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# RUC AND CLEAN VEHICLE ADOPTION

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## Preface

Hawaii pays for the repair and upkeep of its state roads and bridges from taxes and fees on highway users. Funding sources for this repair and upkeep include vehicle registration fees, weight taxes, rental car surcharges, and motor fuel taxes. Historically, motor fuel taxes have generated the largest share of money for state roads and bridges. At 16 cents per gallon on gasoline and diesel, motor fuel taxes are the only revenue source based on how much drivers use the road network. Hawaii's counties also tax fuel in order to pay for county roads, at rates that vary from 16.5 to 23 cents per gallon. Additionally, the Federal government funds the Highway Trust Fund using a federal tax of 18.4 cents per gallon of gasoline, and 24.4 cents per gallon of diesel.

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

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

RUC is a concept where roads are funded by charging vehicle owners an amount based on how much they use those roads. However, there are many details to consider before RUC can be enacted into law or implemented into practice.

In 2017, HDOT secured federal funding to perform more in-depth research into RUC. From 2018-2019, HDOT conducted this research which included a statewide telephone survey of residents, holding a series of focus groups, hosting 13 public meetings across all six islands, broadcasting an online virtual public meeting, as well as meeting with dozens of stakeholders (including county officials, neighborhood boards, civic groups, environmental organizations, chambers of commerce, etc). Building on the earlier feasibility study, this "discovery" phase of RUC research revealed several community concerns regarding the potential transition from the "taxing of fuel" model to a "fee based on miles driven" model.

HDOT and its team of Hawaii Road Usage Charge (HiRUC) researchers reviewed these concerns carefully in order to fully understand their meaning, origin, and degree of urgency. Broadly speaking, the concerns fall into three categories:

- ▶ Often, public **perceptions** are expressed as concerns. For example, some members of the public believe that a RUC system will unfairly burden rural residents. To address perception-based concerns, HDOT conducted research to determine whether there was a factual basis for these assertions and if so, what approaches exist to address these claims through policy or system design adjustments.
- ▶ The operational **challenges** that a RUC system will face are also often identified as concerns. For example, some stakeholders and members of the public worry that a RUC system would be costly to administer, as compared to the current system of fuel taxation. To address these operational and technical challenges, HDOT conducted research to better understand and improve the RUC system design.

- ▶ Sometimes, a policy **choice** is expressed as a concern. Lawmakers and system designers will have to make many choices when creating a RUC program. For example, they must choose a rate, which can be a simple flat rate per mile for all cars, or can vary based on the type of vehicle. Some members of the public would prefer a RUC system that incorporates vehicle weight, or vehicle emissions, as a factor in the rate. HDOT conducted research into the various policy choices available, as well as the relative impacts, strengths, and weaknesses of each approach.

Given the varying concerns and topics they span, HDOT decided to organize further research into these topic areas. For each topic area, a “policy paper” was initiated to summarize the nature of the concern (or concerns) within the topic area, the results of research, the analysis into the concerns, as well as the implications of the research on RUC policy or system design.

The purpose of these policy papers is not to contain recommendations or clear answers on what precisely HDOT or the Legislature should do. The purpose of each policy paper is to provide adequate background and analysis to support decision-making by lawmakers and system designers as they contemplate the enactment of a RUC system.

## Executive Summary

Road usage charging (RUC) is the concept of charging vehicles based on distance driven, instead of gasoline consumed, to generate revenue to invest in the repair, upkeep, and safe operations of state roads and bridges. As consumers adopt more fuel-efficient and electric vehicles (EVs), fuel consumption and fuel tax revenue available for roads are declining. RUC is one way to generate sustainable usage-based revenue for roads and bridges regardless of vehicle type or fuel consumption.

During the outreach phase of the Hawaii Road Usage Charge Demonstration Project (HiRUC), stakeholders and members of the public raised the issue of aligning a prospective RUC with the state's policy to encourage adoption of clean vehicles, including EVs. In response, this paper frames the issue, analyzes the nature and magnitude of the impacts of RUC on clean vehicle adoption, and offers approaches for aligning the two policies that have been used in other jurisdictions.

Introduction of RUC in Hawaii would result in varied cost impacts for motorists depending on the type of vehicle they drive. For example, based on the current fuel tax, a flat per-mile RUC on all vehicles would result in vehicles with below-average fuel economy paying less per mile. By contrast, vehicles with above-average fuel economy would pay more. RUC applied only to electric vehicles (EVs) would preserve the current gas tax on all other vehicles, but would result in increased operating costs for EV owners.

Based on data from the state's vehicle registry and odometer readings collected during the periodic motor vehicle inspection process, analysis shows that under a state RUC of 0.8 cents per mile on all vehicles, a majority would owe within \$10 of what they pay in a year under the state gas tax of 16 cents per gallon. About 84% of vehicles would owe within \$25 of what they pay today in state gas taxes in a year. Only 5.7% of vehicles would pay \$35 or more on top of what they pay today in state gas taxes in a year. Among vehicles owing \$35 or more, all have above-average fuel economy, and the average annual miles driven is 19,910, double the state average.

