contiguous U.S. states and 10 Canadian provinces are reallocated among those jurisdictions on the basis of the fuel used in each one.¹³ Some European countries require onboard units for domestic carriers but allow foreign carriers to self-report distance traveled, and New Zealand uses ELDs to levy taxes on trucks but also allows for paper licenses (prepaid permits for 1,000 kilometers of travel) that can be verified using odometer readings (see Appendix B).

Odometer Readings. The four states with mandatory truck VMT taxes already in place (Kentucky, New Mexico, New York, and Oregon) exclusively or predominantly use truck owners' periodic self-reports of odometer readings to assess taxes owed. Interstate carriers have also traditionally used their own odometer readings in filing IFTA reports, although the use of ELDs and other electronic devices is becoming more common.

RFID Readers. Increasingly, state and local governments have begun using RFID technology to collect tolls from trucks and other vehicles. Rhode Island's new tolls on combination trucks will be collected using RFID readers on gantries at 12 locations in the state. Many other toll roads use RFID systems, and some have eliminated cash collections entirely.¹⁴ An example is the Massachusetts Turnpike, on which video cameras read the license plates of vehicles without RFID transponders, with billing and payment handled by mail or online. Connecticut is considering implementing a similar system of tolls on a number of its Interstates and other major highways.

13. Trucks must have IFTA licenses if they are operated in more than one member state or province and have three or more axles or a GVWR of more than 26,000 pounds. Carriers file quarterly returns with which the tax or refund for each jurisdiction is calculated. For each jurisdiction, tax is due when the fuel consumed (calculated on the basis of reported mileage and average fuel efficiency for the reporting period) exceeds the fuel purchased in that jurisdiction, and a refund is due if the fuel purchased exceeds the fuel consumed.

14. The most widely used RFID system in the United States is the E-ZPass system, which allows for electronic toll collection across 17 states, mostly in the Northeast and Mid-Atlantic regions of the country. Other systems that operate across multiple states include the TxTag network in Texas, Oklahoma, and Kansas and the SunPass network in Florida, Georgia, and North Carolina. Bestpass offers truck owners a transponder that reportedly works on 95 percent of all U.S. toll roads.

Onboard Devices. ELDs are already common in commercial trucks operated by large carriers. Moreover, federal rules governing working hours for truck drivers, known as hours-of-service regulations, will generally require trucks used in interstate commerce to have such devices by the end of 2019 (see Box 2). Once compatible state rules for intrastate drivers have all gone into effect, an estimated 28 percent of commercial trucks, including most combination trucks, will be covered at either the federal or state level.

Although onboard devices such as ELDs and GPS systems are not currently used to report VMT data directly to states, they are increasingly used to automatically report such data (and data on fuel purchases) to company offices or third-party service providers to generate reports for compliance with IFTA. Smartphones could potentially also be used by truck operators to submit odometer information, although unlike other devices, they would not be installed or collect information continuously. (Private companies have created smartphone applications that integrate verification of odometer readings, automatic billing, and remittances; so far, though, such applications have been used only in pilot studies of VMT taxes for passenger vehicles.)

Implications of the Choices

Various design choices would have implications for the feasibility of other choices, for costs to the federal government and the trucking industry, and, potentially, for the efficiency of road use, for state and local governments, and for privacy.

Feasibility of Other Design Choices. A federal tax that did not cover travel on all roads or that differed by location (or location and time) would not be compatible with all assessment methods. In particular, such a tax could not be assessed reliably through periodic odometer readings. (The four states that levy VMT taxes on trucks use that approach but, with limited exceptions, apply the same tax rates to all in-state miles.)¹⁵ One problem would be the cost to carriers of keeping records of mileage charged at different rates. More importantly, because mileage reports could not be reliably verified, enforcement would be difficult, and carriers would have little

15. Carriers are allowed to subtract miles driven on nonpublic roads (such as on farms, military bases, and company property) from their odometer reports, and New York exempts miles traveled on the state's thruway, where tolls are charged.

Box 2.**Hours-of-Service Requirements for Electronic Logging Devices**

As of December 17, 2019, federal rules that limit the working hours of truck drivers, known as hours-of-service regulations, will generally require the use of electronic logging devices (ELDs) in commercial trucks used in interstate commerce and certain intrastate trucks.¹ Manufacturers of ELDs self-certify their devices as compliant with federal specifications. The Federal Motor Carrier Safety Administration (FMCSA) maintains a list of such devices that currently includes more than 450 models.²

There are three categories of exceptions to the federal ELD requirement. First, drivers of some types of vehicles are exempt from federal hours-of-service rules. Among those vehicles are utility service vehicles, pipeline welding trucks, and vehicles used in certain agricultural operations.³

Second, some vehicle use that is covered by hours-of-service regulations can be reported using time cards, which provide less detailed information than the “records of duty” (RODs) required otherwise. Drivers may use time cards if they are operating a vehicle within 100 miles of their normal work reporting location, provided that certain requirements about duty hours are met; that range extends to 150 miles if they are operating a vehicle that does not require a commercial driver’s license.⁴

Third, certain drivers who must file RODs may continue to do so using paper documents rather than ELDs. Such drivers are those who use RODs no more than 8 days during any 30-day

period, drive a vehicle that is itself the commodity being delivered, or drive vehicles with model years before 2000.

According to FMCSA’s estimates, 2.9 million drivers are subject to either the federal ELD rule or a compatible state rule.⁵ FMCSA regulations generally apply not only to trucks used in interstate commerce but also to those used to carry hazardous materials in intrastate commerce. States must have compatible hours-of-service regulations for other trucks used in intrastate commerce to be eligible for Motor Carrier Safety Assistance Program grants; however, they may generally exempt trucks with gross weights of up to 26,000 pounds.

The 2.9 million figure contrasts with CBO’s estimate of 10.5 million commercial trucks registered in 2017.⁶ Several factors help explain the difference. Truck drivers not subject to any ELD requirement include those falling under any of the three federal exemptions (for example, FMCSA estimates that 3 million such drivers can file time cards instead of RODs); those driving intrastate vehicles under 26,001 pounds that are exempted under state waivers; and those who are not subject to FMCSA regulations at all, such as drivers of trucks owned by federal, state, or local governments.

A change in law might be needed to allow ELD data to be used to assess or enforce a tax on vehicle miles traveled. Under current federal law, enforcement personnel are allowed to use ELD data only to determine compliance with hours-of-service rules.

1. Unless otherwise noted, information in this box is drawn from Electronic Logging Devices and Hours of Service Supporting Documents, 80 Fed. Reg. 78291 (December 16, 2015), <https://go.usa.gov/xV5nF>.

2. Federal Motor Carrier Safety Administration, “Registered ELDs” (accessed May 24, 2019), <https://eld.fmcsa.dot.gov/List>.

3. See Hours of Service of Drivers, 49 C.F.R. §395.1 (2019).

4. See Federal Motor Carrier Safety Administration, “Driver’s Records of Duty (RODs) and Supporting Documentation” (accessed May 8, 2019), <https://go.usa.gov/xV5nA>.

5. Memo provided by Robert Armstrong, Department of Transportation (August 20, 2019). That estimate is based on data from December 2017.

6. Data from the Federal Highway Administration (FHWA) show that 9.3 million single-unit trucks and 2.9 million combination trucks were registered in 2017; however, the figure for single-unit trucks includes motor homes. According to a 2016 report, motor homes represented 19 percent of vehicles classified as single-unit trucks in 2011 (the latest year for which data are available). See Environmental Protection Agency, *Population and Activity of On-road Vehicles in MOVES2014* (January 2016), p. 30, www.epa.gov/moves/moves-onroad-technical-reports. Applying that 19 percent to the FHWA data reduces the total number of trucks to 10.5 million.

incentive to comply with the tax. Existing ELDs are not all compatible with location-related taxes, either.

By contrast, a system that used RFID readers would require location-based tax rates, in the sense that such a system would have to exempt large components of

the road network. The capital cost for covering all roads using currently available technology would be prohibitively high.

Costs. Establishing and operating a VMT tax program could entail capital costs for new equipment, as well as

administrative costs and enforcement costs. In general, the costs would be the same regardless of the specific tax rates. Thus, for higher rates, implementation costs to the government would be a smaller percentage of revenues.

Capital Costs. The capital cost of a VMT tax system could vary greatly depending on not only the implementation method but also the tax base and rate structure. A system based on odometer reading would have little or no capital cost. An RFID-based system would have a high capital cost for the installation of all of the necessary readers and related equipment (including cameras and telecommunications equipment). One estimate of the cost of a proposed RFID system covering all Interstate highways was \$55 billion.¹⁶ Including other roads in the tax base, which would dramatically increase the number of access points and lane miles, would make the cost much higher.

The cost of a system using onboard devices would depend on whether the tax covered all roads at the same rate and therefore did not require devices with high spatial resolution. In that case, drivers whose trucks already have ELDs compliant with federal hours-of-service rules or compatible state rules would incur no additional capital costs. (For details about those rules, see Box 2 on page 15.) For other trucks, the Federal Motor Carrier Safety Administration estimated in 2015 that annualized costs would be \$93 to upgrade an older device, \$128 to replace an older device, and \$166 or \$419, respectively, to purchase a new ELD using short-range or longer-range communications technology.¹⁷ A location-specific VMT tax would require more expensive devices that provided greater spatial resolution. The costs for onboard devices could be imposed on the trucking industry or borne by the government through a subsidy program.

Administrative Costs. Administrative costs would take different forms and would vary depending on how the tax

was implemented. For example, self-reporting of odometer readings would require carriers to keep appropriate records, whereas automatic payments through ELDs could result in small increases in the service charges (estimated at \$20 to \$45 per month in 2015) that truckers pay for the devices.¹⁸ The government's processing costs would be lower if payments were made automatically or online rather than by mail. Interstate carriers would face lower administrative costs to the extent that the VMT tax program used data already being reported for the IFTA program; in that case, federal costs might be lower as well.

Enforcement Costs. The cost of enforcing a truck VMT tax could also differ significantly under the different implementation methods. A system based on self-reported odometer readings would pose the highest risk of evasion and hence require the greatest enforcement effort. Estimates of evasion rates from state programs vary widely (perhaps reflecting differences in enforcement), from about 5 percent in Oregon to as much as 50 percent in New York (for more details, see Appendix A). Verification methods could include selective auditing. For instance, IFTA requires that jurisdictions audit the records of 3 percent of carriers each year and that carriers keep records for four years.¹⁹ Alternatively, odometer inspections could be performed during safety checks by state or local officials or authorized contractors. In any case, the level of effort would be informed by the trade-off between the costs of inspections and their effectiveness in increasing compliance.

An RFID-based system would be highly automated and thus more difficult to evade, particularly if it was augmented with video camera enforcement. The potential for evasion under a system using onboard devices would also be relatively small, though perhaps not as small as under a system using RFIDs. No state systems use ELDs directly to assess trucks' VMT taxes (although Oregon accepts mileage data generated by ELDs and reported automatically through a third-party vendor), but the relative levels of human involvement in the three types of systems suggest that enforcement costs for an ELD-based system would be somewhere between those of

16. Robert Poole, *The Case for Toll-Financed Interstate Replacement* (Reason Foundation, April 2019), p. 25, <https://tinyurl.com/y36x38mr>.

