



WHITE PAPER

JANUARY 2022

OVERVIEW OF ASIAN AND ASIA-PACIFIC PASSENGER VEHICLE TAXATION POLICIES AND THEIR POTENTIAL TO DRIVE LOW-EMISSION VEHICLE PURCHASES

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ACKNOWLEDGMENTS

The authors thank Aditya Mahalana, Sunitha Anup, Nibedita Dash, Anh Bui, Hongyang Cui, and Mian Moaz Uddin of the International Council on Clean Transportation (ICCT), Kathleen Dematera-Contreras of Clean Air Asia, Yoshinobu Sato of the Japan Ministry of Economy, Trade and Industry, Youngil Jeong of the Automotive Environment Network, and Iain McGlinchy of the New Zealand Ministry of Transport, for providing country-specific tax policy information and general guidance.

The authors also thank all internal and external reviewers of this report for their constructive comments, with special thanks to Aditya Mahalana, Peter Mock, and Sumati Kohli of the ICCT, Pierpaolo Cazzola of the International Transport Forum, and Urda Eichhorst of the Deutsche Gesellschaft für Internationale Zusammenarbeit.

This publication is part of the NDC Transport Initiative for Asia (NDC-TIA). NDC-TIA is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supports the initiative on the basis of a decision adopted by the German Bundestag. For more information, visit: <https://www.ndctransportinitiativeforasia.org>.

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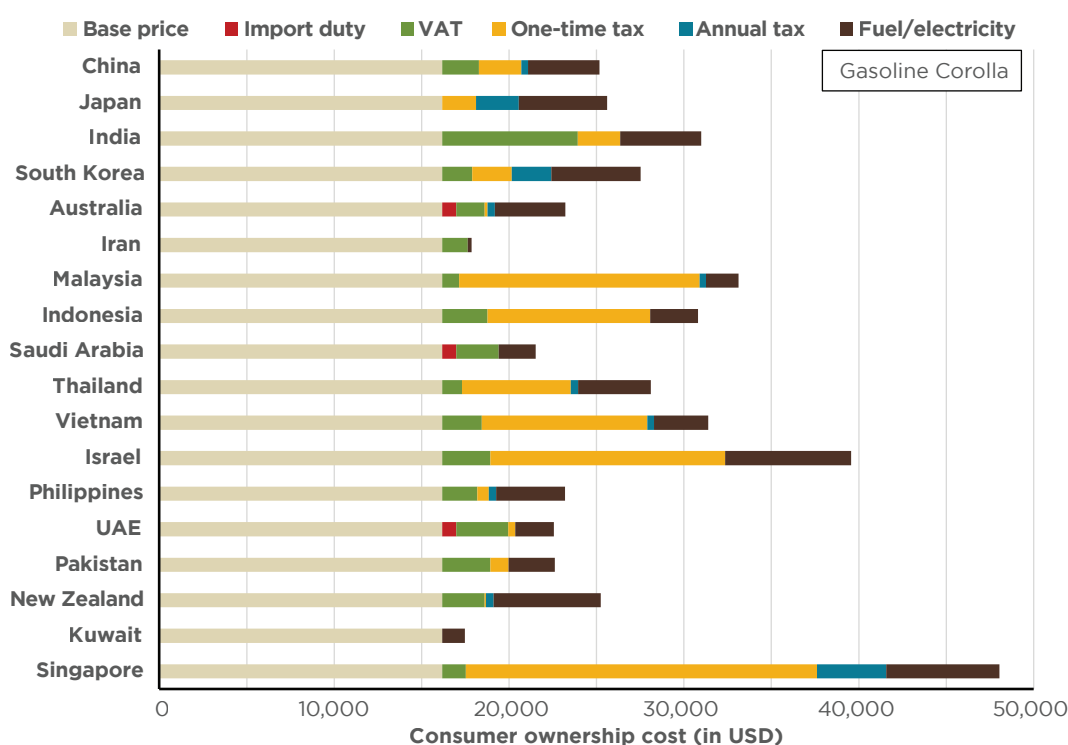
EXECUTIVE SUMMARY

Taxation policies can help drive the transition to low- and zero-emission vehicles by affecting consumer purchase decisions, and this paper provides an overview of vehicle taxation and subsidy policies as of January 2021 in 18 Asian and Asia-Pacific countries. Together these markets account for 99% of passenger vehicle sales in the region.