Nationally, the key barriers to adoption of EVs by the public are limited choices of vehicle models, range anxiety (which is less pronounced in Hawaii), confusion or concern about charging at home, lack of understanding of the operating cost savings of EVs, and higher purchase prices.

EVs have a clear advantage over all other types of vehicles in total cost of vehicle operation, which include usage-based costs such as motor fuel, electricity, maintenance, tires, and usage-based fees like fuel taxes and RUC. High fuel economy vehicles such as newer sedans are the second least costly vehicle category, with older model pickup trucks and SUVs being the costliest. Switching the entire vehicle fleet or only EVs from a fuel tax to a RUC preserves the operating cost advantage for EVs and high fuel economy vehicles. Whether RUC or fuel tax, usage-based fees constitute about 5% or less of vehicle operating costs.

On the other hand, EVs face steep disadvantages when it comes to the cost of vehicle ownership, which include purchase and financing costs, insurance, and state and county registration fees and weight taxes. EVs are costlier to own than equivalent gas-powered sedans, but slightly less costly on average than newer model pickups and SUVs. The majority (60-75%) of these costs of ownership is due to the purchase price. State and county registration fees, including a \$50 state surcharge and \$100 Maui County surcharge on EVs, account for another 6-9%.

In examining what other jurisdictions have done to encourage EV adoption, either alone or in combination with introduction of RUC, 12 approaches emerged for consideration in Hawaii. Seven of

these approaches combine introduction of RUC with policies aimed at encouraging EV adoption, such as offering lower introductory per-mile rates to EVs; delaying application of RUC to EVs until adoption rates reach a pre-determined threshold; introducing RUC on all vehicles to ensure equal costs for equal road usage; and various forms of introducing RUC in combination with reducing or eliminating ownership taxes such as EV registration surcharges.

Other measures that address clean vehicle adoption that can be taken together with RUC or independently from RUC include dedicating revenue from EVs to electrification, EV purchase tax credits or rebates, electricity discounts, and preserving other incentives such as carpool lane access. The U.S. federal government and Hawaii are already undertaking many such policy measures to encourage EV adoption, and the global auto industry is investing in a more diverse, lower-cost line-up of vehicles to meet consumer preference. The Australian State of Victoria offers a recent case study in combining RUC on EVs as a revenue policy tool together with EV incentives. Victoria policymakers found sufficient support from the combined policies to enact them in state legislation. Victoria began assessing RUC on EVs July 1, 2021.

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## Definitions & Abbreviations

| TERM/ABBREVIATION | DEFINITION/DESCRIPTION              | REMARKS |
|-------------------|-------------------------------------|---------|
| AAA               | American Automobile Association     |         |
| EV                | Electric Vehicle                    |         |
| HDOT              | Hawaii Department of Transportation |         |
| HiRUC             | Hawaii Road Usage Charge            |         |
| kWh               | Kilowatt-hour                       |         |
| MPG               | Miles Per Gallon                    |         |
| RUC               | Road Usage Charge                   |         |
| US                | United States                       |         |

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## 1. Introduction

Declining gas tax revenue, and the resultant increase in the inequity of the gas tax as a funding mechanism, serve as motivators for Hawaii's road usage charge (RUC) research effort. The gas tax revenue decline stems from the increased adoption of cleaner, more fuel-efficient vehicles that consume less fuel per mile driven, as well as electric vehicles (EVs) that consume no fuel at all. As Hawaii motorists increasingly turn to zero-emission vehicles, both the Hawaii Department of Transportation (HDOT) and the local counties' reliance on motor fuel taxation to fund road repair and maintenance are becoming less fair as a usage-based revenue mechanism, and less sustainable as a revenue source.

RUC entails assessing a small fee on drivers for each mile driven rather than taxing gasoline and diesel fuel. In essence, the concept represents a fee for the metered use of roads at a flat rate per mile driven. The more one drives, the more one pays, and the less one drives, the less one pays. Designed and implemented with the sole purpose of generating revenue to fund roads, motor fuel taxes in Hawaii (like most other states) follow that same guiding principle. RUC represents a small shift from the historical norm of motor fuel taxation: what changes primarily is the mechanism of *how* the state collects funds.

However, in changing this mechanism (as with any tax policy), some users may pay more, and some may pay less. Under the baseline concept, which is designed to replace existing fuel tax revenues, RUC charges a flat rate per mile at the average of what all vehicles in the state pay. Consequently, vehicles that are less fuel-efficient than average would pay less under RUC than what they pay under fuel taxes, and vehicles that are more fuel-efficient would pay more. Some members of the public, lawmakers, and stakeholders consulted in the first phase of the HiRUC project identified this consequence as a key issue for further study. At a minimum, the change in the road funding mechanism from taxing motor fuels to charging miles represents a signal that contradicts the state and county policies of encouraging clean vehicle adoption. At worst, some fear RUC could undermine efforts to shift to the adoption of clean vehicles by discouraging motorists to purchase them.