17. See Electronic Logging Devices and Hours of Service Supporting Documents, 80 Fed. Reg. 78291 (December 16, 2015), pp. 78346–78347, <https://go.usa.gov/xVbkj>. The annualized estimates are for devices that track location within about 1 kilometer and include the costs of purchasing, installing, and periodically replacing the devices as well as monthly service charges.

18. See Federal Motor Carrier Safety Administration, *Regulatory Evaluation of Electronic Logging Devices and Hours of Service Supporting Documents Final Rule* (November 2015), p. 81.

19. See IFTA, Inc., *Best Practices Audit Guide* (May 2006), pp. 8–9, <https://tinyurl.com/y2oyscao> (PDF, 334 KB).

systems based on self-reported odometer readings and on RFIDs.²⁰

For any of the assessment methods, policymakers would gain experience with various enforcement approaches and their cost-effectiveness over time. As a result, evasion could decline, as it has for federal and state fuel taxes.²¹

Efficiency of Road Use. Taxes that correspond to the social costs of driving may lead drivers to use roads more efficiently by giving them an incentive to forgo trips for which the total costs exceed the benefits. Some of driving's social costs—those associated with greenhouse gas emissions, air pollution, and dependence on foreign oil—are more directly related to fuel use. Others—namely, the costs of pavement damage, congestion, accidents, and noise—are more directly related to miles driven.

Using data from published studies, CBO estimated in 2011 that, on average, mileage-related social costs were twice as large as fuel-related social costs for trucks operating in rural areas and five times as large for trucks operating in urban areas.²² In a 2015 analysis, CBO similarly found that mileage-related costs were roughly three and a half times as large as fuel-related costs nationwide.²³

20. One issue that carriers and jurisdictions have encountered when ELDs are used for IFTA reporting is that the data are frequently not maintained for the required four-year period to allow for audits (personal communication, Monica Halstead, International Fuel Tax Association, Inc., June 19, 2019). A federal VMT tax program that allowed carriers to report mileage via ELDs might set minimum periods for data retention.

21. Justin Marion and Erich Muehlegger, "Measuring Illegal Activity and the Effects of Regulatory Innovation: Tax Evasion and the Dyeing of Untaxed Diesel," *Journal of Political Economy*, vol. 116, no. 4 (2008), pp. 633–666, www.jstor.org/stable/10.1086/591805; Transportation Research Board, *Identifying and Quantifying Rates of State Motor Fuel Tax Evasion* (National Highway Cooperative Research Program report 623, 2008), p. 5, <https://tinyurl.com/y4kgjgyp>; and General Accounting Office (now the Government Accountability Office), *Status of Efforts to Curb Motor Fuel Tax Evasion*, GAO/GGD-92-67 (May 1992), www.gao.gov/products/GGD-92-67.

22. Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), p. 6, www.cbo.gov/publication/22059. For purposes of comparison, CBO converted fuel-related costs to cents per mile using estimated fuel efficiencies.

23. David Austin, *Pricing Freight Transport to Account for External Costs*, Working Paper 2015-03 (Congressional Budget Office, March 2015), p. 3, www.cbo.gov/publication/50049.

Still, maximizing efficiency would require both fuel taxes and VMT taxes because a VMT tax alone would not give carriers an incentive to improve fuel efficiency. Indeed, a VMT tax that replaced the diesel tax and generated the same revenues would shift some of the tax burden from firms operating less fuel-efficient trucks to those operating more fuel-efficient trucks.

Any increases in the efficiency of road use from a federal tax on trucks' mileage would depend on how the tax was implemented. According to a study performed by FHWA, the greatest opportunities for efficiency gains would lie in reducing pavement damage and traffic congestion. Pavement damage sharply increases with trucks' weight per axle; thus, a VMT tax that varied with weight per axle, as Oregon's does for trucks with declared weights over 80,000 pounds, could reduce such damage by giving carriers an incentive to use trucks with more axles. (Note that the existing tax on diesel fuel gives carriers at least a small incentive to use fewer axles because adding axles increases road friction and hence decreases fuel efficiency.)²⁴ By contrast, a uniform tax on all trucks could increase pavement damage if it led carriers to use fewer trucks carrying more weight per axle.

A VMT tax could also lessen trucks' contribution to traffic congestion (most of which is caused by passenger vehicles), particularly if tax rates varied by time and place, either on a set schedule or as determined by real-time traffic conditions. Such a tax would give truckers additional incentive—beyond that already provided by the costs to their own operations—to reduce their contributions to congestion by shifting their routes or modifying their schedules.²⁵ Again, rates that varied by time and place would require an assessment method that could distinguish when and where travel occurred. Moreover, such rates might be more efficiently set and managed by state or local governments, which have easier access to data about specific congestion problems, than by the federal government. A VMT tax that did not vary by time and place would have a limited, indirect effect on

24. For an early but thorough study of road-user charges that would account for trucks' pavement damage, see Kenneth A. Small, Clifford Winston, and Carol A. Evans, *Road Work* (Brookings Institution, 1989).

25. Hours-of-service regulations may constrain truckers' ability to avoid driving during peak congestion hours; see Jeffrey Short, *Technical Memorandum: Hours-of-Service Flexibility* (American Transportation Research Institute, August 2018), <https://tinyurl.com/y5emgl7> (PDF, 1 MB).

congestion by reducing truck traffic in general, to the extent that it increased total levies on trucking companies (rather than replacing existing taxes).

Effects on State and Local Governments. The establishment of a federal VMT tax on trucks could affect state and local governments in at least two ways. To the extent that the federal tax increased total taxes paid by truckers, states might find it difficult to increase their own taxes—particularly the VMT taxes in the four states that have them, but also diesel fuel taxes. Conversely, a federal VMT tax might encourage more states to establish their own VMT taxes using the same methods as the federal tax. In some states, that option might be particularly attractive if the federal system was implemented in a way that allowed for congestion-based pricing.

Concerns About Privacy. A VMT tax could raise concerns about privacy, particularly if it was implemented using a method that tracked where (or where and when) travel occurred. Privacy is more commonly discussed as an issue for a VMT tax on passenger vehicles because many truck drivers work for large carriers that already track the locations of their vehicles. Nonetheless, concerns could be raised about making VMT information available to the government, particularly by independent operators who drive their own trucks. Carriers from Canada and Mexico could have additional privacy concerns if the VMT tax applied to their travel in the United States. Possible ways to address such concerns could include using tax rates that do not depend on time or location, either for all trucks or as an optional alternative, or using onboard devices that cumulated trucks' mileage and reported only the amount of taxes owed.

Illustrative Estimates of Budgetary Effects for 2017

The revenues from a VMT tax on commercial trucks would depend on the tax base, the rate structure, and truck owners' compliance with the tax. CBO used data on truck travel in 2017 to examine the effects of those factors for five tax scenarios. In CBO's main estimates, for each scenario, the tax base covers all roads and includes either all commercial trucks or just combination trucks; the tax rate is the same for all roads and all trucks in the tax base; and the rate of compliance is 90 percent (that is, no tax is collected on 10 percent of trucks' mileage). For two of the scenarios, CBO estimated the revenues that would have resulted from specified tax rates:

- A uniform tax rate of 1 cent per mile and
- A uniform tax rate of 5 cents per mile.

For the other three, CBO estimated the rates that would have been needed to achieve specified revenue targets:

- Taxed trucks' share of the 2017 shortfall between the taxes credited to the HTF and the fund's outlays (equal to \$4.8 billion if all commercial trucks were taxed and \$4.0 billion if only combination trucks were taxed; see Table 2 on page 3),
- Taxed trucks' share of that 2017 shortfall plus their share of fuel tax revenues (\$14.4 billion for all trucks and \$11.3 billion for combination trucks), and
- Taxed trucks' share of the 2017 shortfall plus their share of all HTF tax revenues (\$19.4 billion for all trucks and \$16.1 billion for combination trucks).²⁶

CBO made additional estimates to explore how sensitive its revenue and tax rate estimates were to changes in the tax base, the rate structure, and the compliance rate. For various estimates, the VMT tax base is limited to Interstates and arterial roads or to Interstates alone, different tax rates apply to single-unit and combination trucks, and the rate of compliance is 80 percent or 95 percent. To limit the scope of the analysis, CBO did not consider tax rates that varied by truck weight (or weight per axle) or by the location (or location and time of day) of travel.

In addition to generating revenues, a VMT tax would have two other effects on the federal budget: Its implementation would impose costs, and the revenues it

26. CBO attributed about 2 percent of gas tax revenues to single-unit trucks and none to combination trucks (which use diesel almost exclusively) and attributed 17 percent of diesel tax revenues to single-unit trucks, 75 percent to combination trucks, and 8 percent to other vehicles. Those shares were based on data for 2017 from Energy Information Administration, "Reference Case Projections Tables" (January 24, 2019), Tables 37 and 50, www.eia.gov/outlooks/aeo/tables_ref.php. For the other taxes, CBO attributed 100 percent of revenues from the heavy-vehicle use tax and 95 percent of revenues from the taxes on truck sales and tires to combination trucks. (Most single-unit trucks are below the GVWR threshold for the vehicle sales tax, and the tax rate for a given tire is proportional to its load capacity above 3,500 pounds, which means tires for heavier trucks are subject to higher taxes.)

generated would be partially offset by reductions in receipts from payroll and income taxes. Those effects, which are discussed below, are not reflected in CBO's estimates.

The Basis of the Revenue and Tax Rate Estimates

For its analysis, CBO used FHWA data on the miles traveled in 2017 by single-unit and combination trucks on all roads and on Interstates alone.²⁷ The 2017 data do not distinguish travel on some arterial roads, so for the cases in which the tax would apply to travel on arterial roads, CBO applied shares of miles traveled derived from earlier data to the 2017 totals.²⁸

CBO's analysis accounts for two types of behavioral responses to VMT taxes: reductions in overall freight traffic and shifts in freight traffic from truck to rail (see Appendix C).²⁹ Such responses would be driven by VMT taxes that increased collected revenues; any portion of a tax that replaced existing taxes would not generally raise the cost of shipping freight by truck. CBO's analysis does not reflect two other types of behavioral responses: shifts from smaller trucks to larger trucks and diversions of traffic to untaxed roads.

Estimated Revenues and Tax Rates

For a uniform tax on travel by all trucks on all roads with 90 percent compliance, CBO estimates that the revenues from a tax of 1 cent per mile would have been \$2.6 billion in 2017. For higher tax rates, revenues would have been almost proportionally higher (see Figure 6). For example, the revenues from a tax of 5 cents per mile would have been \$12.8 billion, or 4.9 times larger.

27. See Federal Highway Administration, *Highway Statistics 2017* (accessed April 22, 2019), Table VM-1, <https://go.usa.gov/xVbny>. The data on single-unit trucks include miles traveled by some motor homes. Using information on vehicle registrations and the average annual use of motor homes, CBO reduced FHWA's reported miles for single-unit trucks in 2017 by 7 percent.

28. The earlier data, for 2011, came from Federal Highway Administration, *Modal Shift Comparative Analysis Technical Report* (Department of Transportation, June 2015), pp. 237–238, <https://go.usa.gov/xV4hq>. Specifically, CBO separately divided single-unit and combination trucks' mileage on Interstates and arterial roads by their mileage on all roads and then applied those ratios (70 percent and 87 percent, respectively) to the corresponding 2017 totals.