In addition to accelerating the deployment of electric vehicles (EVs), taxation policies can be designed to improve the fuel efficiency of internal combustion engine (ICE) vehicles. For this study, EVs include battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs). To quantify the effects of taxation on vehicle ownership costs, we compare one model each of a conventional ICE vehicle (the 1.8-L gasoline Toyota Corolla), a hybrid electric vehicle (HEV; the 1.8-L hybrid Toyota Corolla), and a BEV (the 40-kWh Nissan Leaf). We apply the same base price of each model to all countries; identify the taxes applied, from import duties and value-added taxes (VAT) to one-time taxes and recurring taxes; and include the cost of fuel or electricity in the vehicle operating cost.

Of the 18 countries studied, in only five are there taxes determined by vehicle fuel consumption or CO₂ emissions: Japan, Thailand, Israel, Singapore, and Australia (based on the Australian Capital Territory). Additionally, all of these adopt a bin-based taxation structure instead of a continuously increasing rate based on increasing CO₂ emissions. Two other countries, China and the Philippines, offer a tax discount for efficient vehicles, but the benefit is minimal. Seven other countries offer tax benefits only to EVs, and five provide EV subsidies that lower the sale price and thus the taxes that are based on it. In total, 14 countries have some form of favorable taxation policy toward EVs or more efficient vehicles, but we find that only a few of these policies significantly reduce the consumer ownership costs of EVs.

Figure ES-1 shows the six-year consumer ownership cost of the gasoline Toyota Corolla, hybrid Toyota Corolla, and the Nissan Leaf BEV in the 18 markets. For the Nissan Leaf, we deduct the amount of subsidies from the vehicle base price in countries that offer subsidies.