To address this concern, the HiRUC research team examined the issue. The research approach began with an examination of the nature and magnitude of the issue, particularly the extent to which RUC changes the incentives during vehicle purchase in absolute terms. Next, the change was put into context by examining the full range of costs and incentives of driving vehicles of varying fuel economies and understanding the relative magnitude of cost and incentive changes that RUC represents. Finally, a range of approaches from other jurisdictions were presented to harmonize RUC with policies that encourage clean vehicle adoption.

## 2. Issue Definition: Impact of RUC on Vehicles by Fuel Economy

The purpose of motor fuel taxation in Hawaii, at both the state and county levels is to generate revenue to fund the state and county road systems. As a revenue generating tax, the motor fuel tax represents a relatively small portion of the total cost of the product it applies to. At 16 cents per gallon, the state tax represents approximately 3-5% of the cost of fuel. County taxes, which range from 16.5 to 23 cents per gallon, add another 4-6%, for a total of 7-11%.<sup>1</sup> Hawaii motor fuel taxes are comparable to sales taxes, which range from 0-10%, with 36 states in the 5-10% range.<sup>2</sup>

Like fuel taxes, the primary aim of RUC is to generate revenue to invest in the repair, upkeep, and safe operations of state roads and bridges. Assuming the same revenue target as motor fuel taxes, the HiRUC research team determined that a statewide RUC of 0.8 cents per mile driven on passenger vehicles under 10,000 pounds could replace the state’s motor fuel taxes on those vehicles. The state’s motor fuel taxes generate just over \$80 million per year, or about \$80 per vehicle. Under this policy, a vehicle that drives 10,000 miles pays \$80, regardless of its engine type and fuel economy.

Removing the fuel tax and introducing a RUC does, however, cause some changes in who pays for roads, based on vehicle fuel economy. For example, a vehicle with a fuel economy of 18 miles per gallon (MPG) that drives 10,000 miles per year currently pays approximately \$89 in fuel taxes to fund the roads, whereas a vehicle with a fuel economy of 25 MPG that drives 10,000 miles per year pays \$64. Under a RUC, the 18 MPG vehicle would save \$9 compared to currently policy, whereas the 25 MPG vehicle would pay \$16 more. An electric car currently purchases no motor fuel and, therefore, pays no motor fuel taxes. Currently, EVs pay a \$50 flat fee statewide in lieu of fuel taxes. An EV that drives 10,000 miles per year under RUC at 0.8 cents per mile would pay \$80, an increase of \$30 over the flat fee amount.

The changes in who pays under a RUC, as compared to the gas tax, summarizes the fundamental concern shared by some members of the public, stakeholders, and lawmakers with the HiRUC research team.

Table 1 summarizes current state and county gasoline and diesel tax rates.

**Table 1: State and County Fuel Tax Rates**

| JURISDICTION              | GASOLINE AND DIESEL TAX RATE |
|---------------------------|------------------------------|
| State of Hawaii           | 16 cents per gallon          |
| City & County of Honolulu | 16.5 cents per gallon        |
| Hawaii County             | 23 cents per gallon          |
| Kauai County              | 17 cents per gallon          |
| Maui County               | 23 cents per gallon          |

Figure 1 below shows fuel tax expenditures for four illustrative vehicle types over 1,000 miles.

<sup>1</sup> Based on existing Hawaii state and county fuel tax rates and fuel prices published by American Automobile Association (AAA). Accessed from <https://gasprices.aaa.com/state-gas-price-averages/>.

<sup>2</sup> State and Local Sales Tax Rates 2021, Tax Foundation. Accessed from: <https://taxfoundation.org/2021-sales-taxes/>.

**Figure 1: Fuel Tax vs. RUC Comparison over 1,000 Miles by Vehicle Type**



Under RUC, the five vehicle types illustrated above would each pay \$8 per 1,000 miles traveled. This represents a slight savings for the old sport utility vehicle and old pickup, a \$10 new cost for the EV<sup>3</sup>, and an increase of approximately \$7.50 for the hybrid vehicle.

Beyond these illustrative examples, a more complete picture of how many Hawaii motorists would be impacted is described below.

Drawing on the analysis in the companion policy paper on rural motorists, the range of impacts of RUC was examined across the full vehicle population. The Hawaii vehicle registry was used to determine MPG ratings of each vehicle, and the periodic motor vehicle inspection database was used to determine average annual miles driven by each vehicle. Combining those data elements allowed a comparison of the estimated annual motor fuel tax to what each vehicle would pay in RUC.

The results showed that about one-third of vehicles over the course of a given year would owe an amount of RUC that was within \$5 of what is currently paid in fuel taxes. Over half of vehicles would owe within \$10 of what is currently paid, and over two-thirds of vehicles would owe within \$15 of what is currently paid. Over 90% of vehicles in Hawaii would pay within \$35 of what they currently pay in one year, as shown below Table 2.

<sup>3</sup> Note that if RUC leads to elimination of the \$50 annual registration surcharge, the change in cost for EVs would depend on how many miles they drive, with some saving compared to the \$50 surcharge and others paying more.

