HiRUC
HAWAII ROAD USAGE CHARGE DEMONSTRATION

DEPARTMENT OF TRANSPORTATION
STATE OF HAWAII

POLICY CONSIDERATIONS FOR HEAVY VEHICLE CHARGING

January 2022

Milestone CDM Smith

Contents

Tables

Figure

Preface

As Hawaii residents purchase new cars that consume less fuel (or none at all), the amount of county, state, and federal funding available for roads in Hawaii is declining. Moreover, the link between how much people drive and how much they pay to use the roads is disappearing. Although declining motor fuel consumption is a welcome trend for Hawaii's energy and environmental goals, the Hawaii Department of Transportation (HDOT) has identified it as a risk to sustainable, equitable funding of our roads and bridges.

In 2016, HDOT commissioned a feasibility study of transitioning from the gas tax to taxing miles driven to provide road funding. The study concluded that a per-mile road usage charge (RUC) is feasible for Hawaii, but that several major issues must be addressed first.

In 2017, HDOT secured federal funding for more in-depth research into RUC. From 2018-2019, HDOT conducted a statewide telephone survey of residents, held a series of focus groups, hosted 13 public meetings across all six islands, broadcast one online virtual public meeting, and met with dozens of stakeholders including county officials, neighborhood boards, civic groups, environmental organizations, chambers of commerce, and more. Along with the earlier feasibility study, this "discovery" phase of RUC research revealed concerns about a possible transition from taxing fuel to assessing a fee based on miles driven.

HDOT and its team of researchers reviewed the concerns carefully to understand their meaning, origin, and degree of urgency. Broadly speaking, concerns fall into three categories:

- **Perceptions** are often expressed as concerns. For example, some people believe that a RUC system will unfairly burden rural residents. To address perception-based concerns like this, HDOT conducted research to determine whether there was a factual basis for them and, if so, what could be done to address the concerns.
- **Operational challenges** of a RUC system are often identified as concerns. For example, some people worry that a RUC system would be costly to administer compared to today's gas tax system. To address operational and technical challenges, HDOT conducted research to understand and improve how a RUC system would operate.
- **Policy choices** are sometimes expressed as a concern. Lawmakers and state agencies must make many choices to create a RUC program. For example, they must decide the proper per-mile rate. The rate can be a simple flat rate per mile for all cars, or it can vary based on the type of vehicle. Some people prefer a RUC system that takes into account vehicle weight or emissions in the per-mile rate. For policy choices like this, HDOT conducted research into different options and weighed their relative impacts.

Given the broad range of concerns, HDOT is conducting further research into these topic areas. The results of the research are summarized in policy papers (such as this one).

Policy papers do not contain detailed recommendations on what precisely HDOT or the Legislature should do. That is not their purpose. Instead, the purpose of each policy paper is to provide background and analysis to help lawmakers better understand the impacts and tradeoffs of the decisions they will make about a future RUC system.

Executive Summary

To date, the Hawaii Road Usage Charge project scope has focused on light vehicles (defined as less than 10,000 pounds gross vehicle weight). Pressure on revenues from fuel taxes has risen from the growth in use of electric, hybrid, and other more fuel-efficient light vehicles in Hawaii. As such, the need to develop an alternative to the gas tax has been focused on light vehicles to date. Public outreach in the Hawaii Road Usage Charge Demonstration project has revealed concerns that having a single road usage charge rate for light vehicles, without also charging heavy vehicles, is unfair, because heavier vehicles impose greater wear and tear on the road network and generate higher costs per mile than automobiles. This paper provides a high-level overview of how heavy vehicles are charged for road use in Hawaii today, the key issues to consider in evaluating options for heavy vehicle charging, the options available, and what additional work is needed to develop the options further.

About three percent of all vehicles registered in Hawaii are classified as heavy vehicles (heavy trucks or buses). Although they are a small proportion of all vehicles in the state, they are responsible for between 5 and 7 percent of total vehicle miles traveled on rural roads and around 2.5 to 7 percent of total on urban roads (depending on the type of road).[1]

Heavy vehicles in Hawaii pay for road use by the following means:

- State and county fuel taxes
- Annual state and county registration fees
- Annual state and county weight taxes
- Rental and tour vehicle surcharges (for those vehicles liable)

Although vehicle engine technology has not evolved as quickly for heavy vehicles compared to light vehicles, heavy vehicles are nevertheless trending toward greater fuel efficiency and alternative fuels. Beyond continually improving fuel efficiency of diesel engines, natural gas and hybrid engines offer the greatest promise for a shift toward lower-emission heavy vehicles in the next decade. Hybrid technology continues to grow for trucks and buses; approximately 45 percent of transit vehicles bought across the United States in 2015 were alternatively powered. These increases will lead to less frequent fueling and, thus, declining fuel tax revenues from heavy vehicles.

Oregon is the only state in the United States with road usage charges for both light and heavy vehicles. Oregon's program is a weight-mileage tax that assesses for wear and tear generated by heavy vehicles. Vehicle distance is measured using vehicle odometers or on-board units with and other telemetry. Globally, New Zealand is the only country that has a road usage charge program that applies to all vehicles fueled by diesel, based on weight and distance. Vehicles subject to road usage charge in New Zealand are required to have distance prepurchased in blocks of 1,000 kilometers, based on vehicle weight band and configuration, with distance checked using odometers on light vehicles, hubodometers (odometers attached to wheel hubs) on heavy vehicles, or GPS-based on-board units.

[1] See https://www.fhwa.dot.gov/policyinformation/statistics/2018/vm4.cfm.

Drawing on existing examples and research, this paper examines how to charge heavy vehicles for road use based on the following primary policy objectives:

- Preserve or enhance equity between road users
- Support revenue sustainability
- Achieve user acceptability
- Administer the system efficiently
- Encourage efficiency in vehicle operations

These principles create objectives that support revenue sustainability while preserving and enhancing equity between road users and support both system and road user efficiency. Three illustrative options are presented along that spectrum:

1. Light vehicle road usage charge only: Implement a road usage charge on light vehicles, retain existing taxes on fuel and weight, and establish a credit/rebate system for those paying.
2. Light and heavy road usage charge and weight taxes: Replace all fuel taxes with a weight-based mileage tax and retain the existing weight tax.
3. Light and heavy vehicle road usage charge only: Replace all fuel taxes and the weight tax with a weight-based mileage tax featuring multiple weight bands and options to encourage more road-friendly configurations.

To study road usage charges for heavy vehicles further, there are several recommended research initiatives that would inform decision makers and provide a body of evidence to support policy decisions. These include:

- Desktop study and research into the impact of options;
- Inclusion of heavier vehicles into a future pilot;
- Economic study into Hawaii road cost allocation; and
- Key stakeholders engagement.

Definitions & Abbreviations

TERM/ABBREVIATION	DEFINITION/DESCRIPTION	REMARKS
AAA	American Automobile Association	
AASHTO	American Association of State Highway and Transportation Officials	
HiRUC	Hawaii Road Usage Charge	
HTA	Hawaii Transportation Association	
LNG	Liquefied Natural Gas	
LPG	Liquefied Petroleum Gas	
RUC	road usage charge	
U.S.	United States	

1. Introduction

To date, the Hawaii Road Usage Charge (HiRUC) Demonstration project scope has focused on light vehicles (less than 10,000 pounds (lbs.) gross vehicle weight). The reason for this is that pressure on revenues from fuel tax has arisen primarily from the increased use of electric, hybrid, and other more fuel-efficient *light* vehicles in Hawaii. Therefore, the need to develop an alternative to the gas tax has been focused on light vehicles to date.