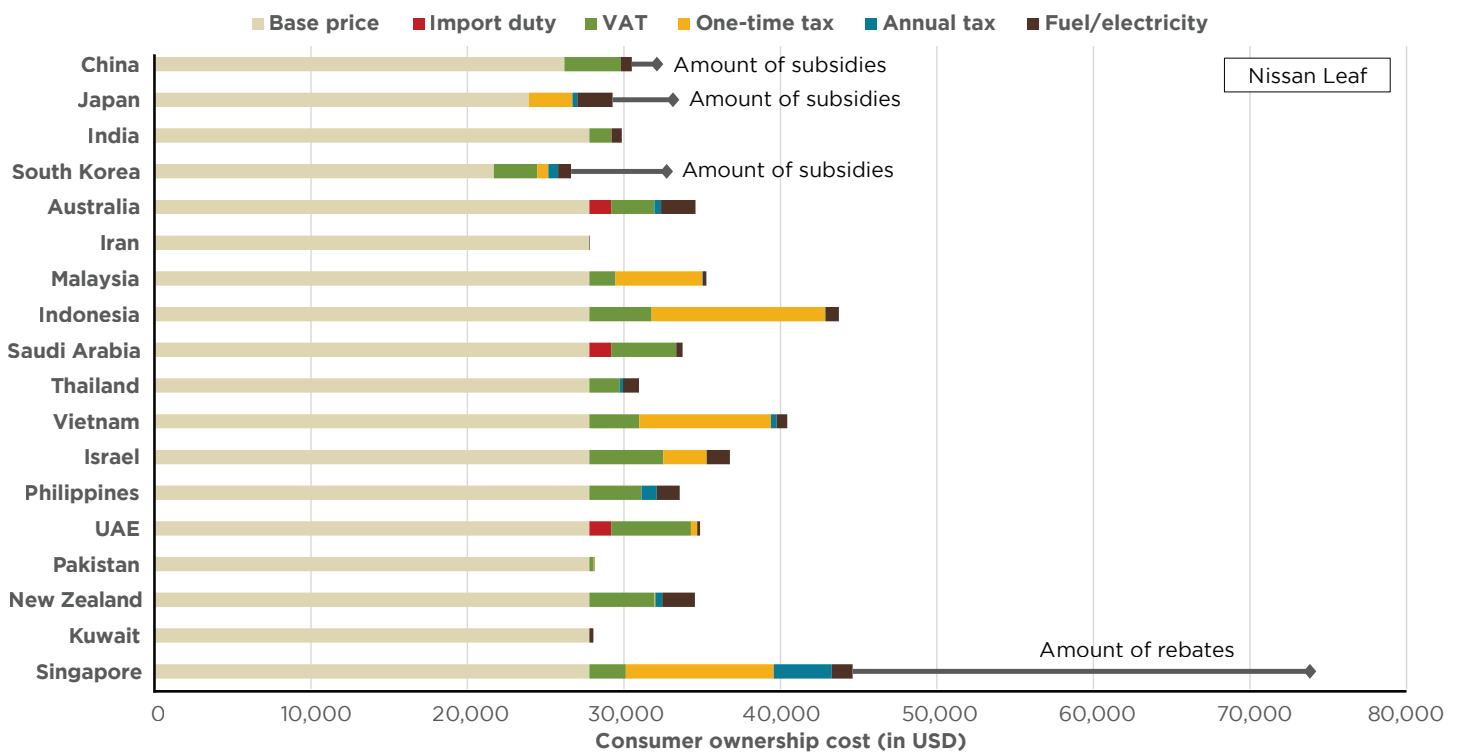
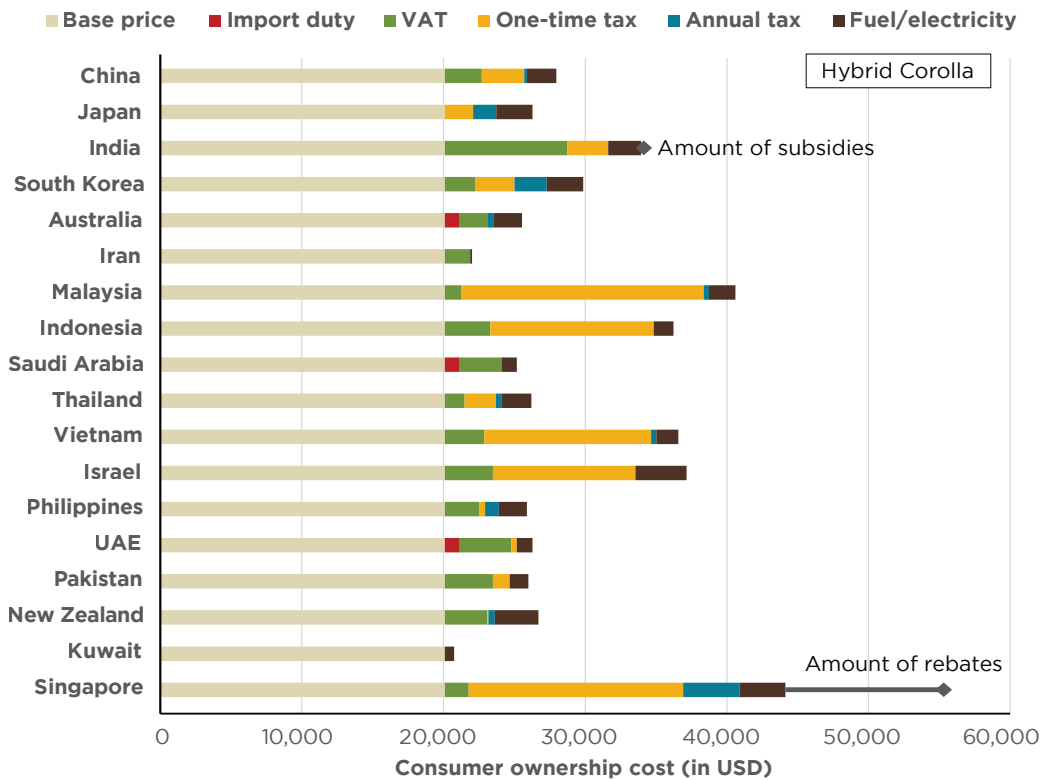


Figure ES-1. Six-year consumer ownership costs of the selected gasoline, hybrid, and electric models in the 18 selected markets. In Singapore, the rebates apply to Additional Registration Fee instead of the base price. Here, the rebates include two parts: the Vehicular Emission Scheme and EV Early Adoption Incentive.

Because the total passenger vehicle tax amount differs from country to country, the consumer ownership costs of a gasoline Corolla can be 2–3 times higher than the base price in Singapore, Israel, and Malaysia, but only slightly higher than the base price in Kuwait and Iran. We find that a high one-time tax is usually the main driver of high consumer ownership costs and therefore has the greatest potential to impact consumer purchase decisions in favor of efficient vehicles and EVs.

Among the five countries with fuel consumption/CO₂-based taxes, HEVs are cost-competitive with conventional ICE vehicles in Singapore, Israel, and Thailand because the high tax levels in these countries create a sufficient tax differential between less efficient and more efficient vehicles. Although 14 out of the 18 countries provide some fiscal benefit to EVs through fuel consumption/CO₂-based taxes, tax cuts, or/and subsidies, only in Singapore, Israel, Korea, and India do these effectively reduce the consumer ownership costs of the Nissan Leaf BEV and make it cost competitive with the gasoline counterpart. The substantial direct rebate in Singapore and the tax cut in Israel, respectively, most reduce the cost of the BEV. High gasoline prices in Singapore and Israel also help both the HEV and BEV achieve cost parity with the gasoline car.