29. Underlying a reduction in overall freight traffic would be a shift in consumption patterns toward goods and services with lower (or zero) embedded shipping costs.

The small departure from full proportionality is due to behavioral effects: Any increase in the taxes paid by carriers would reduce total freight traffic and shift some freight from trucks to rail. Together, in CBO's estimation, those effects would have reduced trucks' mileage by amounts ranging from 0.4 percent to 1.6 percent for the tax rates considered here. For any given rate, estimated revenues from a tax on combination trucks alone would have been 37 percent lower (because such trucks accounted for 63 percent of total miles traveled). Again, increasing the tax rates would cause nearly proportional increases in revenues.

For tax scenarios involving revenue targets, the tax rates needed to meet those targets would be higher if only combination trucks were taxed. For example, for the smallest target, which would cover only the taxed trucks' share of the HTF shortfall, the estimated tax rate would be 1.9 cents per mile for a uniform tax on all trucks but 2.5 cents per mile for a tax on combination trucks alone. The difference reflects the fact that combination trucks' share of all commercial trucks' HTF taxes in 2017 (83 percent) was larger than their share of miles traveled (63 percent). Therefore, combination trucks would contribute a smaller share, and single-unit trucks a larger share, of revenues from a tax that applied a uniform per-mile rate to all trucks than they do from the current taxes. The difference in tax rates is largest for the largest target: The uniform tax rate required to also replace the taxed trucks' existing HTF taxes is 7.5 cents if all commercial trucks are taxed equally but 9.9 cents if only combination trucks are taxed.

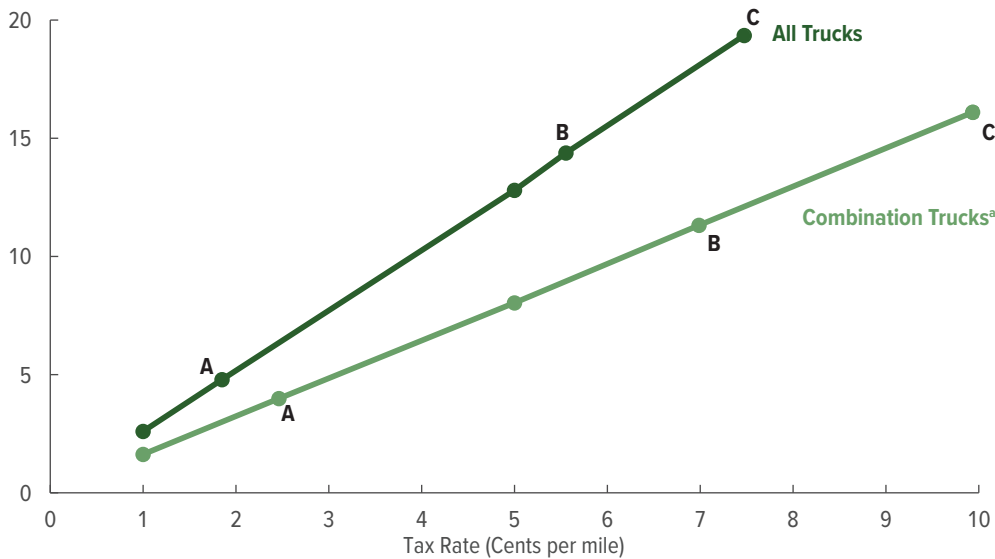
Other approaches could be used to increase the tax revenues credited to the HTF. For example, raising the federal tax on diesel fuel from 24.4 cents to 37.4 cents per gallon would have generated \$4.8 billion in additional revenues from truck carriers in 2017—the same amount that CBO estimates a uniform VMT tax of 1.9 cents per mile would have raised. (That increase in the diesel tax would also have yielded an estimated \$0.4 billion in additional revenues from diesel fuel purchased for buses and passenger vehicles.)

The tax rates considered here are much lower than estimates of the social cost per mile of truck use. For example, CBO estimated in 2011, using results from a FHWA study, that the costs of truck travel from pavement damage, congestion, noise, and accidents were about 25 cents (in 2017 dollars) per mile in rural areas and roughly

Figure 6.

Estimated Annual Gross Revenues From Uniform VMT Taxes on All Roads

Billions of 2017 Dollars



Estimated revenues from taxed trucks would increase almost proportionally with the tax rate. (The estimates shown are for tax rates of 1 cent and 5 cents per mile and revenue targets A, B, and C, defined below.)

Source: Congressional Budget Office.

The points labeled “A” represent scenarios in which the VMT tax would generate revenues equal to the taxed trucks’ share of the shortfall between the Highway Trust Fund’s credited tax revenues and outlays in 2017 (\$13.5 billion). The points labeled “B” and “C” represent the collection of additional revenues that would replace those collected from truckers through fuel taxes and through all current Highway Trust Fund taxes, respectively.

VMT = vehicle miles traveled.

a. Combination trucks are those with one or more trailers.

80 cents per mile in urban areas.³⁰ (Those social costs are distinct from the federal costs shown in Box 1 on page 12.) In that 2011 report, CBO noted that, according to FHWA’s estimates, taxes on passenger vehicles did not cover the social costs of their travel—primarily the

costs of congestion in urban areas and accidents in rural areas—either.³¹

Effects of Changing the Road Network in the Tax Base.

Estimated revenues are sensitive to the road network covered by the VMT tax (see Figure 7). For a tax on all trucks, revenues would be 21 percent lower if local roads (that is, those other than Interstates and arterial roads) were excluded and 59 percent lower if arterial roads were also excluded. If the tax applied only to combination trucks, which primarily travel on Interstates and arterial roads, the effects on revenues would be somewhat smaller: Excluding local roads would reduce revenues by 13 percent, and taxing travel only on Interstates would

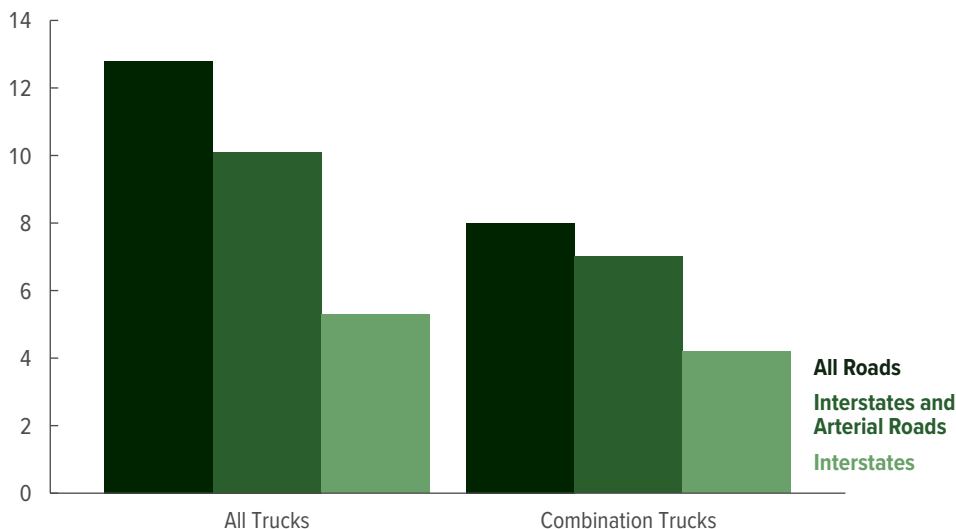
30. See Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), pp. 5–8, www.cbo.gov/publication/22059. Similarly, the existing taxes on diesel fuel are below the estimated social costs of trucks’ diesel consumption. The latest data from the American Petroleum Institute show that federal, state, and local taxes on diesel fuel averaged 62.1 cents per gallon; see American Petroleum Institute, “Diesel Tax” (accessed August 29, 2019), <https://tinyurl.com/y5tw9s5p>. In contrast, the estimated social costs of diesel consumption reported in the CBO study were 82 cents per gallon (in 2017 dollars) for truck travel in rural areas and 89 cents per gallon for truck travel in urban areas.

31. The report also noted that charging drivers of trucks and passenger vehicles for the full social costs of their vehicles would yield revenues in excess of an efficient level of spending on highways, thus potentially generating funds that could be used for other spending programs or to reduce taxes or the deficit.

Figure 7.

Estimated Annual Revenues From a VMT Tax of 5 Cents per Mile, by the Road Network Included in the Tax Base

Billions of 2017 Dollars



Limiting the roads covered by a VMT tax would have less effect on revenues if the tax applied only to combination trucks.

Source: Congressional Budget Office.

Combination trucks are those with one or more trailers.

VMT = vehicle miles traveled.

reduce revenues by 47 percent. (Those figures do not reflect possible reductions in revenues from diversions of traffic to untaxed roads.)³²

Effects of Nonuniform Tax Rates. When the three revenue targets are achieved using different rates for combination and single-unit trucks, the rates for combination trucks are closer to the uniform rates than are the rates for single-unit trucks (see Figure 8). That is because the uniform rates are essentially VMT-weighted averages of the separate rates for the two truck types, and combination trucks travel more miles than single-unit trucks. Moreover, the rates for combination trucks are much higher than those for single-unit trucks; again, that is because combination trucks represent an even larger

share of all trucks' HTF tax revenues than they do of all trucks' mileage.

Effects of Different Compliance Rates. Estimated revenues are modestly sensitive to compliance, at least at the rates CBO considered (see Figure 9). Specifically, they are 11 percent lower if the rate of compliance is 80 percent instead of 90 percent and about 6 percent higher if it is 95 percent instead of 90 percent.³³ Those estimates reflect the static effects of the compliance rate at a single point in time; however, there might also be dynamic effects. In particular, compliance rates that are too low could be seen as a fairness issue and lead to increased evasion over time.

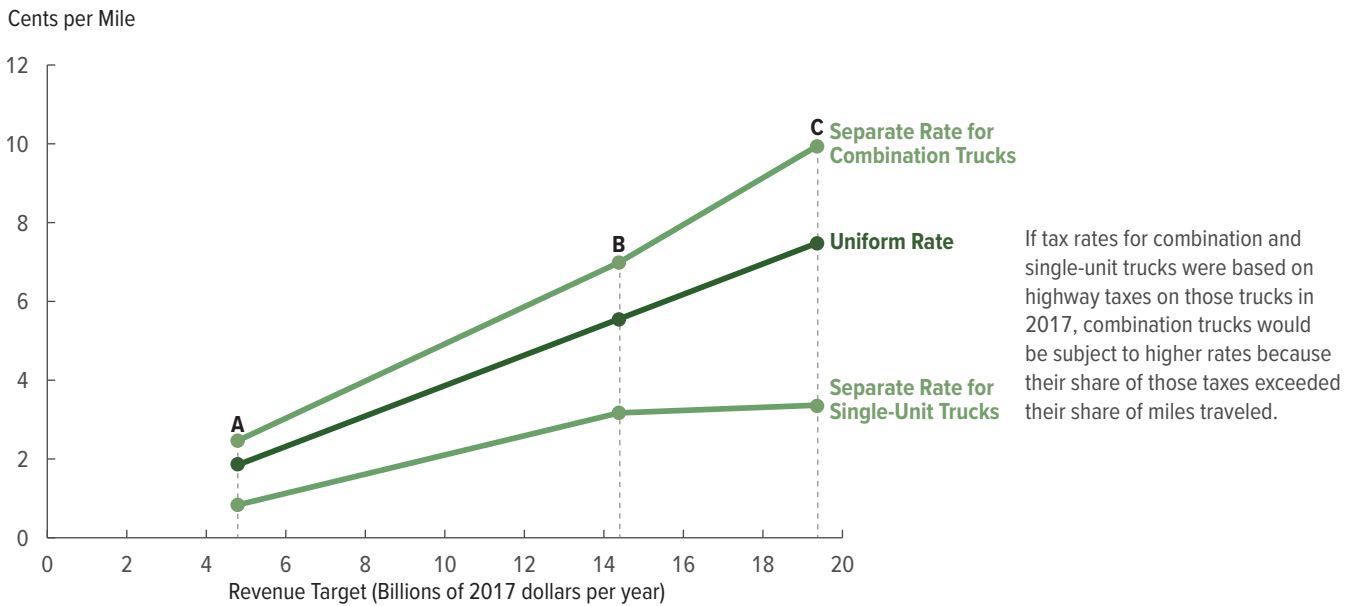
Applicability to Future Revenues. The revenues that a VMT tax would generate in the future would exceed those estimated here to the extent that trucks traveled more miles than they did in 2017. Through 2037, according to FHWA's most recent projections, single-unit and combination trucks' annual mileage

32. A study done in preparation for Rhode Island's program of tolls for combination trucks estimated that 18 percent of the trucks' travel, on average, would be diverted to routes that avoided the 12 toll locations. See Louis Berger Group, *Rhode Island Department of Transportation, Investment-Grade Tolling Study: Final Report* (November 3, 2017), p. 14, <https://go.usa.gov/xVb9g> (PDF, 9.3 MB).