Nevertheless, public outreach in the HiRUC Demonstration has revealed some concerns that having a single road usage charge (RUC) rate for light vehicles, without also charging heavy vehicles, is unfair. This is based on perceptions that heavier vehicles impose greater wear and tear on the road network, generating higher costs per mile than automobiles. Regarding vehicles with gross vehicle weights over 10,000 lbs., there is considerable merit to this perception, going back to an American Association of State Highway and Transportation Officials (AASHTO) study from the 1960s and subsequent studies in other states and countries.[2] This research verifies that higher vehicle weights exponentially generate more wear and tear on road surfaces.

Further development of RUC as a policy must address the question as to whether heavy vehicles are included in future trials or RUC systems, because their inclusion or absence will impact a potential RUC program more generally, including technical features, policy design, regulatory aspects, and financial outcomes.

This paper provides a high-level overview of how heavy vehicles are charged for road use in Hawaii today, the key issues to consider in evaluating options for heavy vehicle charging, the options available, and what additional work is needed to develop the options further. Options range from implementing a RUC only for light vehicles and maintaining the existing system for heavy vehicles, to fully replacing fuel taxes and weight taxes with a RUC based on both distance and vehicle weight. Specific options considered in this paper are as follows:

- Implementing a RUC system only on light vehicles, while maintaining existing taxes (including fuel taxes) for heavy vehicles. This would mean fuel tax is retained for heavy vehicles only; for light vehicles paying a RUC, a system would have to be put in place to ensure that any fuel taxes paid are properly credited so that no vehicle is paying both.
- Implementing a RUC system on all vehicles, based on weight and mileage. This would replace the gas and diesel tax, but not the weight tax.
- Implementing a RUC system on all vehicles, based on weight and mileage, to replace the gas, diesel, and weight taxes.

Oregon has been applying RUC to both heavy and light vehicles, albeit with some important technical and policy distinctions. Oregon's experience and that of some other jurisdictions, such as New Zealand, indicate that it is technically and economically feasible to apply RUC to heavy and light vehicles. Other states and more than 10 other countries have implemented distance-based taxation on heavy vehicle road use.

[2] See https://www.fhwa.dot.gov/reports/tswstudy/TSWwp3.pdf and Highway Research Board 1962, The AASHO Road Test, Report 7, Summary Report, Special Report 61G, Publication no. 1061, National Academy of Sciences, National Research Council, Washington, D.C.

For the purposes of this paper, the term “heavy vehicles” will be used to cover not only vehicles with a gross vehicle weight of 26,000 lbs. and over but also vehicles usually regarded as “medium weight” (between 10,000 and 26,000 lbs.).[3] This includes buses as well as trucks. No decision has been made as to whether heavy vehicles would or would not be included in any future RUC system. It is intended that this paper help inform decisions on the inclusion of heavy vehicles in a RUC program

[3] This broadly correlates with definitions of heavy vehicles internationally. In Europe and New Zealand, heavy vehicles are regarded as any vehicle with a maximum gross laden weight of at least 7,840 lbs.; in Australia, it is 10,080 lbs.

2. How Heavy Vehicles in Hawaii Pay for Road Use

As of 2018, across Hawaii, a total of 40,208 heavy trucks and 2,936 buses are registered.[4] This is approximately 3 percent of all vehicles registered in the state (1,267,385). Although heavy vehicles are a small proportion of the total vehicle fleet, they are responsible for between 5 and 7 percent of total vehicle miles traveled (VMT) on rural roads and around 2.5 to 7 percent of total VMT on urban roads (depending on type of road).[5]

Heavy vehicles in Hawaii pay for road use by the following means:

- State and county fuel taxes
- Annual state and county registration fees
- Annual state and county weight taxes
- Rental and tour vehicle surcharges (for those vehicles liable)

This system is a mix of two fixed charges and one usage-based charge for heavy vehicles (and another time-based charge for rental and tour vehicles). Registration and weight taxes are fixed charges, with weight taxes intended to partly recover weight-related costs of road usage from heavy vehicles. Fuel taxes are the only direct usage-related taxes. This usage-based tax assumes that the further heavy vehicles drive, and the more heavily laden they are, the more they pay due to distance traveled and higher fuel consumption per mile.

2.1. State and County Gasoline and Diesel Taxes

Most heavy vehicles use diesel rather than gasoline, and so pay a state diesel tax of $0.16 per gallon. In addition, counties apply their own diesel tax ranging from $0.165 per gallon for the City and County of Honolulu to $0.23 gallon for Maui and Hawaii Counties. Biodiesel is taxed by the state at $0.04 per gallon with Honolulu alone taxing an additional $0.083 per gallon. Measurements of consumption of gasoline compared to diesel indicates that around 10.6 percent of the motor fuel consumed on Hawaii's roads is diesel. There is no breakdown of how much diesel is consumed by heavy vehicles compared to gasoline in Hawaii. Nationally, light-duty vehicles consume about 97 percent of all highway-use gasoline, and heavy-duty vehicles consume about 94 percent of all highway-use diesel.[6]

2.2. Registration Fees

All vehicles pay an annual state registration fee of $45. With total revenues from registration fees of around $46 million, this means around $1.9 million of revenue is generated from registration fees on heavy vehicles. Counties also have their own additional registration fees. For example, Hawaii County charges a flat $12 on all registrations and Honolulu charges $10. County registration fees are nominal because registration fees do not vary by vehicle type.

[4] See https://www.fhwa.dot.gov/policyinformation/statistics/2018/mv9.cfm and https://www.fhwa.dot.gov/policyinformation/statistics/2018/mv10.cfm 2018 is the latest year for statistics at the time of writing.
[5] See https://www.fhwa.dot.gov/policyinformation/statistics/2018/vm4.cfm.
[6] Based on consultant analysis of U.S. Energy Information Administration 2020 Annual Energy Outlook Reference Case Table 37.

2.3. State and County Weight Taxes

In addition to registration fees, the state collects a weight tax. This applies to all vehicles, but for vehicles of 10,000 lbs. gross vehicle weight or less, the rates vary as shown in Table 1.[7]

Table 1: State Weight Tax Rates

GROSS VEHICLE WEIGHT	WEIGHT TAX RATE
Up to 4,000 lbs.	$0.0175 per lb.
4,001-7,000 lbs.	$0.02 per lb.
7,001-10,000 lbs.	$0.0225 per lb.
Over 10,000 lbs.	$300 flat fee

This means all heavy vehicles effectively pay a single flat rate in state weight tax, whereas lighter vehicles pay rates that vary by weight.

Counties also collect weight taxes in addition to registration fees. These tend to be in weight bands as shown in Table 2.