**Table 2: Annual Difference Between RUC and Fuel Tax Among Hawaii Vehicles**

| DIFFERENCE BETWEEN RUC AND FUEL TAX | PERCENT OF VEHICLES |
|-------------------------------------|---------------------|
| Between \$0 and \$5                 | 33%                 |
| Between \$0 and \$10                | 54%                 |
| Between \$0 and \$15                | 68%                 |
| Between \$0 and \$20                | 78%                 |
| Between \$0 and \$25                | 84%                 |
| Between \$0 and \$30                | 89%                 |
| Between \$0 and \$35                | 92%                 |

Only 2.3% of vehicles would pay less than \$35 in RUC than they currently pay in fuel taxes, and only 5.7% would pay more than \$35. Among the 5.7% paying \$35 or more, the average annual miles driven is 19,910, which is more than double the state average of about 8,560. These vehicles would pay, on average, \$160 per year in state RUC. In other words, the vehicles seeing the biggest increase in RUC already pay the most in fuel taxes, and would continue to pay the most in RUC. The amount they would owe is driven only in part by their higher-than-average MPG, with the bigger factor being that they already drive far more than the average vehicle in the state.

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### 3. Issue in Context: Impact of RUC Relative to Other Factors

Section 2 established that RUC would change the way vehicles pay for road usage. Specifically, RUC in lieu of motor fuel taxes would reduce the relative contribution of low-MPG vehicles while increasing the relative contribution of high-MPG vehicles. For most vehicles (over 90%) the change amounts to less than \$35 per year. This section examines the impact of the change in contributions under a RUC in the context of other vehicle ownership and operating costs.

In this section vehicle costs are examined in two broad categories: ownership and operating. Ownership costs reflect the fixed costs of merely having a vehicle, which includes insurance<sup>4</sup>, finance and depreciation (reflecting the cost of purchasing the vehicle), state and county registration fees, and state and county weight taxes. These fixed costs of ownership can be expressed on an annual basis.

Operating costs include the variable costs of using a vehicle, including the costs of energy to move the vehicle (motor fuel in the case of internal combustion vehicles, and electricity in the case of EVs), maintenance, and usage-based taxes. In Hawaii the only usage-based tax is the motor fuel tax. RUC would also fall in this category.

To compare the impacts of RUC in the context of other operating and ownership costs, six illustrative vehicle types across each of the six islands of Hawaii were considered:

- ▶ A new gasoline sedan. This vehicle has a curb weight of 3,300 pounds and a combined on-road rating of 35 MPG. Cars in this category are similar to a Toyota Camry, Honda Accord, or Chevy Malibu. These are not hybrid sedans.
- ▶ A new gasoline compact utility vehicle. Commonly known as a crossover, this vehicle has a curb weight of 3,700 pounds and an MPG of 27. Similar models include the Toyota RAV-4, Mazda CX-5, and Ford Escape.
- ▶ An older model gasoline sedan. This vehicle has a slightly lower curb weight than the new sedan, weighing in at 3,000 pounds, and a lower combined MPG rating of about 25.
- ▶ A new gasoline pickup truck. With a curb weight of 5,500 pounds, the pickup truck has a correspondingly lower MPG rating of about 18. This corresponds to a Toyota Tundra, Dodge Ram, or Ford F-150.
- ▶ An older model gasoline pickup truck. Although it has a slightly lower curb weight of 4,500 pounds, this pickup truck also has a lower MPG rating of about 15.
- ▶ An electric sedan. Due to the weight of the battery packs, this newer model vehicle has a curb weight of 4,800 pounds. Although it uses no motor fuel, the vehicle can travel about 3.5 miles per kilowatt-hour (kWh) of electricity. Models include the Tesla S and Polestar 2.

Assumptions for operating costs include the cost of electricity, which varies from island to island, from a low of about 29 cents per kWh on Oahu to just over 36 cents per kWh on Lanai. Gasoline prices fluctuate more than electricity, with prices during the first half of 2021 ranging from an average of \$3.91 on Oahu to \$5.59 on Lanai, with Maui at \$3.93 and Hawaii and Kauai both at \$4.17. Molokai averages about \$5.00 per gallon. Fuel taxes are included in the aforementioned prices. Operating costs also

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<sup>4</sup> Although auto insurers increasingly offer usage-based options, which would make insurance more like an operating cost than a fixed cost of ownership, the vast majority of policies are based very little on miles driven and have high fixed costs built in to the premiums. Consequently, for now, auto insurance is more appropriately categorized as an ownership cost.

include maintenance, which runs about 7 cents per mile for EVs and 9 cents per mile for all other vehicle types. Maintenance includes routine preventive maintenance, repairs, and tires.<sup>5</sup>

**Scenario analysis: EVs pay RUC, others pay fuel tax.** For this analysis, it was assumed that all gasoline vehicles would continue to pay fuel taxes, while EVs would pay a RUC of 0.8 cents per mile. Under this assumption, Table 3 illustrates the total operating costs of these six types of vehicles across the six islands on a per-mile basis. The green shaded cells indicate lower costs, while the red shaded cells indicate higher costs. Across all islands, the EV is the lowest cost vehicle to operate, ranging from 16 to 19 cents per mile, and from 10-60% less costly than other vehicle types. RUC represents 4-5% of total operating costs. Among other vehicles, a new gas sedan is the cheapest to operate, at 20 to 25 cents per gallon. Fuel taxes represent about 5% of this cost as well. Other vehicles range as high as 46 cents per mile, for the older gas pickup on Lanai, where fuel costs are highest.