33. $1 - .80/.90 = .11$; $.95/.90 - 1 = .056$.

Figure 8.

Estimated Tax Rates to Meet Specific Revenue Targets, by Type of Truck



Source: Congressional Budget Office.

Combination trucks are those with one or more trailers.

For each group of trucks, the lowest rate would meet a revenue target representing the trucks’ share of the Highway Trust Fund’s \$13.5 billion shortfall in 2017, based on the share of the fund’s revenues from taxes on those trucks. The higher two rates would meet revenue targets representing the taxed trucks’ share of that shortfall plus their share of fuel taxes or all Highway Trust Fund taxes, respectively.

The data points for the three targets on the “Uniform Rate” line are the same as the corresponding points in the “All Trucks” line in Figure 6; the two lines look different because the horizontal and vertical axes are swapped here to better show the tax rates as functions of the revenue targets.

will grow by an average of 1.6 percent and 1.5 percent per year, respectively.³⁴ Such projections are inherently uncertain, however, because trucks’ future mileage will depend on factors such as economic activity, the price of diesel fuel, and competition from other modes of freight transportation. Indeed, FHWA projected that over the next 20 years, the average annual increase in mileage would be 1.1 percent for single-unit trucks and 1.1 percent for combination trucks under a scenario with slower economic growth and 2.0 percent for single-unit trucks and 1.5 percent for combination trucks under a scenario with faster economic growth.

Other Budgetary Effects

Some of the federal costs of a truck VMT tax program would depend greatly on how the tax was designed and

implemented. Capital costs would be high under a system based on an extensive network of RFID readers, for example, but low under a system based on self-reported odometer readings. Other costs, such as those for processing tax payments, would be similar for any implementation method.

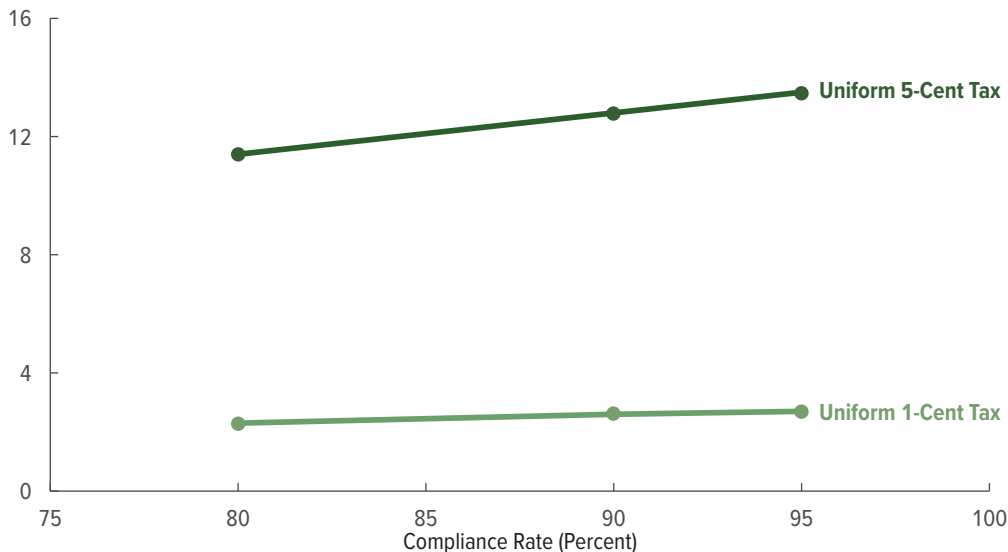
The costs of Oregon’s VMT tax may shed light on some of those federal costs. Data from the state’s VMT tax program show that Oregon’s annual costs for processing payments, auditing compliance, and collecting from delinquent accounts amount to roughly \$20 per truck. For a nationwide program, that figure implies overall costs of \$210 million for a tax covering all 10.5 million commercial trucks and about \$60 million for a tax covering 2.9 million combination trucks. Compared with the revenues collected in the tax scenarios considered above, those annual costs would represent about 0.4 percent on the low end (for the largest tax of 9.9 cents per mile on combination trucks only) and 8 percent on the high end

34. Federal Highway Administration, “FHWA Forecasts of Vehicle Miles Traveled (VMT): Spring 2019” (May 2019), <https://go.usa.gov/xVb9T>.

Figure 9.

Estimated Annual Revenues From a VMT Tax on Trucks, by Tax Rate and Rate of Compliance

Billions of 2017 Dollars



Compliance rates—CBO used 90 percent as the base case and considered alternative rates of 80 percent and 95 percent—have a proportional effect on estimated revenues in CBO’s analysis.

Source: Congressional Budget Office.

CBO did not evaluate the possibility that low compliance rates could lead more people to evade the tax over time.

VMT = vehicle miles traveled.

(for a tax of 1 cent per mile on all trucks). However, the \$20-per-truck figure does not reflect start-up costs, such as those to establish a program office and accounting systems, or field enforcement costs. For comparison, a 2011 study that surveyed the fuel-tax programs of eight states found that administrative, collection, and enforcement costs averaged 0.9 percent of revenues.³⁵

Other estimates of states’ annual costs to administer and collect VMT taxes are lower or higher than \$20 per truck. CBO estimates that Kentucky spends much less than Oregon—about \$5 per truck—perhaps in part because of its simpler flat-rate tax structure. By contrast, the authors of a 2012 study estimated that states’ annual administrative and collection costs for a VMT tax program would be \$35 per vehicle.³⁶

For an RFID system, annual costs would include maintenance of the readers and other equipment. Taking those costs into account, the Rhode Island Department of Transportation has estimated that when the state’s RFID system for combination trucks is complete, annual costs will be 9 percent of toll revenues (\$4 million of \$45 million).³⁷ Similarly, Connecticut’s proposed system to toll both trucks and passenger cars is forecast to have annual costs of about 8 percent to 10 percent of revenues (between \$80 million and \$100 million of about \$1.1 billion).³⁸

Federal costs could be higher or lower than state costs because of differences in employee compensation, reporting and payment methods, auditing efforts, economies of scale, and other factors.

35. Transportation Research Board, *Costs of Alternative Revenue-Generation Systems*, Report 689 (National Highway Cooperative Research Program, 2011), p. 2, <https://doi.org/10.17226/14532>.

36. National Academies of Sciences, Engineering, and Medicine, *Dedicated Revenue Mechanisms for Freight Transportation Investment* (National Academies Press, 2012), pp. 53–54, <https://doi.org/10.17226/22799>.

37. Rhode Island Department of Transportation, “RIDOT Releases Data for Second Month of Tolling” (press release, September 3, 2018), www.ri.gov/press/view/34206.

38. See CDM Smith, *Connecticut Tolling Options Evaluation Study* (Connecticut Department of Transportation, November 2018), www.ct.gov/dot/cwp/view.asp?A=1373&Q=606464.

The net budgetary effect of a VMT tax on trucks would also depend on how it affected other tax revenues. Payments of excise taxes, including existing fuel taxes and potential future VMT taxes, reduce the taxable income of households and businesses. Accordingly, when estimating the effects of legislative proposals that would raise excise tax revenues, CBO and the staff of the Joint Committee on Taxation employ an offset to account for reduced revenues from income and payroll taxes.³⁹ The offset varies over time, depending on tax rates and economic projections. In 2017, it was about 26 percent; as a result of changes in tax law that went into effect in 2018, it is now about 22 percent but is projected to rise to about 25 percent beginning in 2026.⁴⁰

Distributional Effects of Diesel and VMT Taxes for Commercial Trucks

The diesel tax paid by owners of commercial trucks increases the cost of shipping goods, which in turn increases the prices that households pay for those goods. Because lower-income households spend a larger share of their income on goods, the tax has a disproportionate effect on their purchasing power. In other words, the diesel tax is regressive.⁴¹ Specifically, CBO estimates that in 2017, households in the lowest income quintile (the bottom fifth of the distribution) paid about 0.06 percent of their income as a result of the diesel tax, compared with roughly 0.02 percent for households in the highest quintile. In CBO's assessment, those households would have spent the same proportions of their income as the result of a VMT tax that yielded the same amount of revenues.

To make that comparison, CBO analyzed data for 2017 from the Bureau of Labor Statistics' Consumer

Expenditure Survey on consumer spending and household income. Those survey data provide information on each quintile's share of spending on a wide range of goods and services, such as foods, furniture, motor vehicles, and insurance.

Drawing on those data, CBO made a series of calculations. CBO first estimated the spending on shipping implied by the spending on goods, using cost shares from the Transportation Satellite Accounts created by the Bureau of Economic Analysis.⁴² From those estimates, CBO calculated volumes of freight, using information on the average shipping rates charged per ton-mile (one ton of freight moved one mile).⁴³ Finally, those estimates of freight volumes were used in conjunction with data on average fuel economy (from the Bureau of Transportation Statistics) and shipment payloads (derived from the Department of Transportation's Freight Analysis Framework) to estimate the gallons of diesel fuel consumed and truck miles traveled.⁴⁴ In CBO's assessment, the full incidence (100 percent) of the taxes on those gallons and miles traveled would be passed on to consumers.⁴⁵

In theory, a diesel tax and a VMT tax could differ in their regressivity because of differences in the sets of trucked goods purchased by different households. Shipping less dense goods requires less fuel per mile—and therefore incurs lower diesel taxes—than shipping denser goods; that cost advantage would be lost under a VMT tax. However, CBO's calculations suggest that in practice, the density of shipped goods consumed

39. See Joint Committee on Taxation, *The Income and Payroll Tax Offset to Changes in Excise Tax Revenues*, JCX-59-11 (December 23, 2011), <https://go.usa.gov/xVJqZ> (PDF, 19 MB).