Based on the analysis, this paper offers the following recommendations for governments seeking to use taxation policies to drive decarbonization of their passenger vehicle fleets:

- 1. Most countries, especially those with high taxation levels, would benefit from changing displacement- or weight-based taxes to a continuous fuel efficiency/CO₂-based tax based on linear metrics.** Linear metrics encourage and reward continuous advancement in technology. They can also help promote fleet fuel efficiency in countries lacking fuel economy standards.
- 2. Countries with low taxation levels should consider increasing the tax on higher-emitting vehicles or switching to a feebate system to bridge the gap between ICE vehicles and BEVs.** Low tax levels for conventional vehicles do not provide enough opportunity for the tax benefits applied to low-emitting vehicles and EVs to reach cost parity with conventional vehicles. Therefore, in countries that do not currently levy high tax on conventional vehicles, increasing the tax on higher emitters would reduce in relative terms the tax rates on efficient vehicles and EVs. Countries could also consider a feebate system that uses the punitive fee charged to higher-emission vehicles to subsidize the cleaner ones.
- 3. Before EVs reach cost parity with ICE vehicles, direct subsidies at the time of purchase are necessary to lower the upfront cost.** Taxation could further increase the cost disadvantage of EVs because most taxes are proportional to the vehicle base price. Before EVs reach upfront cost parity with ICE vehicles, direct subsidies, a fuel consumption/CO₂-based tax, and tax cuts for EVs are necessary to lower the upfront cost of EVs.
- 4. Directly informing consumers about the tax benefits of efficient vehicles at the time of purchase will maximize the impact of the taxation system.** Taxation design can be difficult for consumers to understand. As cost is a key factor in consumers' decision-making, helping them understand the tax benefits of efficient vehicles will maximize the positive impact of the taxation system. Vehicle efficiency-related cost and benefit information can be presented in multiple ways, including on the vehicle label in the showroom, in vehicle advertisements, and on manufacturers' websites.

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LIST OF ACRONYMS

ACT	Australian Capital Territory
ARF	additional registration fee (Singapore)
BEV	battery electric vehicle
CO ₂	carbon dioxide
COE	Certificate of Entitlement (Singapore)
EEAI	Electric Vehicle Early Adoption Incentive (Singapore)
EV	electric vehicle
FAME	Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (India)
FCEV	fuel cell electric vehicle
GST	goods and services tax
HEV	hybrid electric vehicle
ICE	internal combustion engine
NEV	new energy vehicle
PHEV	plug-in hybrid electric vehicle
VAT	value-added tax
VES	Vehicular Emissions Scheme (Singapore)

1. INTRODUCTION

Fiscal incentives have direct impacts on consumers' vehicle purchase decisions. Asia and the Asia-Pacific, which have a large population and diverse passenger vehicle markets, offer ample opportunities to study vehicle fiscal policies and better understand how transportation decarbonization and electrification can be accelerated by affecting consumer behavior in these countries.

Governments in Asian and Asia-Pacific countries are encouraging the deployment of battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and in some countries, more efficient vehicles, to lower emissions from the transport sector. The penetration rates of BEVs and PHEVs are still relatively low in most Asian and Asia-Pacific countries. Figure 1 depicts the shares of BEV, PHEV, and hybrid electric vehicle (HEV) sales in 18 markets, which account for 99% of the total passenger vehicle sales in Asia and the Asia-Pacific. In all of the leading markets except for China, BEVs and PHEVs constitute less than 5% of total passenger vehicle sales. Japan, South Korea, Australia, Israel, and New Zealand have a higher share of HEVs than other countries.