**Table 3: Operational Costs Per Mile for Various Vehicle Types Under RUC for EVs Only**

| ISLAND  | NEW GAS SEDAN | NEW GAS CROSSOVER | OLD GAS SEDAN | NEW GAS PICKUP | OLD GAS PICKUP | EV*    |
|---------|---------------|-------------------|---------------|----------------|----------------|--------|
| Oahu    | \$0.20        | \$0.23            | \$0.25        | \$0.31         | \$0.35         | \$0.16 |
| Maui    | \$0.20        | \$0.24            | \$0.25        | \$0.31         | \$0.35         | \$0.18 |
| Molokai | \$0.23        | \$0.28            | \$0.29        | \$0.37         | \$0.42         | \$0.19 |
| Lanai   | \$0.25        | \$0.30            | \$0.31        | \$0.40         | \$0.46         | \$0.19 |
| Hawaii  | \$0.21        | \$0.24            | \$0.26        | \$0.32         | \$0.37         | \$0.19 |
| Kauai   | \$0.21        | \$0.24            | \$0.26        | \$0.32         | \$0.37         | \$0.17 |



\*\$0.008 per mile RUC assumed for EVs

**Scenario analysis: All vehicles pay RUC, none pay fuel tax.** Table 4 reflects the scenario in which all vehicles pay a RUC and none pay a fuel tax. The operating costs per mile for most of the vehicles are unchanged in this scenario. This is due to the fact that the RUC represents such a small fraction of total operating costs to begin with, and the switch from fuel tax to RUC is a small difference relative to the total cost. Overall, the cost advantages of newer and more fuel efficient vehicles, especially EVs, continues to hold in this scenario.

<sup>5</sup> Figures based on consultant analysis of electricity costs using average rates from HECO and other electric utilities in Hawaii; fuel, maintenance, and insurance costs from AAA; and registration tax and registration fee costs from county DMVs and DoTAX.

**Table 4: Operational Costs Per Mile for Various Vehicle Types Under RUC for All**

| ISLAND  | NEW GAS SEDAN | NEW GAS CROSSOVER | OLD GAS SEDAN | NEW GAS PICKUP | OLD GAS PICKUP | EV     |
|---------|---------------|-------------------|---------------|----------------|----------------|--------|
| Oahu    | \$0.21        | \$0.24            | \$0.25        | \$0.31         | \$0.35         | \$0.16 |
| Maui    | \$0.21        | \$0.24            | \$0.25        | \$0.31         | \$0.35         | \$0.18 |
| Molokai | \$0.24        | \$0.28            | \$0.29        | \$0.37         | \$0.42         | \$0.19 |
| Lanai   | \$0.26        | \$0.30            | \$0.32        | \$0.40         | \$0.46         | \$0.19 |
| Hawaii  | \$0.22        | \$0.25            | \$0.26        | \$0.32         | \$0.36         | \$0.19 |
| Kauai   | \$0.22        | \$0.25            | \$0.26        | \$0.32         | \$0.36         | \$0.17 |

**Ownership costs.** Although RUC constitutes about 5% of the cost to operate a vehicle, full ownership costs need to be considered. Table 5 illustrates the range of ownership costs by vehicle type across each island. In Table 5 the EV is toward the high end of the range, and the newer gasoline sedan is the lowest cost. The majority of the fixed ownership costs (from 60-75%) are purchase price costs (purchase price costs are reflected as annual costs of finance and depreciation), exclusive of federal or state incentives. Insurance is also a substantial component of total annual ownership costs, ranging from 10-30%. Vehicle registration fees and weight taxes make up the remaining 6-9% of costs. This includes the statewide \$50 per EV annual surcharge, and Maui County’s \$100 per EV annual surcharge.

**Table 5: Ownership Costs Per Year for Various Vehicle Types by Island**

| ISLAND  | NEW GAS SEDAN | NEW GAS CROSSOVER | OLD GAS SEDAN | NEW GAS PICKUP | OLD GAS PICKUP | EV      |
|---------|---------------|-------------------|---------------|----------------|----------------|---------|
| Oahu    | \$4,468       | \$5,376           | \$5,542       | \$6,710        | \$6,620        | \$5,994 |
| Maui    | \$4,352       | \$5,246           | \$5,437       | \$6,518        | \$6,463        | \$5,926 |
| Molokai | \$4,352       | \$5,246           | \$5,437       | \$6,518        | \$6,463        | \$5,826 |
| Lanai   | \$4,352       | \$5,246           | \$5,437       | \$6,518        | \$6,463        | \$5,826 |
| Hawaii  | \$4,270       | \$5,155           | \$5,361       | \$6,386        | \$6,353        | \$5,710 |
| Kauai   | \$4,303       | \$5,191           | \$5,392       | \$6,435        | \$6,395        | \$5,754 |

Additional costs of driving that are not reflected in this analysis include parking, cleaning, and storage costs, which vary widely depending on individual circumstances.