40. From the 2017 and 2019 editions of Joint Committee on Taxation, *New Income and Payroll Tax Offsets to Changes in Excise Tax Revenues*, JCX-5-17 (February 9, 2017), <https://go.usa.gov/xVJHE>, and JCX-6-19 (February 28, 2019), <https://go.usa.gov/xVb5u>.

41. Taxes on gasoline, which affect households primarily through the cost of passenger vehicle use, tend to be less regressive than taxes on diesel fuel, in part because members of households in the bottom fifth of the distribution of income are less likely to own passenger vehicles. See Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), www.cbo.gov/publication/22059.

42. Bureau of Transportation Statistics, *Transportation Satellite Accounts: A Look at Transportation's Role in the Economy* (Department of Transportation, 2011), Appendix Table 4.

43. David Austin, *Pricing Freight Transport to Account for External Costs*, Working Paper 2015-03 (Congressional Budget Office, 2015), Table A-6, www.cbo.gov/publication/50049.

44. For data on fuel economy, see Bureau of Transportation Statistics, "Freight Facts & Figures 2017" (Department of Transportation, 2017), Chapter 6, <https://rosap.nsl.bts.gov/view/dot/34923>. For data on shipment payloads, see David Austin, *Pricing Freight Transport to Account for External Costs*, Working Paper 2015-03 (Congressional Budget Office, March 2015), Table A-8, www.cbo.gov/publication/50049.

45. For empirical evidence supporting the standard assumption that diesel fuel taxes are, on average, fully passed on to consumers, see Justin Marion and Erich Muehlegger, "Fuel Tax Incidence and Supply Conditions," *Journal of Public Economics*, vol. 95, no. 9-10 (October 2011), pp. 1202–1212.

by households in different quintiles does not differ significantly.

CBO conducted a similar assessment for rural and urban households (instead of income quintiles); that analysis also revealed no significant difference in the sets of goods consumed by the two groups. Thus, shifting from a diesel tax on commercial trucks to a VMT tax that generated a similar amount of revenues would have a negligible effect on the relative burden.⁴⁶ That analysis

46. For taxes on passenger vehicles, research shows that rural households would pay less if a gasoline tax was replaced

also suggested that the burden of the existing diesel tax through its effect on consumer prices is similar in rural and urban areas.⁴⁷

with a VMT tax that yielded the same revenues. See, for example, Stephen S. Fitzroy and Kyle Schroeckenthaler, "Estimating Revenue-Neutral Mileage-Based Fees for Urban and Rural Households in Eight Western States," *Transportation Research Record*, vol. 2672, no. 4 (September 2018), <https://doi.org/10.1177/0361198118794714>.

47. The burden would be different only if average shipping distances for the goods and services consumed were significantly greater in one area than the other and those differences in distance were reflected in retail prices.

Road-User Charges on Commercial Trucks in the United States

Several states currently tax vehicle miles traveled (VMT) by commercial trucks. Four of those states—Kentucky, New Mexico, New York, and Oregon—have mandatory VMT taxes on commercial trucks over a state-determined weight threshold. Each of those states, with the exception of Kentucky, has graduated VMT tax rates that vary with the truck’s weight. Another state, Illinois, allows the owners of trucks used only within the state to pay a reduced annual registration fee if they agree to pay a tax on mileage in excess of a yearly allotment. Additionally, Rhode Island is instituting a program that will collect tolls from combination trucks (those with one or more trailers) at 12 locations, mostly on Interstate highways; the tolls act like a VMT tax for through travel on the tolled roads.

This appendix summarizes various aspects of those state VMT tax programs for commercial trucks. Specifically, it briefly discusses the methods for reporting mileage and the programs’ administrative costs; the revenues generated and the underlying tax rates; and available estimates of evasion rates (including some for past VMT programs that have been repealed), as well as some factors that might contribute to the wide range of those estimates.

Reporting and Administration

All of the programs except for Rhode Island’s rely on self-reported VMT and weight from trucking firms (carriers). Carriers that regularly use public roadways must register their trucks with the states and periodically submit mileage reports, usually on a monthly or quarterly basis.¹ Trucks that do not make regular trips can obtain temporary or onetime permits.² In New Mexico, New

York, and Oregon, carriers report mileage and weight for each vehicle; in Kentucky, carriers report total mileage for all vehicles in their fleet.

Each state allows carriers to submit their mileage reports online or by mail. Paper submissions entail a larger administrative burden for states because of the need to manually enter the reported information into an electronic database. States also require carriers to keep mileage records for periods ranging from three to five years after submitting their reports.

Both states and carriers have expressed interest in reducing the burden of administering and complying with the VMT tax programs. One such effort is a collaboration between Oregon and a technology company to develop an automated mileage-reporting system that communicates directly with the state’s electronic filing system and adheres to its reporting and recordkeeping standards. The system, which was implemented in 2014 after successful pilots, relies on data collected by onboard GPS-based tracking devices. The devices transmit data on each trip to a third-party online platform that compiles mileage reports and submits them, along with payment, to the Oregon Department of Transportation.³ To date, relatively few carriers—approximately 300 of 28,000—are using the system to compile, report, and pay their VMT taxes.⁴

Tax Revenues and Rates

The mandatory state VMT tax programs generated a combined \$608 million in 2018. Much of that total

1. Miles traveled on private roads are exempt from the states’ VMT taxes. New York exempts miles driven on the New York State Thruway. Farm vehicles and federal vehicles are also generally exempt from the state VMT tax programs.
2. In New Mexico, drivers of in-state vehicles subject to the state’s VMT tax must have a tax identification permit, but drivers of out-of-state vehicles may pay trip fees instead. See New Mexico Motor Transportation Division, *Motor Transportation*

Division Trucker’s Guide (accessed June 17, 2019), p. 10, <https://go.usa.gov/xVJqd>.

3. Oregon Department of Transportation and EROAD, *Oregon Electronic Weight-Mile-Tax Implementation: Case Study* (April 2015), <https://tinyurl.com/y598a3w2> (PDF, 864 KB).
4. Staff of the Oregon Department of Transportation, Motor Carrier Transport Division, personal communication (May 9, 2018).

was from Oregon's tax, which generated \$328 million (see Table A-1). Kentucky, New Mexico, and New York each generated between \$80 million and \$115 million through their programs. In each state, the VMT tax revenues go to the state's dedicated highway or road fund.

Oregon is the only state in which most vehicles subject to the VMT tax—namely, trucks with a declared gross weight (the combined weight of the truck, any trailers, and the maximum load to be carried during the registration period) over 26,000 pounds—are exempt from the state fuel tax.⁵ It is also the state with the highest VMT tax rates, starting at about 6.2 cents per mile and increasing with trucks' weight to 20.5 cents per mile for trucks with a declared weight of 80,000 pounds.⁶ Trucks with gross weights over 80,000 pounds pay a VMT rate that varies with gross weight and the number of axles; it can be as high as 28.8 cents per mile.

New Mexico and New York also have VMT tax rates that increase with a truck's weight, up to 4.4 cents per mile and 5.5 cents per mile, respectively. New Mexico's VMT tax is levied on trucks with gross weights over 26,000 pounds; if trucks are empty for at least 45 percent of the miles they travel within the state in a given year, the owners can discount their VMT tax bill by one-third. New York allows carriers to choose one of two rate schedules: one based on gross weight for miles traveled while loaded and on unloaded weight for miles traveled while unloaded, the other based only on the unloaded weight of the truck, excluding the weight of any trailers.⁷ Carriers using the former method apply it to trucks and tractors with gross weights above 18,000 pounds; the latter method is applied to trucks and tractors with unloaded weights above 8,000 pounds and 4,000 pounds, respectively. By contrast, Kentucky assesses a flat-rate VMT tax of 2.9 cents per mile and applies it to a smaller set of vehicles—only those over 60,000 pounds in gross weight.

5. Oregon allows trucks to be registered with different declared gross weights for different trailer configurations.

6. The tax rate increases by about 0.3 cents per mile for each additional ton between 26,001 pounds and 60,000 pounds and by about 0.9 cents per mile for each additional ton between 60,001 pounds and 80,000 pounds.

7. Carriers choosing the gross-and-unloaded-weight option can calculate their VMT tax on the basis of either the weights for their heaviest loaded and unloaded trucks or the weights for each individual truck. For more information on New York's VMT tax rate schedules, see New York State Department of Taxation and Finance, "How to Determine Your Highway Use Tax" (accessed April 5, 2019), <https://tinyurl.com/y6zyscy3>.

Of the four states, Oregon has increased its rates most recently, in both 2010 and 2018. New Mexico and New York last revised their rates in 2004 and 2001, respectively; Kentucky has not changed its VMT tax rate since the tax was reinstated in 1988.⁸ Consequently, VMT tax revenues have grown more in recent years in Oregon than in the other states. Specifically, over the 2009–2018 period, Oregon's VMT tax revenues grew by about 55 percent, whereas Kentucky, New Mexico, and New York each saw increases of 5 percent to 15 percent.⁹

The amount of revenues generated by Illinois' optional VMT program is unknown but probably small. Only about 5 percent of commercial and farm trucks in Illinois are registered in the program, which is open only to those operating entirely within the state, and in 2018, only 12 percent of the registered trucks exceeded the yearly mileage limit beyond which the VMT tax was owed on each additional mile.¹⁰ Rhode Island projects that its tolling program will generate \$45 million in annual revenues when all the toll facilities are open.¹¹ In the nine months after the first two facilities opened in June 2018, the tolls, set at \$3.25 and \$3.50, generated about \$5 million.

Evasion and Enforcement

Evasion of truck VMT taxes by carriers that underreport their trucks' weight or mileage or operate unregistered trucks has posed a challenge to some state programs. In fact, extensive evasion has been a significant factor in some states' decisions to end their truck VMT tax programs.¹² (Other factors have included high administrative costs and legal challenges.) Studies in the 1980s and

8. Kentucky's VMT tax was reinstated after the supplemental highway-use tax on heavy vehicles that replaced it in 1986 was declared unconstitutional; see Ron Zimmer and others, *Kentucky's Road Fund Tax Structure* (Kentucky Transportation Center Research Report KTC-99-50, 1999), pp. 52–53, https://uknowledge.uky.edu/ktc_researchreports/361/.

9. Oregon's rate increase in January 2018 contributed to a 10 percent increase in its VMT tax revenues from 2017 to 2018.

10. Staff of Illinois Vehicle Services Department, Commercial and Farm Truck Division, personal communication (March 27, 2019).

11. That projection is based on volumes of traffic in 2016; see Louis Berger Group, *Rhode Island Department of Transportation Investment-Grade Tolling Study Final Report* (submitted to Rhode Island Department of Transportation, November 3, 2017), p. 14, <https://go.usa.gov/xVb9g>.

12. Seven states have repealed their truck VMT taxes since 1989: Arizona, Arkansas, Colorado, Idaho, Nevada, Ohio, and Wyoming.

Table A-1.