Table 2: County Weight Tax Rates

COUNTY	WEIGHT TAX RATES (ALL HAVE A MINIMUM $12)
Honolulu	$0.075 per lb. for commercial vehicles
Hawaii	$0.025 per lb. for commercial vehicles over 6,500 lbs.
Maui	$0.0436 per lb. for commercial vehicles
Kauai	$0.02 per lb.; $0.03 per lb. (commercial vehicles)

State weight tax revenues were approximately $84 million in 2019 (including light commercial vehicles), but county weight taxes generated ~$220 million[8] because their weight tax rates escalate by weight, unlike the flat state-based weight tax. The state generates the same revenue for all heavy vehicles regardless of weight, but counties charge more as gross vehicle weight increases. The effect of this is depicted in Table 3. As shown, charges vary considerably by county and vehicle weight, effectively encouraging heavy vehicle operators to optimize fleet purchase decisions to recover the high annual cost of weight taxes.

[7] HI Rev Stat § 249-33 (2019).
[8] Sources are: (Honolulu) http://www4.honolulu.gov/docushare/dsweb/Get/Document-235412/FINAL_BBook_Operating_FY20_2019-03_01_v1_OPTIMIZED.pdf.
(Maui) https://www.mauicounty.gov/ArchiveCenter/ViewFile/Item/27268.
(Hawaii) https://www.hawaiicounty.gov/departments/finance/vehicle-registration-licensing/motor-vehicles-fee-information#:~:text=County%20Weight%20Tax,are%202.5%20cents%20per%20pound. Proportionate estimate for Kauai.

Table 3: Weight Tax by County for Various Vehicle Weights (Including State Weight Tax)[9]

	10,000 LBS.	17,000 LBS.	26,000 LBS.	40,000 LBS.	80,000 LBS.
Honolulu	$1,050	$1,575	$2,250	$3,300	$6,300
Hawaii	$550	$725	$950	$1,300	$2,300
Maui	$736	$1,041	$1,434	$2,044	$3,788
Kauai	$600	$810	$1,080	$1,500	$2,700

2.4. Rental and Tour Vehicle Surcharges

The Rental Motor Vehicle, Tour Vehicle, and Car-Sharing Vehicle Surcharge Tax generates about $54 million per year. Although much of that revenue comes from rental cars, it also includes tour buses, which pay between $16 and $66 per vehicle on a monthly basis. It is not clear what proportion of revenue from this surcharge is raised from heavy vehicles, but a high-level estimate based on bus registrations is that it is likely less than 2 percent of total revenues (~$1.1 million).[10]

2.5. Other Sources

Some private local road and road-related facilities are funded from local general sources such as property taxes. In addition, Hawaii receives federal funding for investment in state roads and bridges. Federal funds come from federal gasoline and diesel taxes as well as a heavy vehicle use tax and tire tax. Although local and federal funding are critical to maintaining Hawaii's infrastructure overall, HiRUC focuses on analyzing possible replacement sources for the state fuel tax as a funding source for the state highway system.

[9] Amounts are rounded.
[10] Around 3,000 buses are registered in the State of Hawaii, of which 58% are publicly owned, indicating annual revenue of likely not in excess of $1 million. https://www.fhwa.dot.gov/policyinformation/statistics/2018/pdf/mv10.pdf.

3. Key Challenges for Revenues from Heavy Vehicles

3.1. Diesel Tax Revenue Decline

Although vehicle engine technology has not evolved as quickly for heavy vehicles compared to light vehicles, they are not immune to the trend toward greater fuel efficiency and alternative fuels. Beyond continually improving fuel efficiency of diesel engines, it is natural gas and hybrid engines that offer the greatest promise for a shift toward lower-emission heavy vehicles in the next decade or so.

Both liquefied petroleum gas (LPG) and liquefied natural gas (LNG) are growing in popularity for heavy vehicle use, particularly buses. In 2016, only 3 percent of heavy vehicle sales were natural gas-powered.[11] Across the United States, there have been increases in sales of both kinds of natural gas-powered heavy vehicles,[12] albeit from low numbers (and with sales dominated by buses and refuse vehicles). More recently, United Parcel Service (UPS) announced a purchase of 6,000 LNG-powered trucks by 2022 for its U.S. fleet.[13] LPG is taxed by the state at $0.052 per gallon and LNG at $0.04 per gallon. This means, if either LPG or LNG (or both) grow significantly in use by heavy vehicles, this shift in use will generate on average between 25 and 30 percent less revenue, per mile, compared to use of diesel fuel.

Notwithstanding the emergence of this vehicle engine technology, it is estimated that the proportion of alternative-fuel heavy vehicles in Hawaii is very low. For LPG and LNG, there are only three fueling stations (one of which is private) in the state, which significantly limits likely adoption. The key factors influencing take-up are relative fuel prices, the ability of LNG and LPG vehicles to meet local air emissions standards more readily than diesel, and the availability of specific government incentives for purchases (e.g., California offers carbon credits for use of *renewable* natural gas only).

Heavy vehicle hybrid technology is emerging for lighter trucks and buses globally. The three key types of heavy vehicle hybrids are as follows:

- **Mild parallel hybrids** are relatively simple hybrid heavy vehicles. An electric motor assists the diesel motor during acceleration, particularly from the start, and acts like a generator to capture energy when the vehicle decelerates.
- **Series hybrids** rely on the electric motor to propel the vehicle. The diesel motor is tuned optimally to drive a generator to charge the battery. The battery also may be able to be charged as a plug-in.
- **Power split hybrids** are a more common hybrid configuration. Generally, these vehicles can be driven by the electric motor alone, the diesel motor alone, or any combination of the two, similar to most hybrid automobiles.

While hybrid trucks over 26,000 pounds are rare, multiple heavy vehicle manufacturers have announced product launches for hybrid and electric trucks, including Ford, Kenworth, Scania, and Volvo. For example, Tesla has announced it is developing the Tesla Semi – a pure electric truck

[11] See https://www.fleetowner.com/equipment/article/21695888/act-uptick-for-used-class-8s-and-natural-gas-trucks.
[12] See https://www.truckinginfo.com/337132/natural-gas-truck-sales-are-on-the-rise.
[13] See https://www.fleetowner.com/equipment/article/21131786/truckings-road-to-zero-emissions.

tractor, to be launched later this year. Furthermore, conventional diesel engine technology continues to improve fuel efficiency, such as start/stop technology and ongoing efforts to reduce tare weight of heavy vehicles, all of which reduces fuel consumption (and diesel tax revenues). Hydrogen fuel cell technology in trucks is also under development.[14]

Hybrid heavy vehicles are already seen in Hawaii. Since 2005, *TheBus* (Honolulu) has acquired 58 hybrid buses, and a small number of new local tour buses are pure electric or hybrids. Given trends in other cities, it is likely that hybrid and pure electric buses will become increasingly common. In 2015, approximately 45 percent of transit vehicles bought across the United States were alternatively powered. Although sales of hybrid trucks and buses in the United States are still relatively low, trends in Europe indicate significant growth in such vehicles is likely in the coming five to 10 years. For example, London requires all new buses operating scheduled services in the city to be hybrid or pure electric, to meet environmental policy goals.

Such vehicles are particularly suited for delivery and local use, and it is likely that vehicle technology will make such vehicles increasingly competitive. Given vehicle trip distances are shorter in Hawaii on average, compared to some other jurisdictions, the potential for such vehicles to become an increasingly significant part of the *lighter* truck and bus fleet is likely to be as high as it has been for light vehicles in recent years. Modeling of such scenarios would indicate the likely impacts of trends on gasoline and diesel tax revenue.