Importantly, policy decisions impact many of the built-in vehicle costs. For example, tax rates impact the operating costs (whether fuel taxes or RUC), but are generally in the range of less than 5% of all operating costs. Vehicle registration fees (state and county registration fees and weight taxes) impact ownership costs, and generally represent around 10% or less of annual ownership costs. Incentives such as purchase price rebates or tax credits on EVs could reduce the ownership costs substantially. For example, the federal tax credit of \$7,500 per EV reduces the effective annual ownership cost of EVs by several hundred dollars or more, relative to the values shown in Table 5 above.

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## 4. Barriers to Electric Vehicle Adoption

To understand the relative impact of RUC on the adoption of cleaner vehicles, and particularly on EVs, this section offers a summary of research into the barriers to EV adoption. These barriers offer a more complete context to better understand the available approaches for addressing EV adoption through, or in parallel with, the policy design of RUC.

A 2015 consensus report by the National Research Council entitled “Overcoming Barriers to Deployment of Plug-in Electric Vehicles”<sup>6</sup> thoroughly documented a number of the trends and barriers to EV adoption at the time. Although the market has substantially changed in just six years, many of the findings and observations of the report remain relevant today. Aside from **purchase price**, other deterrents to EV adoption by mainstream consumers that the authors noted include the following:

- ▶ A **limited variety** of EV models from which consumers can choose. Although the number of available models as of 2021 has substantially grown since 2015, it is still only a small fraction as compared to the number of internal combustion engine model vehicles available. The variety of choices, styles, and vehicle types across brands will gradually and significantly shift in the coming decade as major automakers invest in larger and more varied line-ups of EV models. However, at the present time, of the nearly 300 model year 2021 cars available for sale in the United States, only about 20 of them are all-electric models. Recent announcements by automakers such as Volkswagen, Hyundai, Ford, BMW, Tesla, General Motors, and others suggest a proliferation of EV model choices over the next several years.
- ▶ There is **range anxiety** among consumers that EVs will not provide motorists the comfort and convenience of a gas-powered car. Despite improvements in range and charging infrastructure, range anxiety remains a large source of resistance of car buyers in the United States. However, this factor is likely less important in Hawaii where most new EV models more than cover the typical daily ranges of driving, and where long mileage road trips are rare. At the national level, the recent passage of federal infrastructure legislation dedicates close to ten billion dollars in grant programs to increase electrification infrastructure.
- ▶ **Installing home charging** to keep EVs operational. This barrier to adoption stems in part from extra cost and hassle of home charging, but also from the perceived complexity and lack of understanding of how it works. Residents of multi-family housing complexes may also face challenges with gaining access to home charging. Research of EV owners from 2012-2018 in California identified lack of home-charging access as one reason why some EV owners decided not to purchase another EV as their next vehicle.<sup>7</sup> Among the grant funds in the recently enacted federal infrastructure legislation are over \$1 billion for electrification in rural and low-income communities, including those with higher proportions of multi-family housing units.

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<sup>6</sup> Transportation Research Board and National Research Council. 2015. *Overcoming Barriers to Deployment of Plug-in Electric Vehicles*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/21725>.

<sup>7</sup> Hardman, Scott and Gil Tal (2021) Discontinuance Among California’s Electric Vehicle Buyers: Why are Some Consumers Abandoning Electric Vehicles?. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-21-07.

- ▶ A **lack of understanding or trust** remains a common source of resistance for new car buyers to EV technology. Gasoline powered vehicles are familiar and easy to operate, and the shortcomings are known. EVs, by contrast, represent a number of risks to mainstream buyers, which is why, despite greater 5% market share in Hawaii, EVs still remain an “early adopter” phenomenon.
- ▶ The **complexity of calculating true operational costs** such as electricity costs, as compared to fuel. The report cites confusion among buyers making simple apples-to-apples comparisons of the cost of operating an EV versus an internal combustion vehicle. Despite the clear cost advantages (as shown in Chapter 3, and even under high energy costs in Hawaii), consumers find the mathematics of calculating “miles per kWh” or “miles per 100 kWh” challenging. This is especially challenging when the cost per kWh of electricity must be known in the first place and then multiplied by the expected kWh per mile or per 100 miles. After this calculation, these costs must be then compared to the cost of motor fuel, which itself requires a knowledge of the MPG metric and how to calculate costs from it. The report concludes that EV buyers likely do not reliably calculate or factor in operational cost savings when making vehicle purchasing decisions.

## 5. Approaches for RUC Policy Design that Address Clean Vehicle Goals

RUC by itself changes the architecture of how motorists pay for road usage. As shown in the preceding sections, this change results in all vehicles paying the same per mile for road usage. RUC means that less fuel-efficient vehicles would pay less than they currently do under fuel taxes, while highly fuel-efficient and electric cars would pay more. In Hawaii a large majority of vehicles would pay within \$35 per year of what they pay today. Relative to the total cost of vehicle operations, RUC represents about 5% of costs, and relative to total costs of vehicle ownership, operating costs represent 10-40%. In other words, a RUC overall represents less than 2% of total annual vehicle costs.