Summary of States' Road-User Charges for Commercial Trucks

State	Gross Weight Threshold (Pounds)	Rates (Cents per mile)	Reporting Method	2018 Revenues (Millions of dollars)	Estimated Evasion Rate (Percent) ^a	Other Notes
Illinois	12,001	2.6–27.5, based on weight up to 80,000 pounds	Annual reporting	n.a. ^b	n.a.	The program is optional, offered only for trucks used entirely within Illinois. Participants pay a reduced registration fee and a per-mile tax for mileage over an annual allotment (7,000 for most trucks).
Kentucky	60,001	2.9	Quarterly reporting	82	7 ^c	Carriers report total mileage for trucks in their fleet.
New Mexico	26,001	1.1–4.4, based on weight up to 80,000 pounds	Quarterly reporting	87 ^d	27–43	Vehicles that are primarily used for one-way hauls are eligible for lower rates (reduced by one-third).
New York	18,001	0.8–5.5, based on weight up to 80,000 pounds; 0.28 cents added per additional ton or fraction of a ton ^e	Annual, quarterly, or monthly reporting, depending on previous year's tax liability	111 ^d	33–50	Carriers that have no more than three vehicles transporting certain commodities (such as logs, wood chips, and raw milk) can pay a reduced rate for those vehicles.
Oregon	26,001	6.2–28.8, based on weight and (for trucks above 80,000 pounds) number of axles	Monthly reporting (quarterly offered for carriers in good standing)	328	3–7	Carriers transporting certain commodities (such as logs, wood chips, and sand) can pay a weight-dependent monthly fee instead of the tax.
Rhode Island	n.a. ^f	n.a. ^g	RFID readers	45 ^h	n.a.	Tolls are mainly on Interstate highways. Two of the planned 12 toll facilities are currently operational.

Source: Congressional Budget Office, using information from state taxation and transportation agencies.

Gross weight is the combined weight of the truck, any trailers, and the maximum load to be carried in the registration period.

RFID = radio-frequency identification; VMT = vehicle miles traveled; n.a. = not applicable or not available.

a. The rates shown were estimated in various years from 1996 to 2015; for information about individual estimates, see the text.

b. The state of Illinois does not track the revenues collected from its optional VMT tax, but they are very small compared with those generated by other states' VMT tax programs. Truck owners who anticipate high mileage do not opt into the program; only 1,285 of the 10,690 commercial and farm trucks registered for the program in 2018 (about 12 percent) exceeded the yearly mileage limit beyond which their travel was subject to the tax.

c. State officials consider 7 percent to be an underestimate.

d. Estimated.

e. Rates shown are for miles driven while the truck is loaded; for miles driven while unloaded, rates range from 0.8 cents to 1.4 cents per mile. Carriers can also opt to use a different rate schedule based only on the unloaded weight of the truck without any trailers.

f. Tolls apply to combination trucks of any weight.

g. Fixed tolls of \$2.00 to \$9.50 are charged.

h. Estimated average annual revenues for the completed system.

1990s found that Arizona, Colorado, and Ohio each lost roughly 25 percent to 30 percent of potential VMT tax revenues through evasion.¹³ But other states that repealed their truck VMT tax programs reported significantly lower evasion rates. For example, Nevada estimated that 7 percent of potential VMT tax revenues went uncollected, and a study of Idaho's program found "relatively little evasion."¹⁴

Estimates of evasion rates in current truck VMT tax programs vary widely.

- The most recent estimate for Oregon, from a 1996 study conducted for the state's legislative revenue office, found that between 3 percent and 7 percent of the state's potential VMT tax revenues went uncollected.¹⁵
- A 2015 study in Kentucky estimated that at least 7 percent of its potential truck VMT tax revenues went uncollected. However, state officials consider that estimate low, especially because truck traffic has increased in recent years.¹⁶
- A 2013 report to the New Mexico Legislative Finance Committee found that between 27 percent and 44 percent of the state's potential VMT tax revenues went uncollected.¹⁷
- A 1998 study of New York's program estimated an evasion rate of one-third; a later study by the

American Transportation Research Institute covering the years 2002 through 2005 estimated the rate at one-half.¹⁸

Differences in enforcement methods and efforts help to explain the range of estimated evasion rates. Among the states with less evasion, Oregon uses data collected automatically from vehicles at weigh-in-motion sites to monitor and enforce compliance; also, it requires carriers that do not meet certain criteria identifying them as low-risk to post a bond to ensure that their taxes will be paid in the event of bankruptcy.¹⁹ Notwithstanding Kentucky's relatively low estimated evasion rate, state officials report constraints on their resources for enforcement, such as a reduction of more than 50 percent in the number of enforcement officers over the past decade.²⁰ The state's relatively low rate may partly result from its simpler flat-rate tax structure, which eliminates some of the potential for underreporting weight and might make compliance easier by reducing recordkeeping burdens.

Among the state programs with more evasion, New Mexico's rate may reflect resource constraints: The state's department of public safety has claimed that the presence of state transportation police is "inadequate" for enforcement.²¹ And New Mexico's reported spending on VMT tax auditing in 2013 was about one-eighth the amount Oregon spent in 2017. New York may have less incentive to prioritize enforcement of its VMT tax because the tax provided only about 5 percent of the state's highway fund revenues in 2018 (by contrast, New Mexico's provided roughly 20 percent, and Oregon's provided 25 percent). Additionally, enforcement in New York is difficult because a relatively large number of trucks travel short distances in the state.²²

13. The results of the studies were reported as shares of revenues actually collected. The Congressional Budget Office converted those shares to shares of potential revenues collected. See Government Accounting Office (now the Government Accountability Office), *Highway User Fees: Updated Data Needed to Determine Whether All Users Pay Their Fair Share*, GAO/RCED-94-181 (June 1994), www.gao.gov/products/GAO/RCED-94-181.

14. *Ibid.*, p. 16.

15. Oregon Office of Economic Analysis, *Highway Cost Allocation Study: 2017–2019 Biennium* (prepared by ECONorthwest, 2017), p. 21, www.oregon.gov/das/oea/pages/hcas.aspx.

16. The study, conducted at the Kentucky Transportation Center of the University of Kentucky, is unpublished, but a summary was provided to CBO by Brian Beaven of the Kentucky Transportation Cabinet, personal communication (April 4, 2019).

17. New Mexico Department of Public Safety, Motor Transportation Division, *A Review of New Mexico's Motor Transportation Police Mission and Organization*, Report 13-09 (September 2013), pp. 31–32, <http://tinyurl.com/yya2n96u> (PDF, 3.7 MB). A 2009 study indicated that nearly 30 percent of local carriers had not registered with the state's truck VMT tax program.

18. American Transportation Research Institute, *New York State Ton-Mile Tax Analysis: Estimation of Untaxed Commercial Vehicle Miles Travelled* (February 2008), <https://tinyurl.com/yxe27xom> (PDF, 153 KB).

19. Amy Ramsdell, Oregon Department of Transportation, personal communication (June 17, 2019).

20. Staff of the Kentucky Department of Vehicle Regulation, Division of Motor Carriers, personal communication (March 24, 2019).

21. New Mexico Department of Public Safety, Motor Transportation Division, *A Review of New Mexico's Motor Transportation Police Mission and Organization*, Report 13-09 (September 2013), p. 5, <http://tinyurl.com/yya2n96u> (PDF, 3.7 MB).

22. National Academies of Sciences, Engineering, and Medicine, *Dedicated Revenue Mechanisms for Freight Transportation Investment* (National Academies Press, 2012), p. 50, <https://doi.org/10.17226/22799>.

Road-User Charges on Commercial Trucks in Selected Foreign Countries

A number of countries, most of them in Europe, tax trucks on the basis of the distance they travel. This appendix summarizes various aspects of the tax programs in six of those countries: Germany, Austria, Switzerland, New Zealand, Russia, and the Czech Republic (listed from biggest to smallest in terms of revenues collected).¹ Switzerland and New Zealand tax truck travel on all roads nationwide, whereas the other four countries tax travel only on certain highways (see Table B-1). The trucks included in the countries' tax bases also differ: Austria, Switzerland, New Zealand, and the Czech Republic have the broadest coverage, taxing trucks with gross weights (registered operating capacities) above 3.5 metric tons (7,716 pounds), whereas the thresholds in Germany and Russia are 7.5 metric tons (16,535 pounds) and 12 metric tons (26,456 pounds), respectively.²

Like Appendix A, this appendix summarizes available information on the programs' reporting methods and administrative costs, tax rates and revenues, and evasion rates.³ Steps taken to address privacy concerns are also discussed.

Reporting and Administration

In Germany, tolls are charged using an onboard device that uses GPS to communicate the vehicle's location to Toll Collect, a private contractor that developed and operates the toll system. Because EU law prohibits countries from requiring foreign truckers to install devices to use their roads, drivers of trucks without the devices may pay the toll online or at kiosks at gas stations and highway rest stops; in such cases, the fee is determined on the basis of information reported by the driver about the truck, its origin, and its destination. The U.S. Government Accountability Office reported that the German government paid Toll Collect roughly \$664 million per year—or about 13 percent of the system's average annual revenues—from 2007 through 2011.⁴

The Austrian system does not rely on GPS—instead, microwave transponders mounted behind trucks' windshields communicate with toll-collection devices on road-spanning gantries. (Trucks with German or Swiss onboard devices do not need transponders.) The Austrian government considered extending its road-user charges to all federal and state highways—in part to address complaints that heavy trucks have been changing their routes to avoid using the taxed roads and in part to generate additional revenues for state governments—but rejected the idea. Such a change would have required Austria to shift from its transponder-based system to something else—potentially a GPS-based system like Germany's, which would probably be expensive to

1. For further discussion of international taxes on trucks based on the distances they travel, see Robert S. Kirk and Marc Levinson, *Mileage-Based Road User Charges*, Report for Congress 44540 (Congressional Research Service, updated June 22, 2016); and HVCI, *International Review of Road Funding and Heavy Vehicle Charging Mechanisms* (prepared by Matthew Bereni, National Transport Commission, July 2012), <https://tinyurl.com/y3f5muec> (PDF, 7 MB).

2. New Zealand also levies a similar tax on passenger vehicles using diesel fuel.

3. Foreign currency conversions were made using purchasing power parity exchange rates from the Organisation for Economic Co-operation and Development; adjustments for inflation in U.S. dollars were made using the gross domestic product price index.

4. Over that period, the government spent another 15 percent of average annual revenues—about \$740 million annually—to assist German trucking firms in complying with the system. Government Accountability Office, *Highway Trust Fund: Pilot Program Could Help Determine the Viability of Mileage Fees for Certain Vehicles*, GAO-13-77 (December 13, 2012), www.gao.gov/products/GAO-13-77.

Table B-1.