3.2. Equity

If RUC is introduced for light vehicles, but not heavy vehicles, it will create two “tiers” of motor vehicles in Hawaii. Light vehicles would be charged based on distance traveled, while heavy vehicles would be charged based on fuel consumed.

RUC for light vehicles ensures that a shift in light-vehicle motive power toward electric, plug-in hybrid, and other alternative-fuel vehicles (and growing fuel efficiency for gasoline-powered vehicles) does not impact net revenue to the state highway fund. It will not matter if all light vehicles are powered by electricity or hydrogen, because they will all pay the same to use the roads.

If RUC is *not* applied to heavy vehicles, revenues from heavy vehicles would be progressively reduced because fuel efficiency decreases revenues from that fleet. Conversely, as the fleet evolves to other alternative fuels, heavy vehicles will pay a smaller proportion of the revenue generated from road use. This can be mitigated in several ways: transitioning heavy vehicles to RUC, increasing diesel taxes, or increasing registration and weight taxes for heavy vehicles. The policy question may be a case of *when* consideration of one or more of these options is most appropriate to meet the state’s transportation policy objectives. Otherwise, heavy vehicle road use would be increasingly cross-subsidized by light vehicles, which is likely to undermine acceptability of RUC to light-vehicle users.

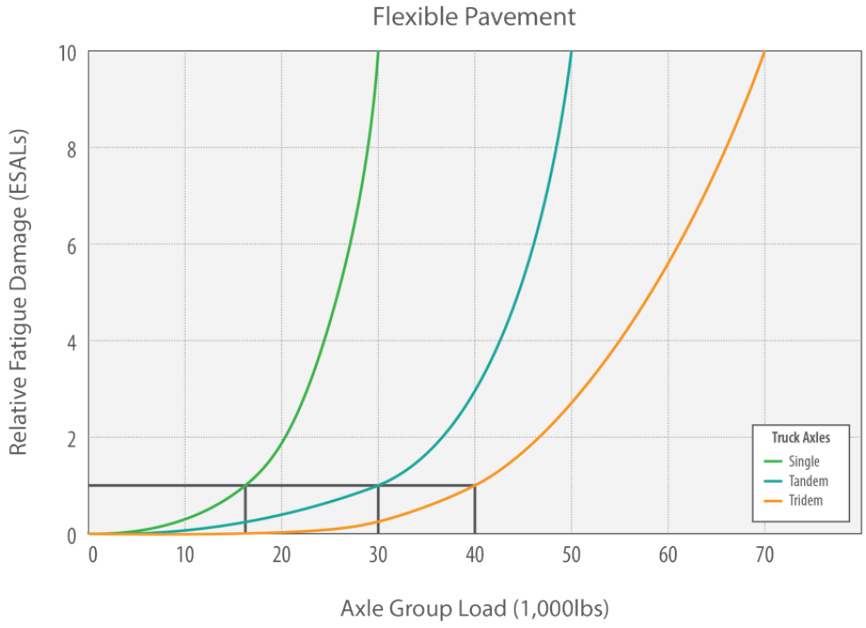
If existing taxes on heavy vehicles are adjusted to offset trends in fuel efficiency, then both fuel and weight taxes will likely increase. Over time, this means that heavy vehicles will be charged increasingly more based on *fixed* charges that do not reflect road use, rather than *usage*-based charges. This means that trucks and buses are taxed increasingly more to be idle, when they are not generating any revenue. At a time of economic downturn, this increases the burden of taxation on truck and bus operators who have less business. (Although, it means tax revenue is more

[14] See https://www.fleetowner.com/running-green/article/21695857/toyota-unveils-fuelcell-class-8-tractor-prototype.

reflective of the size of the fleet than level of activity.) Conversely, during periods of fast economic growth, when vehicles are highly utilized and heavily laden, the extra wear and tear they generate on the road network is only partly reflected by the additional revenue generated from a tax on fuel.

The equity issue has already been raised in public outreach, with some expressing concern that heavier vehicles that generate more wear and tear would pay the same RUC as lighter vehicles. Research from AASHTO many years ago established a general rule regarding pavement wear and tear related to the weight of an axle load, known as the "fourth power rule." In essence, for each extra ton of weight, the additional wear and tear would grow to the power of four. The effect of weight on road maintenance grows steeply from around 8,500 lbs. of total vehicle weight, with a much steeper increase in wear and tear impact beyond 26,000 lbs. of weight. This is depicted in Figure 1.

Figure 1: Effect of Heavy Vehicle Axle Loads on Pavement Damage



Intuitive perceptions from the public about the wear and tear generated by heavy vehicles is reasonable, and allowing heavy vehicles to pay fewer diesel taxes over time and seeking to recover this from a relatively blunt (at least at the state level) fixed weight tax is unlikely to fairly reflect the damage caused by road use (damage that would need to be recovered from other road users, or disproportionately from road users that do not travel many miles). This suggests that eventually including heavy vehicles under RUC should produce the most equitable outcomes between road users, regardless of whether RUC replaces only the diesel tax or the diesel tax and the weight tax.

Another dimension of equity relates to compliant versus noncompliant taxpayers. Regardless of whether RUC is implemented for light- and/or heavy-duty vehicles, the ability for vehicle owners to easily understand and pay the RUC contributes to a system with high rates of compliance. High compliance, in turn, improve equity. A RUC system that leverages the vehicle registration system will see similar levels of compliance and equity as other fees assessed at vehicle registration.

4. Experience Elsewhere

Oregon is the only state with RUC for both light and heavy vehicles. Two other states have a weight-mileage tax for heavy vehicles (New Mexico and New York), and another has a heavy vehicle distance charge (Kentucky), but none of those three states has a light RUC program. Most other states charge heavy vehicles a combination of registration fees and fuel taxes, and some have weight taxes like Hawaii. All face similar revenue challenges.

Outside the United States, New Zealand is the only country that has a RUC program based on weight and distance. It applies to all heavy vehicles and light vehicles powered by diesel. Ten countries in Europe charge heavy vehicles based on weight and distance. The cases of Oregon and New Zealand are most pertinent to Hawaii, given their long-standing experience and the relative sophistication of the approaches of both jurisdictions. Programs in New Mexico, New York, and Kentucky are summarized for comparative purposes.

4.1. Oregon

Oregon established a weight-mileage tax in 1933 for heavy vehicles over 26,000 lbs., alone or in combination. The intent was to charge for potential wear and tear generated by heavy vehicles through weight-mileage tax rather than through fuel taxation and fixed weight taxes. Oregon's weight-mileage tax is effectively RUC for heavy vehicles. Oregon has no annual weight tax as in Hawaii. Furthermore, vehicles paying weight-mileage tax in Oregon do not pay diesel tax unlike in Hawaii. Heavy vehicles are charged the tax monthly (or quarterly if approved) based on the following factors:

- Laden weight in 2,000-lb. bands
- Number of axles (for vehicles weighing more than 80,000 lbs.)
- Miles traveled within the state on public roads

Distance is measured using vehicle odometers or on-board units with global positioning system (GPS) and other telemetry.