Other states that have explored RUC in the past decade have done so purely as a user-fee-based revenue policy for road funding. With an emphasis on sustainable funding that would match the impacts the vehicles have on the road system to the costs they pay, addressing clean vehicles becomes a separate policy consideration.

Beyond treating road funding and clean vehicle policies separately, other approaches do exist. Other states and countries have used other approaches either alone, or in combination with RUC policy design, to explicitly address clean vehicle adoption. The remainder of this section covers two main categories of these policy approaches.

### 5.1. Explicit Harmonization of RUC and Clean Vehicle Adoption Policies

Several approaches exist for explicitly harmonizing RUC with clean vehicle incentive or encouragement policies. Most of these examples draw on precedents from other jurisdictions, whether proposed or implemented. A few represent policy possibilities that stem from Hawaii's existing policy and unique geographic environment. Approaches that could harmonize RUC with clean vehicle incentives or encouragement policies include the following:

**Enacting RUC with an introductory per-mile rate.** One benefit of a RUC over a motor fuel tax is that RUC is explicitly tied to a vehicle through an account. This feature allows policymakers to introduce variations in how the RUC rate is set, depending in the vehicle type. Any type of per-mile rate variation that ties to a vehicle characteristic could be theoretically implemented in practice. To use two hyperbolic examples, red cars could be charged more, and four-door cars could be charged less. With respect to clean vehicle adoption, an introductory rate could be enacted and applied to EVs and/or hybrid vehicles. In the state of Washington, legislation introduced in 2021 (SB 5444) would have offered an introductory RUC rate for EVs discounted 20% from the base rate paid by other types of vehicles. The benefit of this approach is that it allows policymakers to adjust the rate in order to balance other competing policy priorities. On the other hand, introductory rates for one group may quickly catch on for other groups seeking discounts, resulting in discount policies that undermine overall revenue targets.

**Introducing RUC tied to fleet transition milestones.** New Zealand applies RUC to all non-gasoline vehicles, which includes over 500,000 diesel cars and a small but fast-growing number of EVs. Parliament exempted EVs from RUC until they constitute 2% of the fleet or January 2022, whichever comes first. Recently the exemption was extended to March 2024. The precedent policy approach here is to tie the introduction of a RUC system to a related external trigger such as Hawaii exceeding 5% of new car sales as all-EVs.

**Introducing RUC but removing flat EV fees.** The State of Hawaii enacted a \$50 flat fee on EVs in 2019, joining over two dozen states that have identified flat fees on EVs as one way to address the future shortfall in gas tax revenues. Maui County also has a \$100 annual flat fee on EVs and \$50 flat fee on hybrids. In Washington State, Senate Bill 5444 (2021) would have removed that state's \$225 annual flat fee on EVs as part of the introduction of a RUC system. As described in Section 3, flat fees contribute to the higher cost of ownership of EVs compared to similar gasoline-powered cars. Removing them in favor of a usage-based fee would make the cost of ownership of EVs more competitive while preserving the advantage EVs enjoy in operating costs.

**Creating a RUC program as an opt-out for flat EV fees.** Short of eliminating the EV flat fees, three states (Utah, Oregon, and Virginia) have created RUC programs as an option for vehicles subject to additional registration surcharges. In each state, drivers may choose between enrolling in a RUC program to pay by the mile or paying the flat annual registration surcharge. In Utah and Virginia, the amount drivers would pay under RUC is capped at the flat fee amount.

**Introducing RUC on all vehicles.** Introducing RUC on all vehicles ensures equal treatment for equal road usage. New Zealand is aiming for this as the eventual evolution of its existing policy, under which RUC currently applies to about 15% of the vehicle fleet. Oregon's legislature has considered draft legislation that likewise would expand the application of the state's RUC program to all vehicles above 20 MPG, leaving vehicles below 20 MPG to continue paying the gas tax.

**Introducing RUC and equalizing weight fees.** EVs face significantly higher weight fees in Hawaii than comparable gas-powered vehicles. Yet, evidence from decades of pavement research shows that there is no difference in road impact among vehicles under about 10,000 pounds, and certainly among passenger cars with or without batteries. Given the lack of difference in road impact, only a handful of states assess weight-based fees for passenger cars. Reducing or eliminating weight taxes, or combining weight taxes with existing registration fees and making them equal for all vehicles, would level the playing field for EVs relative to other vehicle types, while harmonizing revenue policy with road impacts.

**Enacting a direct carbon tax on top of RUC.** An explicit measure that can harmonize clean vehicle incentive policy is to impose a carbon tax on motorists for the emissions they cause from the vehicles. Such a system can be constructed as part of or separately from a RUC system, with the aim of assessing fees for carbon emitted.