Summary of Selected Countries' Road-User Charges for Commercial Trucks

Country	Gross Weight Threshold (Pounds)	Rates (2017 cents per mile)	Reporting Method	Road Coverage	Revenues (Billions of 2017 dollars) ^a	Estimated Evasion Rate (Percent)	Other Notes
Germany	16,535 (7.5 metric tons)	19–54, based on weight, number of axles, and emissions	Onboard devices for domestic trucks; self-reports for foreign trucks	National motorway (Autobahn) network	6.1	2	Data are reported in real time. Compliance is monitored using gantries equipped with video cameras and license-plate readers, mobile enforcement vehicles, and random checks of trucking companies. The toll operator is responsible for maintaining data privacy.
Austria	7,716 (3.5 metric tons)	37–92, based on number of axles, emissions, and time of day	Transponders on roads with gantries	Expressways and certain other high-speed roads	1.8	n.a.	German and Swiss onboard devices can serve the role of transponders.
Switzerland	7,716 (3.5 metric tons)	41–106, based on weight and emissions	Onboard devices for domestic trucks, data reported periodically; self-reports for foreign trucks	All roads	1.3	n.a.	Data on distance and driving time are downloaded from the device by the vehicle owner and transmitted to Swiss authorities.
New Zealand	7,716 (3.5 metric tons)	8–95, based on truck configuration and weight	Electronic logging devices or paper licenses verified with odometer readings	All roads	1.1 ^b	5	Electronic logging devices account for more than 40 percent of truck charges.
Russia	26,456 (12 metric tons)	12 (flat rate)	Onboard devices or prepayments for specified one-way routes	Federal roads	0.9	n.a.	Compliance is monitored using gantries and specially equipped mobile patrols that can verify toll registration and payment. Penalties include fines, vehicle seizures, and border stoppages.
Czech Republic	7,716 (3.5 metric tons)	10–146, based on number of axles, emissions, and place and time of travel	Transponders on roads with gantries	Select major roads	0.8	n.a.	Compliance is monitored using tolling gantries and portable monitoring devices on roadways, both of which can be used to dispatch mobile patrols to intercept vehicles. Penalties include fines and the seizure of vehicles.

Source: Congressional Budget Office, using information from Robert S. Kirk and Marc Levinson, *Mileage-Based Road User Charges*, Report for Congress 44540 (Congressional Research Service, updated June 22, 2016); HVCI, *International Review of Road Funding and Heavy Vehicle Charging Mechanisms* (prepared by Matthew Bereni, National Transport Commission, July 2012); Ekaterina Reshetova and Nikita Krupenskiy, "Road Pricing as a Modern Mechanism for Road Sector Financing," in Mikhail Blinkin and Elena Kocheva, eds., *Transport Systems of Russian Cities: Ongoing Transformations* (Springer International Publishing, 2016); Ekaterina Fomina, "We Have Plenty of Reasons to Protest Apart From Platon," *Open Democracy* (December 14, 2017); Road and Motorway Directorate of the Czech Republic, *Roads and Motorways in the Czech Republic: 2016*; and from Toll Collect (Germany), GO Toll (Austria), the Federal Customs Administration (Switzerland), the New Zealand Transport Agency, Platon (Russia), and MYTO CZ (Czech Republic).

Foreign currency conversions were made using purchasing power parity exchange rates from the Organisation for Economic Co-operation and Development; adjustments for inflation in U.S. dollars were made using the gross domestic product price index.

Gross weight is the combined weight of the truck, any trailers, and the maximum load to be carried.

VMT = vehicle miles traveled; n.a. = not available.

a. Based on most recent data.

b. Includes revenues from trucks and passenger vehicles using diesel fuel.

implement. Operational costs for the current system are reported to be about 10 percent of toll revenues.⁵

The Swiss system relies on an onboard device that records distance and driving time. (For trucks pulling trailers, the driver also enters information about the trailer into the device before departure.) Unlike the German devices, the Swiss devices do not convey travel data in real time—instead, the vehicle owner must regularly download the data from the device and send them to the Swiss Customs Administration, which is responsible for collecting payment. To account for travel outside of Switzerland, the system is automatically switched on or off by a microwave beacon at border crossings. Again, vehicles registered in other countries are not required to have the devices. Instead, drivers may register vehicles at a Swiss border crossing and receive an identification card. Each time the truck enters or exits the country, the driver inserts the card in a terminal and enters the vehicle's weight and odometer reading. The government's annual operating costs are variously estimated to be between 4 percent and 7 percent of revenues.⁶

In New Zealand, truck operators (and drivers of diesel-fueled passenger vehicles) must purchase in advance licenses that allow 1,000 kilometers of travel. As of 2016, about 40 percent of all charges for trucks' licenses were collected through installed electronic devices, which can be used to purchase new licenses as needed.⁷ Alternatively, paper licenses placed on the passenger side of the windshield specify the vehicle's odometer readings at the start and end of the license's validity.⁸ Administrative costs for the 2007–2008 fiscal year were estimated to total about 3 percent of revenues but were

mostly covered by administrative fees, which range from about \$2.60 to \$7.30 per license.⁹

Russia's tolling system, known as Platon, is similar to Germany's in that a private contractor, RT-Invest, developed the system and is responsible for its operation. The toll applies to both domestic- and foreign-registered vehicles on all federal highways.¹⁰ Carriers can equip their trucks with an onboard tracking device, which uses GPS to calculate the toll on the basis of the distance a truck has traveled on taxed roads. Alternatively, drivers can pay in advance for one-way tickets based on their planned routes.¹¹ Payments can be made with automatic bank transfers or with credit cards at kiosks, at Platon offices, and online.¹²

In the Czech Republic, road-user charges apply to a network of major roads.¹³ Like the Austrian system, the Czech system uses vehicle-mounted transponders that communicate with antennas mounted on overhead gantries.¹⁴ The toll can be prepaid using cash or a credit card; the transponders issue alerts if the prepaid amount falls below a certain level. Truck owners can also pay tolls after taxable trips through bank transfers or with payment cards known as fleet cards.¹⁵

5. James Hill, Tony Gibson, and Warren Young, *An Independent Review of the New Zealand Road User Charging System* (Road User Charges Review Group, March 2009), <https://tinyurl.com/y3lasmb6> (PDF, 1.8 MB).

6. Bernhard Oehry, *Swiss Heavy Vehicles Fee LSVa* (accessed June 28, 2019), <https://tinyurl.com/y6mevo3y> (PDF, 1.4 MB); Robert S. Kirk and Marc Levinson, *Mileage-Based Road User Charges*, Report for Congress 44540 (Congressional Research Service, June 22, 2016); and HVCI, *International Review of Road Funding and Heavy Vehicle Charging Mechanisms* (prepared by Matthew Bereni, National Transport Commission, July 2012), <https://tinyurl.com/y3f5muc> (PDF, 7 MB).

7. Allen and Clarke, *Evaluation of the New Road User Charges System: Cycle Three Evaluation Report* (December 2016), <https://tinyurl.com/yymtvmx> (PDF, 1.9 MB).

8. New Zealand Transport Agency, "RUC Distance Recorders" (accessed June 28, 2019), <https://tinyurl.com/y4hzs9j6>.

9. The revenues used to calculate that percentage are for the 2008–2009 fiscal year. See James Hill, Tony Gibson, and Warren Young, *An Independent Review of the New Zealand Road User Charging System* (Road User Charges Review Group, March 2009), <https://tinyurl.com/y3lasmb6> (PDF, 1.8 MB).

10. Ekaterina Reshetova and Nikita Krupenskiy, "Road Pricing as a Modern Mechanism for Road Sector Financing," in Mikhail Blinkin and Elena Kocheva, eds., *Transport Systems of Russian Cities: Ongoing Transformations* (Springer International Publishing, 2016), www.springer.com/gp/book/9783319477992.

11. Platon, "About the ETC System" (accessed August 5, 2019), platon.ru/en/about/.

12. Ekaterina Reshetova and Nikita Krupenskiy, "Road Pricing as a Modern Mechanism for Road Sector Financing," in Mikhail Blinkin and Elena Kocheva, eds., *Transport Systems of Russian Cities: Ongoing Transformations* (Springer International Publishing, 2016), www.springer.com/gp/book/9783319477992.

13. Road and Motorway Directorate of the Czech Republic, *Roads and Motorways in the Czech Republic: 2016*, p. 18, <https://tinyurl.com/yywtl8uc> (PDF, 6.4 MB).

14. MYTO CZ, "Tolling System" (accessed August 9, 2019), <https://tinyurl.com/y6hwdj86>, and "General Architecture" (accessed August 8, 2019), <https://tinyurl.com/y4dzpbcz>.

15. MYTO CZ, "Payment Methods" (accessed August 9, 2019), <https://tinyurl.com/yy45bf2v>.

Tax Rates and Revenues

The tax systems in the six countries differ in their rate structures. The Russian charge is a flat rate for all vehicles; the other five systems charge different tax rates based on trucks' weight and, in some cases, number of axles: Three charge higher rates for trucks with more axles, one charges lower rates for trucks with more axles (all else being equal), and one does not take axles into account. Rates in some countries are also adjusted to account for trucks' emissions, the time of day they travel, and the type of road they travel on. In all six countries, the rates tend to be higher, on a per-mile basis, than those charged by the VMT tax programs in U.S. states.

In Germany, the charge per kilometer varies with a truck's gross weight (registered operating weight), emissions, and, in some cases, number of axles. There are three weight classes, with gross weight thresholds of 7.5 metric tons (16,535 pounds), 12 metric tons (26,456 pounds), and 18 metric tons (39,683 pounds). Trucks in the heaviest class are subject to even higher rates if they have four or more axles (presumably because those trucks tend to carry more weight). Trucks are also categorized by their emissions, with trucks that pollute more subject to higher toll rates. The toll rates in the German system range from €0.093 per kilometer (\$0.19 per mile) for trucks in the lowest emissions and weight classes to €0.261 per kilometer (\$0.54 per mile) for trucks with four or more axles in the highest classes.¹⁶ In 2016, Germany raised €4.6 billion (\$6.1 billion) from the tolls.¹⁷ Trucks registered in other countries accounted for 40 percent of the kilometers subject to the tolls.¹⁸

In Austria, rates per kilometer are more than twice as high for vehicles with four or more axles as for two-axle vehicles with similar engines (and, therefore, emissions). Rates for all trucks are also slightly higher at night (from 10 p.m. to 5 a.m.) than during the day. Rates range from €0.1855 per kilometer (\$0.37 per mile) during the day for a two-axle truck that has zero emissions (because it has a hydrogen or pure electric engine) to €0.4620 per kilometer (\$0.92 per mile) at night for a truck that has

four or more axles and is in the highest emissions class.¹⁹ In 2018, total revenues from the toll on trucks were roughly €1.5 billion (about \$1.8 billion).²⁰

Tax rates in Switzerland are based on a truck's gross weight and the emissions category of its engine. As examples, the rate for a 10-ton truck in the highest emissions category is 0.31 Swiss francs per kilometer (approximately \$0.41 per mile), and the rate for a truck with a gross weight of 35 metric tons in the lowest emissions category is 0.80 francs per kilometer (\$1.06 per mile).²¹ In 2017, revenues were approximately 1.6 billion francs (about \$1.3 billion).²²

In New Zealand, the rate charged per 1,000 kilometers depends on the specific class of vehicle, defined by its number of axles and other characteristics. Within a class, heavier trucks face higher charges. New Zealand's road-user charges are designed to ensure that individual users of New Zealand's roads cover the cost of that use, based on recent or anticipated amounts of government spending on the road network. All else being equal, charges are lower for trucks with more axles, consistent with the fact that the most significant source of usage costs is road wear and that distributing a vehicle's weight among more axles reduces road wear. Rates on trucks of different sizes range from 76 New Zealand dollars per 1,000 kilometers (8 cents per mile) to more than 895 New Zealand dollars per 1,000 kilometers (95 cents per mile).²³ In 2017, New Zealand raised about 1.6 billion New Zealand dollars (about \$1.1 billion) in total from trucks and passenger vehicles using diesel.²⁴

16. Toll Collect, "Toll Rates" (accessed July 30, 2019), <https://tinyurl.com/yyz873wx>.

17. VIFG, "Toll and Toll Usage" (archived link, accessed August 1, 2019), <https://tinyurl.com/yxarq6ck>.

18. Robert S. Kirk and Marc Levinson, *Mileage-Based Road User Charges*, Report for Congress 44540 (Congressional Research Service, June 22, 2016).