Oregon charges between $0.0654 per mile for vehicles from 26,001 lbs. up to $0.3025 per mile for vehicles up to 98,000 lbs. with five axles.[15] It charges less per mile for trucks with more axles to carry the same weight, reflecting the less wear and tear generated by spreading vehicle weight across more axles. For example, a 98,000-lb. truck with nine axles would only be charged US$0.1922 per mile, 36 percent less than a five-axle truck of the same weight. This incentivizes truck configurations that reduce road maintenance impacts. Oregon's weight-mileage tax raised around $335 million in 2018.[16]

4.2. Kentucky, New Mexico, and New York

Kentucky, New Mexico, and New York have weight-mileage taxes similar to Oregon's, albeit less sophisticated.

[15] See https://www.oregon.gov/odot/Forms/Motcarr/9928-2020.pdf.
[16] See https://olis.leg.state.or.us/liz/2019R1/Downloads/CommitteeMeetingDocument/155731.

Kentucky charges a flat rate of $0.0285 per mile for trucks weighing more than 60,000 lbs., in addition to other taxes. New Mexico charges a tax per mile that varies according to the total gross vehicle weight, as seen in Table 4.

Table 4: New Mexico Weight Mileage Tax Rates[17]

GROSS VEHICLE WEIGHT (ALONE OR IN COMBINATION)	TAX PER MILE
12,001-26,000 lbs.	$0.07
26,001-54,000 lbs.	$0.12
54,001-72,000 lbs.	$0.15
72,001 lbs. and above	$0.16

In New York, the "Highway Use Tax" (weight-mileage tax) rates range from $0.0056 per mile (for unloaded weight from 8,001 to 9,000 lbs.) to US$0.0546 (up to 80,000 lbs. with additional rates per ton above that). New York has a range of options for declaring miles traveled when unladen compared to fully laden.

All three states measure distance using self-declared odometer readings reported on paper tax returns. None of those states credit fuel tax paid, although New York does not charge the tax for miles driven on toll roads in the state.

4.3. New Zealand

Outside the United States, New Zealand has had a RUC system since 1978 that applies to *all vehicles fueled by diesel*, based on weight and distance. About three times as many diesel vehicles in New Zealand are light vehicles than heavy vehicles, and its RUC program meant the removal of tax on diesel altogether. Tax on gasoline remains, and gasoline-powered vehicles are not on the RUC program. Vehicles subject to RUC in New Zealand are required to have distance prepurchased in blocks (or multiples) of 1,000 kilometers, based on vehicle weight band and configuration, with distance checked using odometers on light vehicles, hubodometers (odometers attached to wheel hubs) on heavy vehicles, including all trailers, or GPS-based on-board units. This system generates just over $1 billion in net revenues annually. Table 5 summarizes heavy vehicle RUC systems in the jurisdictions discussed in this section.

[17] See https://dot.state.nm.us/content/dam/nmdot/trucking/New_Mexico_Truckers_Guide_2019.pdf.

Table 5: Summary of Heavy Vehicle Road Usage Charge in Select Jurisdictions

JURISDICTION	THRESHOLD FOR HEAVY RUC	PER MILE RATE STRUCTURE	DIESEL TAX RATE[18]	WEIGHT TAX	TECHNOLOGY USED
Oregon	> 26,000 lbs.	Declared weight and number of axles	Not applicable	None	GPS-based on-board unit or odometer reading with quarterly tax filing of distance traveled
Kentucky	> 60,000 lbs.	Flat rate per mile	$0.23/gallon	None	Manual tax filing of distance traveled
New Mexico	> 12,000 lbs.	Maximum allowable weight	$0.2288/gallon	Registration has weight element	Manual tax filing of distance traveled
New York	> 8,000 lbs.	Declared or maximum allowed weight	$0.4243/gallon	Registration has weight element	Manual tax filing of distance traveled
New Zealand	> 7,840 lbs.[19]	Maximum allowable weight and number of axles/tires	Not applicable	Not applicable	GPS-based on-board unit (choice of four providers) or hubodometer reading with prepaid distance license

4.4. Other Jurisdictions[20]

Eleven European countries have heavy vehicle RUC programs based on weight and distance, although none apply RUC to light vehicles. All but two of those countries only apply RUC to heavy vehicle trips on major highways, not local roads. All but two systems introduced RUC to replace a time-based license for heavy vehicle use of the road (known as “vignettes”). These time licenses required heavy vehicle operators to prepay for access to the highway network between one day and one year, based on vehicle weight and emissions rating. No European system has used RUC to replace taxes on fuel.

In early 2020, Australia completed a small-scale pilot of heavy vehicle RUC, using existing GPS-based commercial telematics systems already installed in some trucks and buses. It is now planning a large-scale pilot with 1,000 vehicles across the country. If RUC were introduced in Australia, it would be to replace fuel tax on heavy vehicles and to reduce Australia’s high weight-based registration fees.

[18] Source: https://www.api.org/oil-and-natural-gas/consumer-information/motor-fuel-taxes/diesel-tax includes fuel specific taxes only levied at the level of the state (or nation for New Zealand), not Federal or local taxes.
[19] 3.5 metric tonnes.
[20] Eastern Transportation Coalition ran a pilot test of distance-based charging for heavy vehicles in 2019 that employed a flat per mile rate for all trucks.

4.5. Conclusion

There is extensive experience with weight- and distance-based RUC for heavy vehicles in some states and in other countries. This experience indicates that charging heavy vehicles by distance and weight can work as an equitable and efficient means of collecting revenue. The main barrier to implementation in other jurisdictions is opposition from the trucking industry around concerns that RUC might result in heavy vehicles being charged more than they are now. There is also concern that weight- and distance-based RUC for heavy vehicles would result in higher administrative costs for commercial vehicle owners and operators. In the absence of information to counter such concerns, this is an understandable reaction to the RUC concept. However, a more detailed review of the experience of other jurisdictions will reveal how they have addressed these issues and sustained their weight-distance RUC system, and how the lessons from those jurisdictions may be applicable to Hawaii.

5. Principles for Developing Options

Assessing how to charge heavy vehicles for road use requires some primary policy objectives. The objectives used in this paper are as follows:

- Preserve or enhance equity between road users
- Support revenue sustainability
- Achieve user acceptability
- Administer the system efficiently
- Encourage efficiency in vehicle operations

5.1. Equity

As a principle, all motor vehicles should be charged on a similar basis, to share the costs of maintaining and developing the road network based on usage and their impacts on the network. As indicated, not including heavy vehicles in the current HiRUC Demonstration has given rise to concerns that heavy vehicles are being treated preferentially, in that they would not be charged by distance, but light vehicles would be. It is not uncommon for some road users to perceive that heavy vehicles "don't pay their way," and that the system puts an unfair burden on them. As RUC is being researched in part on the basis that it represents a fair way to pay, based on actual use of the roads, concerns about the absence of heavy vehicles may result in more widespread objection to RUC for light vehicles.

5.2. Revenue Sustainability

Any system for charging heavy vehicles should be sustainable, and not result in revenues declining in real terms due to factors such as changes in vehicle engine technology and the resulting reduced fuel consumption. As mentioned, the core purpose of RUC as a policy in Hawaii is to provide revenue sustainability as a replacement to the gas tax (which increasingly sees revenues eroded due to increased fuel efficiency and movement toward other alternative sources of vehicle motive power). Although at a slower pace, heavy vehicles are also becoming more fuel efficient, and alternative sources of fuel are being rolled out for such vehicles. This indicates that sustainability of revenue from fuel taxes on heavy vehicles will face similar challenges as anticipated from light vehicles, requiring policy action to ensure sufficient revenue is generated to pay for the roads.