## 5.2. Other Measures that Address Clean Vehicle Adoption

In addition to measures that simultaneously affect RUC and clean vehicle adoption, approaches exist for encouraging clean vehicle adoption distinct from the design of a RUC policy. Hawaii has already taken steps to encourage EV adoption, including state funding and financing of charging infrastructure, programs through utilities to encourage electric vehicle supply equipment, HDOT's service contract that allows other state and county agencies to obtain electric vehicles and charging infrastructure as a service on a per mile cost basis and lower upfront costs, and HDOT's provision of carpool lane access to EVs. Other examples include:

**Dedicating revenue to electrification.** To address concerns about range anxiety or charging availability generally, proceeds or a portion of proceeds from early stages of a RUC program (especially from fees on EVs) could be dedicated to programs like electrification. This measure would ensure a connection (at least in the near term) between a policy designed to sustain road funding when more cars are EVs and a policy designed to help ensure those EVs come to exist in the first place.

**Offering income tax credits for EV purchases.** The federal government has long offered a \$7,500 income tax credit on the purchase of an EV. Many states have additional income tax credits as well. These credit schemes entice buyers who may not otherwise be inclined to purchase an EV, by making the purchase price closer to the price of a comparable gasoline-powered vehicles.

**Providing a discount on EVs taxes at point of purchase.** States like Washington offer a discount on sales tax at the point of purchase of an EV. Hawaii could consider a similar policy as an inducement to EV adoption. By putting the purchase price reduction directly at the point of sale, consumers can benefit immediately and may value the tax credit higher (as opposed to an income tax credit which lags and sometimes is not fully available).

**Providing electricity discounts to EV owners.** Given the relatively high costs of electricity in Hawaii, offering subsidies for EV owners to offset the cost of charging at home, could further reduce the operational costs of EVs in Hawaii. Similarly, providing incentives or assistance with installation of home solar could help customers to reduce their reliance on relatively costlier electric utilities.

### 5.3. Case Study: Utah RUC Enactment

In 2018, Utah enacted annual registration surcharges on alternative fuel vehicles. As with the over 25 other states, including Hawaii, that have enacted such surcharges, the policy purpose is to proactively establish a revenue mechanism to capture contributions from alternative fuel vehicles, which are expected to proliferate in the future. Over time the cost of the surcharges in Utah has increased. As of 2021 the rates are \$120 for all-electric vehicles, \$52 for plug-in hybrid vehicles, and \$20 for hybrid vehicles.

Recognizing that a flat fee does not equate to usage, Utah lawmakers simultaneously directed the Utah Department of Transportation (UDOT) to establish a RUC program that allows owners of alternative fuel vehicles to pay by the mile in lieu of the annual registration surcharge. By rule, vehicles who enroll in the RUC program cannot pay more than they pay in the annual surcharge. For example, at the current per-mile rate of 1.5 cents, electric vehicles reach the surcharge after driving 8,000 miles. Miles driven after that are essentially free.

The purpose of this policy is to encourage participation in the RUC program and to help the state build a user-based revenue mechanism that can more accurately equate to road usage for the future. As of 2021, over 5,000 vehicles have enrolled in the RUC program in Utah.

### 5.4. Case Study: Victoria (Australia) RUC and EV Adoption Policies

Australia lags most of the developed world in adoption of EVs. As a relatively small market far removed from the vehicle manufacturing industrial centers in North America, Europe and Asia, automakers have been slow to introduce EV models down under. Among the eight states and territories in Australia, the State of Victoria ranks fourth, with EVs constituting only 0.3% of new vehicle sales in 2019.<sup>8</sup> Hawaii's adoption rate is ten times higher at close to 3% in 2019.

Australia policymakers at the national and state levels have been considering policies to reform road funding by introducing RUC on heavy and light vehicles, as well as to encourage more EV adoption in the country. Among light vehicles the focus to date has been around assessing RUC on EVs as a starting point. In Australia, fuel is taxed only at the federal level, at a rate of about 42 Australian cents

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<sup>8</sup> Electric Vehicle Council (Australia), "State of Electric Vehicles," August 2020. Accessed from: <https://electricvehiclecouncil.com.au/wp-content/uploads/2020/08/EVC-State-of-EVs-2020-report.pdf>.



per liter, or about US\$1.16 per gallon. This is about double the rate of the combined federal, state, and county gas taxes in Hawaii.

In Spring 2021, the State of Victoria, Australia's second largest and home to Melbourne, introduced legislation to enact a RUC on EVs at the rate of 2.5 Australia cents per kilometer (about 2.94 U.S. cents per mile). Several other states including South Australia and New South Wales (the nation's largest) also introduced similar proposals in the same time frame. The proposals faced opposition from stakeholders advocating policies to advance EV adoption.

In response, the Victoria government revised its initial proposal. Rather than scrap or reduce the RUC proposal, the state added a package of EV adoption incentives valued at Australia \$100 million and funded in large part by revenue from the RUC itself. Incentives include purchase price incentives of up to AUD \$3,000 per EV, expanding the state's EV charging stations, and investing in EVs for the state-owned vehicle fleet.<sup>9</sup> This combination of policies gained sufficient support among lawmakers to pass and went into effect July 1, 2021.

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<sup>9</sup> <https://thedriven.io/2021/05/01/victoria-to-offer-3000-subsidy-for-electric-vehicles-sets-50pct-target-by-2030/>.