19. Asfinag, *GO Toll Rates 2019* (January 2019), www.asfinag.at/media/3760/go-toll-rates-2019.pdf (81 KB).

20. Asfinag, "Most Important Facts About ASFINAG at a Glance: May 2019" (accessed September 5, 2019), www.asfinag.at/about-us/investor-relations/.

21. Federal Customs Administration, "HVC—General/Rates" (accessed July 30, 2019), <https://tinyurl.com/y2jg3s2v>.

22. Federal Customs Administration, "HVC—Overview" (January 2017), p. 2, <https://tinyurl.com/yy2ekgpn> (PDF, 439 KB).

23. New Zealand Transport Agency, "Road User Charges From 1 July 2019" (accessed 30 July 2019), <https://tinyurl.com/y99yzy4p>.

24. Brent Lewers, *Increases to Road User Charges: Regulatory Impact Summary* (2019), www.transport.govt.nz/about/governance/ris-bccs/.

In Russia, a flat rate of 2.04 rubles per kilometer (\$0.12 per mile) is charged.²⁵ Estimates from the Russian government put revenues from the toll in 2016 at 22 billion rubles (\$0.9 billion).²⁶

In the Czech Republic, rates are higher for vehicles with higher emissions; for vehicles with more axles; for travel on higher-speed roads (motorways and expressways), which make up the bulk of the taxed network; and for travel between 3 p.m. and 8 p.m. on Fridays. Per-kilometer rates for trucks range from 0.79 Czech koruna (\$0.10 per mile) to 11.76 koruna (\$1.46 per mile).²⁷ In 2017, the toll generated 10.4 billion koruna (\$0.8 billion) in revenues from trucks and buses.²⁸

Evasion and Enforcement

The German system involves an extensive surveillance effort. About 300 gantries have been installed, each equipped with video cameras and license-plate readers. Half of the gantry locations have parking lots where enforcement personnel can check vehicles flagged by that equipment, and about 280 mobile enforcement vehicles are equipped with electronic equipment necessary to verify compliance. Enforcement personnel can also access shippers' premises to verify toll payments against manifests. As part of its contract with the German government, Toll Collect must verify 10 percent of all truck trips and ensure that the violation rate is no higher than 5 percent. Recent estimates place the rate at 1.7 percent.²⁹

In the Austrian system, transponders are placed behind a truck's windshield, which facilitates enforcement efforts. CBO does not have an estimate of the evasion rate in the Austrian system.

Trucks' onboard units in the Swiss system are also mounted behind the windshield, and enforcement personnel can observe lights indicating whether the device is operating and the requisite information about any trailers being pulled has been entered. The Congressional Budget Office has no evasion estimate for Switzerland, either.

In New Zealand, vehicles operated using paper licenses (rather than licenses purchased automatically with installed electronic devices) must have a hub odometer installed on one axle; police and New Zealand Transport Agency inspectors can readily check the hub odometer to determine whether a truck's license is valid. An estimate for the 2007–2008 fiscal year placed the evasion rate at about 5 percent.³⁰

In Russia, enforcement of toll payments falls under the jurisdiction of the transportation ministry.³¹ As in Germany, compliance is monitored with overhead gantries and with patrols of specially equipped monitoring vehicles.³² Penalties include fines of up to 10,000 rubles (\$410), vehicle retention, and border stoppages.³³ CBO does not have information on enforcement costs or evasion rates, although sources suggest that evasion rates may be high.³⁴

In the Czech Republic, portable monitoring devices are stationed along roadways to support enforcement. If a violation is detected by such a device or by a tolling gantry, information about the offending vehicle is transmitted to officers in a mobile enforcement fleet. Enforcement officers may issue fines and, in some

25. Platon, "About the ETC System" (accessed August 5, 2019), platon.ru/en/about/.

26. Ekaterina Fomina, "We Have Plenty of Reasons to Protest Apart From Platon," *Open Democracy* (December 14, 2017), <https://tinyurl.com/y2cqddt6>.

27. MYTO CZ, "Toll Rates" (accessed August 9, 2019), <https://tinyurl.com/yxnf99t>.

28. Ptolemus Consulting Group, "Electronic Toll Collection Global News" (accessed August 8, 2019), <https://tinyurl.com/y5tlzkog>.

29. HVCI, *International Review of Road Funding and Heavy Vehicle Charging Mechanisms* (prepared by Matthew Bereni, National Transport Commission, July 2012), <https://tinyurl.com/y3f5muc> (PDF, 7 MB).

30. James Hill, Tony Gibson, and Warren Young, *An Independent Review of the New Zealand Road User Charging System* (Road User Charges Review Group, March 2009), <https://tinyurl.com/y3lasmb6> (PDF, 1.8 MB).

31. International Road Transport Union, *Tolls/Road Use Charge, Goods Transport: Russia* (April 2017), <https://tinyurl.com/y2gddg45> (PDF, 89 KB).

32. Platon, "About the ETC System" (accessed August 5, 2019), platon.ru/en/about/.

33. International Road Transport Union, *Tolls/Road Use Charge, Goods Transport: Russia* (April 2017), <https://tinyurl.com/y2gddg45> (PDF, 89 KB).

34. Ekaterina Fomina, "We Have Plenty of Reasons to Protest Apart From Platon," *Open Democracy* (December 14, 2017), <https://tinyurl.com/y2cqddt6>.

cases, seize vehicles.³⁵ CBO does not have information on enforcement costs or evasion rates in the Czech Republic.

Privacy

The German road-user toll system includes significant provisions intended to protect privacy. Data on vehicles' toll payments, route, time of travel, registration number, number of axles, or engine characteristics may not be

disclosed or transferred to any other party. Unless a vehicle is under investigation for toll evasion, data communicated by its onboard device or any surveillance devices must be destroyed as soon as the system operator receives payment of a toll or determines that the vehicle is not subject to a charge. The system in New Zealand does not generate information about individual vehicles' itineraries, and the Swiss system does so only to note when a vehicle enters or leaves the country. CBO does not have information about privacy issues in the Austrian, Russian, or Czech systems.

35. MYTO CZ, "General Architecture" (accessed August 9, 2019), <https://tinyurl.com/y4dzpbcz>; and Eurowag, "How Toll Works in the Czech Republic" (accessed August 13, 2019), <https://tinyurl.com/y4pk3aof>.



Modeling Behavioral Responses to Changes in Taxes on Trucks

In the Congressional Budget Office's analysis, all else being equal, levying a vehicle miles traveled (VMT) tax on trucks in 2017 would have caused a slight reduction in trucks' mileage for two reasons. First, some shipments would not have been profitable and would therefore not have been sent, causing a decline in total freight shipping. And second, some freight transport would have shifted from truck to rail because rail shipments would not have been subject to the tax. (Such shifts would have occurred only when the shipper valued truck and rail service about equally for a particular shipment in the absence of the tax.) Trucks' mileage might also have decreased if carriers had used larger trucks to consolidate freight shipments.¹ However, CBO did not analyze that possibility.

To estimate the size of the first two effects, CBO used data from the Census Bureau's Commodity Flow Survey on freight shipments, combined with estimates from a number of economic studies of the price sensitivities (known as elasticities) of those shipments.² The data cover volumes and average distances for shipments, by either truck or rail, of 39 types of commodities within and between each of the 48 contiguous states and the District of Columbia.

Each of the 39 commodity groups is associated with a demand elasticity, which helps determine the effect of a given tax rate on total shipments of the commodity, and a mode-choice elasticity, which is used to calculate the share of the shipments sent by truck or rail. The demand elasticities ranged from -0.1 for coal and petroleum products to -2.6 for electronic components and equipment, meaning that 10 percent increases in

shipping costs would lead to a 1 percent decrease in coal shipments and a 26 percent decrease in shipments of electronic components. The mode-choice elasticity also varied by commodity type but tended to cluster around -0.5 for bulk freight (such as coal, oil, and grains) and -4.0 for finished goods.³

Those elasticities—and many other factors relevant to the analysis, including carrier rates, average payload sizes, fuel efficiency, the extent to which taxes are passed through to consumers, rail-route circuitry, and handling costs—are not known with certainty, so CBO used a simulation approach to estimate the effects of VMT taxes. Under that approach, the effects of a given tax are estimated not by making a single set of calculations but by averaging the results of many sets, each using randomly selected values from specified ranges for the uncertain factors. Specifically, for each tax rate, CBO calculated movements of freight resulting from 1,000 sets of values for the uncertain factors, then averaged those 1,000 results to minimize the influence of any particularly unlikely combinations of the uncertain factors.

Not all of the illustrative tax scenarios considered in this report are defined by a specified tax rate, however. To accommodate scenarios defined by specified revenue targets, CBO calculated the revenues associated with a range of tax rates, then modeled the relationship between revenue estimates and tax rates using a regression analysis. The resulting equation (which is roughly linear) allowed CBO to estimate the tax rate that would achieve each given revenue target, taking into account the reduction in truck mileage (and thus revenues) that that tax rate would cause.

1. That effect would be likely to grow over time, as the mix of trucks in service and the mix of small and large carriers in the trucking industry changed in response to the tax.

2. For a previous CBO analysis using this modeling approach, see David Austin, *Pricing Freight Transport to Account for External Costs*, Working Paper 2015-03 (Congressional Budget Office, March 2015), www.cbo.gov/publication/50049.

3. The latest research on such mode-choice elasticities was published in the 1990s. Subsequent improvements in the freight transport industry (such as better tracking of shipments and better communication between carriers and shippers) may have changed those elasticities. However, CBO estimates that shifts in the mode of transport have been small, and the results of its analysis would not change significantly if plausible alternative elasticities were used.



List of Tables and Figures

Tables

1.	Characteristics of Assessment Methods for VMT Taxes on Trucks	2
2.	Illustrative Scenarios for a VMT Tax on Trucks, Covering All Public Roads, 2017	3
3.	Miles Traveled, by Type of Commercial Truck and Type of Road, 2017	10
A-1.	Summary of States' Road-User Charges for Commercial Trucks	29
B-1.	Summary of Selected Countries' Road-User Charges for Commercial Trucks	32

Figures

1.	Sources of Revenues Credited to the Highway Trust Fund, 2017	5
2.	Revenues and Outlays of the Highway Trust Fund, 2000 Through 2029	6
3.	Considerations in Designing a VMT Tax on Trucks	8
4.	Taxable and Exempt Trucks in CBO's Analysis	9
5.	State VMT Tax Rates for Commercial Trucks	11
6.	Estimated Annual Gross Revenues From Uniform VMT Taxes on All Roads	20
7.	Estimated Annual Revenues From a VMT Tax of 5 Cents per Mile, by the Road Network Included in the Tax Base	21
8.	Estimated Tax Rates to Meet Specific Revenue Targets, by Type of Truck	22
9.	Estimated Annual Revenues From a VMT Tax on Trucks, by Tax Rate and Rate of Compliance	23



About This Document

This report was prepared in response to a request from the Ranking Member of the House Transportation and Infrastructure Committee. In keeping with CBO's mandate to provide objective, impartial analysis, it contains no recommendations.

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CBO continually seeks feedback to make its work as useful as possible. Please send any comments to communications@cbo.gov.

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October 2019