5.3. User Acceptability

Alongside equity concerns is the broader need for user acceptability behind RUC. RUC will not be implemented unless vehicle owners and policy makers perceive it to be fair and reasonable. Furthermore, heavy vehicle owners will not accept changes in policy that they will perceive to be complex or unfair. It is critical to propose a RUC system that garners acceptance across all road user groups for such a policy change.

5.4. Efficient Administration

The system of charging for road use should avoid unnecessary complexity, minimize administrative costs for vehicle owners and government agencies, and minimize the opportunity for fraud. The introduction of RUC will add a new system for light vehicle owners. However, if there is no charge

for heavy vehicles, it will mean fuel taxes will remain, and if light vehicle owners pay RUC, the owners who do not drive pure electric or alternative-fueled vehicles will be charged RUC and fuel taxes. Therefore, there will need to be a system in place to refund or credit fuel tax paid by light vehicle owners who are charged RUC, so they are not paying twice. For heavy vehicle owners, they will simply continue to pay as they do now.

5.5. Encourage Efficiency

Whatever system of charging for road use is in place, the rates that are set are, in effect, price signals to owners and operators of vehicles that may influence behavior. Charges that are fixed tend to discourage ownership of vehicles that do not generate enough business to recover those taxes. For example, higher vehicle registration fees and fixed charges such as weight taxes will reduce the likelihood that vehicles are not used, but this also increases the relative burden on vehicle owners that have highly seasonal businesses. In Oregon and New Zealand, RUC has been used to encourage vehicle purchase and usage decisions that reduce wear and tear on their road networks. Adding an axle or second tires on an axle, spreads the weight of a vehicle across more tires, reducing wear and tear on the road, and road maintenance costs. RUC rates in Oregon and New Zealand charge heavy vehicles less for having more axles on a vehicle of a similar weight (see Section 4.1). This has resulted in some vehicle owners choosing to pay more for a vehicle with an additional axle because the savings in RUC more than offset the additional cost, which, in turn, reduces costs of road maintenance. For Hawaii, RUC may be an opportunity to encourage such choices and have a positive impact on the costs of maintaining the road network.

5.6. Additional Issues in Refining and Assessing Options

In addition to the aforemetioned five objectives, other issues that need to be addressed to inform the selection of a preferred option are as follows:

- Future of the state gasoline/diesel tax (and county fuel taxes)
- Administrative costs for government and operators in having parallel systems for light and heavy vehicles
- Possible technical options for applying RUC to heavy vehicles
- Impacts of various options on heavy vehicle operators and government, including distributional impacts by county and industry sector

5.6.1. Future of State Fuel Taxes

One of the central elements of the HiRUC Demonstration is the exploration of an alternative to fuel taxes. The underlying assumption is that, for light-duty vehicles, if RUC were introduced, then there would be no need to keep the state fuel tax for highway purposes. However, if RUC were not introduced for heavy vehicles, fuel tax would need to be retained for application to those vehicles.

Should the fuel tax remain in place to capture revenue from heavy vehicles, then light vehicle users paying RUC will require a method for obtaining refunds of fuel taxes paid; otherwise, such vehicles would be paying twice to use the roads.

Alternatively, one transitional option is to remove the gasoline tax and apply RUC to gasoline vehicles, leaving the diesel tax in place to address heavy vehicles.

A little known, but significant, equity issue that would be resolved if the diesel tax were abolished is the removal of diesel highway taxes on diesel consumed by power companies in Hawaii.

5.6.2. Administrative Costs in Having Multiple Systems

Retention of a fuel tax for heavy vehicles only would have a very low administrative cost, because costs of collection are insignificant. However, if RUC were applied to some vehicles that also pay fuel taxes, a refund/exemption system would be needed, adding costs to government, road users, and possibly fuel retailers.

Part one of the HiRUC Demonstration tested a system that estimated the gas tax calculated from miles driven using U.S. Environmental Protection Agency (EPA) fuel efficiency estimates. This option was low cost and not complex to implement, because it did not require inputs from road users, the use of receipts, or records of actual consumption or implementing an exemption to the gas tax at the point of purchase. Although it may not reflect every individual driver's personal fuel usage exactly, any alternative would need the technology or process to record and transmit actual fuel consumption or fuel purchases to calculate precisely how much of a refund/rebate to pay.

The effect would be adding the costs of RUC collection onto the existing system for fuel taxes, which would be retained, and adding the costs of a refund/exemption system for those fuel taxes. Further work is needed to identify those costs and investigate alternatives, particularly if they were to apply to heavy vehicles for a transitional period as well.

5.6.3. Technical Options for Heavy Vehicles Needed

If RUC were introduced for heavy vehicles, not all technical options for mileage reporting for light vehicles are appropriate for heavy vehicles. Larger trucks that do not always operate with trailers as tractor-trailer articulated trucks will need technology to identify when they do and do not operate with trailers. There are options to do this, including having separate devices on trailers to report miles, or having on-board units that communicate with devices on trailers to identify them, and report miles with or without trailers. Other options exist that could be evaluated as part of a future program including heavy vehicles. RUC for heavy vehicles would require some technical work and conducting pilots with heavy vehicle operators, which is beyond the scope of the current HiRUC Demonstration program.

5.6.4. Industry and Government Impact Analysis

It has not been determined what impacts any options to introduce RUC for heavy vehicles will have on operators in Hawaii, by industry type, or location and fleet, nor what impact it might have on state revenues, or the costs of setting up and operating a RUC system.

Impact analysis research on details of these impacts fall under two broad categories:

- Impacts on the industry (heavy vehicle owners and operators)
- Impacts on state revenues and administration costs

Impacts on state revenues would seek to forecast how various options impact future revenues. Although such forecasts may not identify what proportion of revenues *should* be recovered from heavy compared to light vehicles, it could start with the assumption that proportions are maintained as they are today. In addition, any policy choice has administrative costs for public agencies. Options should be assessed against what costs would be generated in having RUC for heavy vehicles, including application of charges, processing of payments, and enforcement. Any costs could be offset by the abolition of fuel and/or weight taxes and their associated administrative and enforcement costs.

In turn, the impacts on heavy vehicle owners and operators comprise two sub-categories:

- How much heavy vehicle owners pay the state (and counties) to own and use their vehicles on public roads
- What compliance costs they bear

The first sub-category is simply an impact analysis that compares current charges (taxes on fuel and weight) with what RUC might charge comparably (whether it simply replaces fuel tax or also replaces weight taxes). This would need to take into account whether RUC may be used to encourage use of vehicle configurations that have lower impacts on the road network.

The second sub-category of industry impacts compares costs of compliance with existing taxes (notably weight taxes), with any need to report distance or have any specific equipment to record and transmit data to be assessed by RUC. This is a key concern for some heavy vehicle operators and is largely a function of how a heavy vehicle RUC system might be designed. States/regions with experience can provide information on this. One cost to consider is the impact of having a fuel tax refund system, and any savings from removing weight taxes.

6. Options for Taxing Heavy Vehicles

The options developed in this section reflect the principles in the previous section. The objectives are to support revenue sustainability while preserving and enhancing equity between road users and to support both system and road user efficiency.

The range of options available for treating heavy vehicles includes no change through to implementing some form of RUC with partial or total replacement of existing charges. The inclusion of these options is not a judgment of their appropriateness over the longer term. It is likely that heavy vehicle motive power technology will result in the same challenges for revenues from heavy vehicles by taxing fossil fuels as is arising for light vehicles today.

This paper identifies three illustrative options along that spectrum, as summarized:[21]

1. Light vehicle RUC only: Implement RUC on light vehicles, retain existing taxes on fuel and weight, and establish a rebate system for those paying RUC.
2. Light and heavy RUC and weight taxes: Replace all fuel taxes with a weight-based mileage tax and retain the existing weight tax.
3. Light and heavy vehicle RUC only: Replace all fuel taxes and the weight tax with a weight-based mileage tax featuring multiple weight bands and options to encourage more road-friendly configurations.[22]

These options also represent possible evolutions, from one approach to another over time.

6.1. Option 1: Light Vehicle Road Usage Charge Only

This option involves no changes to how heavy vehicles are charged. Registration and weight taxes would continue, as would diesel taxes. A policy justification for not including heavy vehicles at this stage is that pressures on revenues are focused on light vehicles, and technology for heavy vehicle motive power has not changed as rapidly as that for light vehicles (while retaining the option to transition heavy vehicles at a later date). The introduction of RUC for light vehicles only would be unlikely to restrict options for the introduction of RUC for heavy vehicles at a later date, though heavy vehicle RUC has additional complexities compared to light vehicle RUC.

It is assumed that light vehicles would be subject to a single RUC rate per mile, but the future of fuel taxes paid by light vehicles would be a key policy issue (this is subject to a separate policy paper).

[21] An option of introducing a flat mileage tax for heavy vehicles was rejected for inclusion in this paper. No jurisdiction has replaced fuel taxes for heavy vehicles with a flat mileage tax. Fuel tax contributions increase for vehicles based on weight, so charging a flat mileage rate for heavy vehicles, regardless of weight, would likely have significantly negative impacts on revenue and equity. Consequently, such an approach in Hawaii would put significant upward pressure on weight taxes to offset the reduction in revenue.
[22] Weight taxes also apply to light vehicles, but the future of those taxes, if RUC is introduced, has not been considered here but might be considered if weight taxes for heavy vehicles are replaced with RUC.

It would be possible to remove the gasoline tax and subject all gasoline vehicles to RUC (including heavy vehicles that use gasoline), accepting that heavy vehicles account for a very small percentage of gasoline consumption. (Although, this would incentivize a small shift from diesel- to gasoline-powered heavy vehicles, few such vehicles are available at weights of more than 20,000 lbs.)

Alternatively, it would be possible to leave the gasoline tax in place and develop a fuel tax refund or rebate approach for those vehicles subject to RUC. This would require a parallel system to be introduced alongside RUC to refund or rebate fuel taxes paid for vehicle subject to RUC. However, over time, revenues would reduce progressively from heavy vehicles as changes in vehicle technology result in decreasing yields from gasoline and diesel taxes, just as with light vehicles. This would increase pressure to increase these taxes (and taxes on natural gas options), encouraging further changes in the vehicle fleet to reduce consumption.

Advantages: Simplicity—heavy vehicle user acceptability does not preclude other options in the future, but it enables RUC for light vehicles to be "bedded in" before further evolution.

Disadvantages: Revenue erosion from vehicle engine technology changes in heavy vehicles will continue and grow. Diesel taxes would need to be retained, and possible gasoline taxes as well, which could require a fuel tax refund/rebate/exemption system alongside RUC. Perceptions of unfairness as light vehicles pay an increasing proportion of revenues, unless diesel taxes are increased sufficiently to keep pace, might result in deferment of RUC for light vehicles.

6.2. Option 2: Replace All Fuel Taxes with Light and Heavy Vehicle RUC

As in Oregon, RUC could be extended to heavy vehicles by varying the rate structure by weight category and/or charging differentiated rates by number of axles for heavier weights. Once all vehicles are transitioned to RUC, fuel taxes could be abolished, and the RUC rate structure could reflect weight and broadly what fuel consumption (and tax paid) different groups of vehicles pay currently. Heavy trucks would need a technical option to report the presence or absence of trailers to aid in reporting gross vehicle weight. This option would retain existing weight and registration taxes, because RUC rates would be based on average fuel tax payments, by weight category. Rates could vary by county if desired; although, that should reflect decisions on geographic and political variations in rates around light vehicles. The policy justification for this option would be to transition all vehicles at a similar pace and minimize the duration of the parallel operation of fuel taxes and RUC, to reduce administrative costs.

The vehicle fleet would need to be categorized by weight bands, with larger bands for light and medium weight vehicles, and smaller ones for larger weights (e.g., a single band for light vehicles, then bands around 10,000–18,000 lbs., 18,000–26,000 lbs., 26,000–33,000 lbs., and so on). Research would be needed to survey the average fuel consumption of vehicles within those bands, as well as identify differences between trucks hauling trailers compared to those without. Policy and technical issues that would need to be considered include the following:

- The basis upon which weight is calculated (and the technical and operational issues around this).[23]

[23] Typically, the choice is whether to rate a vehicle based on maximum allowable weight or on reporting of its actual weight. Maximum allowable weight includes an average load factor across all vehicles of that type base, so that – on average – weight per mile is about right. Actual weight requires some sort of measurement, reporting and audit so is more complex as there is potential for fraud. Actual weight is rarely used in practice.

- Whether heavy vehicles that haul trailers would be treated as a single vehicle (as in Oregon) or the trailer and tractor units charged separately (as in New Zealand).
- Appropriate technologies for heavy vehicles to report miles, which may not necessarily be the same as those used for light vehicles.
- Whether for heavy vehicles, some record of vehicle location identification may be needed to ensure they pay differential rates by county (although in most cases this could be readily identified).

A challenge of this approach is that, in retaining weight taxes alongside a RUC system that has rates varying by weight, the perception would be that weight is being taxed twice, even though RUC would only be replicating the current fuel tax. However, a weight-based RUC could still evolve to replace such weight taxes in the future, reducing administrative costs and complexities once RUC has been established.

Advantages: RUC for all vehicles could fully replace fuel taxes, securing revenue sustainability, allowing those taxes to be removed for highway funding purposes, and eliminating any need to retain a refund system for light vehicles. All vehicles would pay broadly what they pay now, improving perceptions of fairness. This approach is proven in other jurisdictions. Retention of weight taxes would keep some revenue not dependent on significant variations in demand, but RUC allows revenue to better reflect usage and impacts on the network.

Disadvantages: Specific technical options need to be developed for heavy vehicles to report miles and configuration. Retention of weight taxes would result in perceptions of paying twice for weight.

6.3. Option 3: Replace Fuel and Weight Taxes with Road Usage Charge on All Vehicles

Similar to Option 2 technically, (in terms of the implementation of RUC) this third option extends beyond RUC by replacing fuel taxes to also include replacement of weight taxes.[24] The main effect is that the rate structure would see higher per-mile rates on heavier vehicles to offset lost weight tax revenue, so that most heavy vehicles would only pay RUC and registration fees. Beyond the work required for Option 2, revenues from weight taxes are modeled on a per-mile basis across the state and by county, so that RUC rates reflect both average fuel consumption and weight tax revenues. Rates may reflect relative impacts of various configurations on road damage to encourage road friendly configurations for higher weight vehicles. Vehicles get classified based on maximum allowable weight and wheel configuration, and pay rates reflecting relative road impacts. Generally, the heavier weights a vehicle can carry, the more it would be charged, but the higher the number of axles or tires, the lower the charge for the same weight. Oregon and New Zealand have heavy RUC systems that correspond with this option.[25] The policy justification for this option would be to use RUC to simplify the tax structure for vehicles more generally and focus taxing of vehicles more on usage rather than ownership.

[24] This may also require weight taxes on light vehicles to be removed, with countervailing increases in RUC rates for those vehicles.
[25] Oregon also allows vehicle owners to declare actual weight in their RUC tax returns, but owners must keep detailed records to provide verification of this for audit purposes.

Rates also may vary by county if desired. Although, that should reflect decisions on geographic and political variations. Such a variation requires a means to identify the broad location of trips by county. This need not necessarily be complex, given counties are distinguished by islands.

The key challenge of this approach pertains to additional work on rates tables and the need to manage the transition away from weight tax revenues. However, this would be a simple evolution from Option 2. Furthermore, as with Option 2, the impacts are uncertain across the heavy vehicle fleet, and additional research is needed on the impacts of different charge rate structures on heavy vehicle operators and state revenues.

Advantages: RUC for all vehicles could fully replace fuel taxes, securing revenue sustainability, allowing those taxes to be removed for highway purposes, and eliminating any need to retain a refund system for light vehicles. Replacement of weight tax would mean revenue would grow as heavy vehicle traffic grows. Administrative costs for government and costs for heavy vehicle operators would decline by not having to collect an additional tax. This approach offers scope to refine RUC rates to encourage use of more road-friendly configurations. All vehicles would pay broadly what they pay now, improving fairness and perceptions of fairness. This approach is proven in other jurisdictions.

Disadvantages: Specific technical options need to be developed for heavy vehicles to report miles and configuration. Revenues are more susceptible to sudden downturns in demand, rather than fleet size. Weight taxes also should be removed for light vehicles, resulting in light vehicle RUC rates increasing.

7. Further Work

The purpose of the HiRUC Demonstration is to enable public outreach about RUC with the general public, and it was decided that the project would not include heavy vehicles at this stage. If it is decided to consider the role of RUC regarding heavy vehicles further, there would be significant policy value in undertaking a number of research initiatives to inform decision makers and provide a body of evidence to support policy decisions.

To better inform decisions on options for heavy vehicles, a number of approaches are proposed to obtain additional data and to facilitate analysis on the impacts, costs, and industry acceptability of those options, as well as developing stakeholder buy-in to whatever policy option is decided upon:

1. Desktop study and research into the impact of options
2. Inclusion of heavier vehicles into a future pilot
3. Economic study into Hawaii road cost allocation
4. Engage with key stakeholders

7.1. Impact Study

An impact study would include more detailed gathering of data about heavy vehicle trips including distances traveled, vehicle types (specifically by weight), and fuel consumption. This would include a mix of surveys and observational data so that heavy vehicles could be categorized by county, industry sector, vehicle type/weight, and trip type. Desktop analysis could be undertaken for a number of scenarios. It would consider forecasts of future fleet composition (including adoption rates of alternative-fuel vehicles) and their impacts on state revenues. This should improve the understanding of what the impact of an option would be on a specific type of heavy vehicle business (e.g., tour bus, local delivery, containerized freight), which may inform decisions on what options are put forward for further development, and how policy options for heavy vehicles might be adjusted to minimize negative impacts. This study could be used to inform the incorporation of heavy vehicles into a future RUC pilot.

7.2. Heavy Vehicle RUC Pilot

Should Hawaii move forward with RUC for light vehicles, there are likely to be considerable merits in including heavy vehicles in a RUC program, either on their own or as part of future research. Heavy vehicle participation would be to engage primarily with heavy vehicle operators in what a RUC system for heavy vehicles might look like, but also to enable them to compare what they might pay under a RUC system to what they pay now. Experience from New Zealand's and Oregon's heavy vehicle charging programs, as well as the inclusion of trucks as a small group in the Australian National Heavy Vehicle Charging Pilot, could be applied and adapted for conditions in Hawaii, so that one or more RUC options are available for heavy vehicle operators to choose from to inform future policy.

7.3. Economic Study into Road Cost Allocation

A more fundamental approach to understanding whether and how to include heavy vehicles in future transportation revenue policy would be to undertake an economic cost allocation study, similar to that undertaken regularly in Oregon and New Zealand, to establish how to fairly allocate highway costs among various groups of road users. Such a study would combine engineering and economic approaches, looking at future needed revenues for the highway network, expected traffic volumes by vehicle type, and cost divisions for maintaining and upgrading the network between types of road users. It would look at different types of costs (maintenance and network enhancements) and how these costs are generated (e.g., attribution to the effects of weather compared to road traffic and the relevance of weight in generating wear and tear). The study should look at the differences in costs specifically between counties and between state and county roads, to consider how vehicle fleet mixes and local conditions impact on costs and how well those costs are recovered from taxes at different levels of government.

This will provide a relatively objective basis upon which to develop future policy and engage with road user groups on how much different types of vehicles should pay, and if there is a need for policy mechanisms to address any significant disparities in costs and revenues between counties or user groups. Such a study would not decide policy, but it would provide an evidential base to enable answers to questions such as *"Is X paying enough to use the roads?"* based on analysis.

7.4. Engage with Key Stakeholders

As with light vehicle owners, it is critical to engage with key stakeholders as to the advantages, disadvantages, costs, and impacts of the options on how heavy vehicles should be charged for road use. This engagement should be supported by the evidence that would be generated by an impact study and a road cost allocation study. It may precede or follow inclusion of heavy vehicles in a future RUC project, and seek to examine how options might affect them, as well as providing information relevant to how RUC might work for them (which may differ from the application of RUC to light vehicles).

These stakeholders include:

Commercial vehicle and heavy truck owners or fleet operators: This group includes commercial vehicle owners, trucks and buses. Consideration of RUC on heavy vehicles will have a direct impact on businesses and input from commercial vehicle and heavy truck owners and operators will be critical to informing policy decisions about whether and how to proceed with any type of reforms to Hawaii's road funding model for heavy vehicles.

American Automobile Association (AAA): Although the AAA represents private vehicle owners, all vehicles use the same road network, and how they pay to use the roads affects all users, because the money collected is used to maintain and upgrade the network. The AAA will seek to ensure that reformation of road use taxation treats its members fairly and does not result in an unreasonable share of road infrastructure costs.

Organizations that analyze governmental tax scenarios and educate the public and stakeholders: Since RUC is a tax reform, it is important to ensuring reforms are both equitable and promote economic growth and stability. It is important to understand how charging of heavy vehicles affects goods producers, consumers, service providers to industry, and tourism.

Counties: Given that countries rely disproportionately on fixed weight taxes and fuel taxes for revenue to fund county road systems, any possible changes to the state-level funding mechanisms could represent opportunities for the counties to likewise make changes in parallel. County involvement in HiRUC to date has focused on the possible interest of counties in converting light-duty vehicles from fuel taxes to per-mile taxes. Should this concept take hold, a natural extension of this collaboration is to examine whether and how counties may wish to reform heavy vehicle charging and road funding.