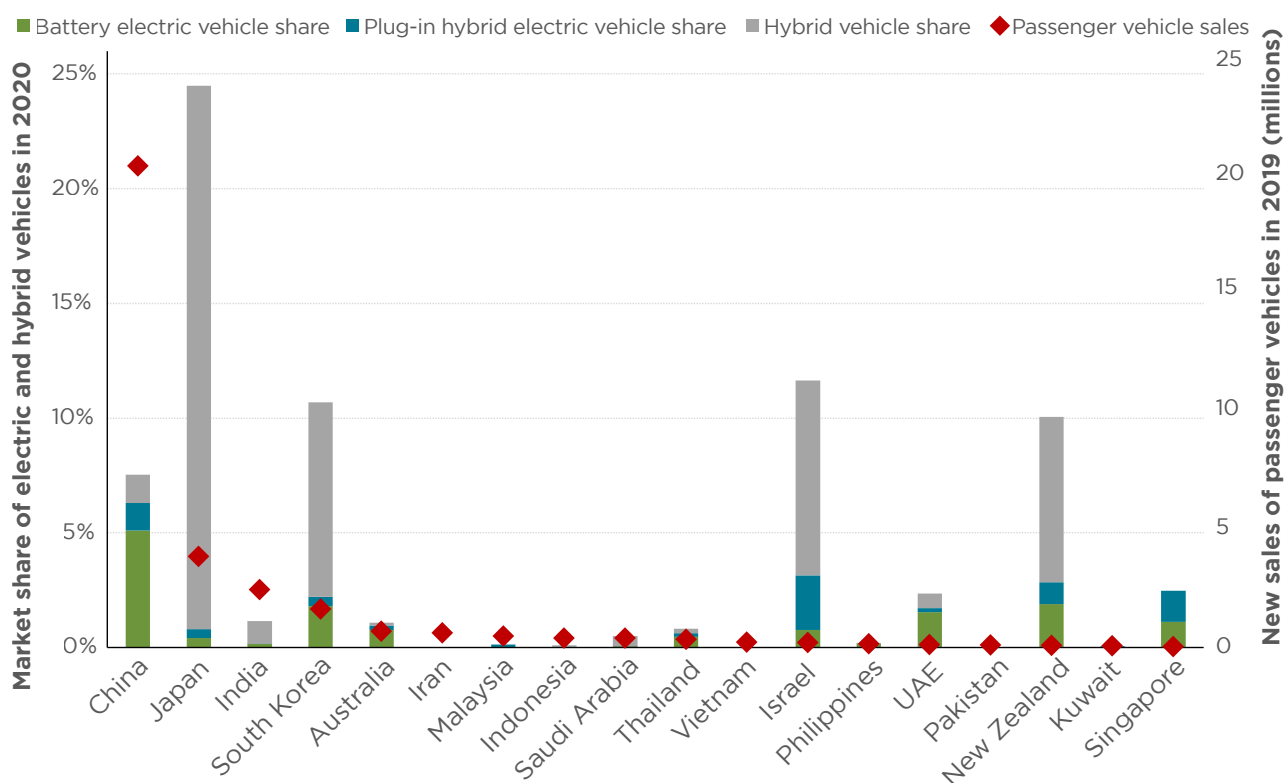


Figure 1. Passenger vehicle sales in leading Asian and Asia-Pacific markets in 2020. Data derived from EV-volumes, 2020; International Organization of Motor Vehicle Manufacturers, 2019; Marklines, 2020.

Asian and Asia-Pacific countries are at different stages in developing their low-carbon transportation policies. For example, as of 2021, only China, India, Japan, and South Korea have implemented fuel economy standards to lower emissions from passenger vehicles. New Zealand has a CO₂ emission standard for imported new and used light-duty vehicles that will take effect in 2022 (New Zealand Ministry of Transport, 2021). Meanwhile, Singapore, Thailand, and Vietnam have developed fuel efficiency labeling programs that require the disclosure of fuel efficiency information to consumers.

Apart from fuel economy standards and fuel efficiency labeling programs, taxation can also be a useful tool to reduce emissions from the transport sector, as shown in previous ICCT studies in different regions (Wappelhorst et al., 2018; Mock & Yang, 2014; He & Bandivadekar, 2011). This paper attempts to understand the taxation mechanisms in use for passenger vehicles in Asian and Asia-Pacific countries, most of which were not included in the previous studies.

The European taxation study categorized vehicles with tailpipe emissions lower than 95 g CO₂/km as low-emission vehicles (Wappelhorst et al., 2018). However, Asian and Asia-Pacific countries define low-emission vehicles in various ways and differ in their stage of promotion of these vehicles. Therefore, instead of quantitatively defining low-emission vehicles, this paper focuses on how taxation policies can reduce transport emissions in Asian and Asia-Pacific markets by improving the fuel efficiency of ICE vehicles and/or by promoting electric vehicles (EVs). We select representative gasoline, HEV and BEV models to quantify the effect of taxation benefits on their consumer ownership costs.

Here, we focus on national-level taxation and subsidy policies for passenger vehicles in Asian and Asia-Pacific countries as of January 2021. We exclude sub-national policies from the discussion unless a country implements the policy both nationally and with detailed rules determined at the sub-national level.

To perform our analysis, we collected all policies from published regulatory documents, local stakeholders, and third-party websites (for a list of sources, see Appendix A). The countries studied levy a variety of taxes on passenger vehicles, including one-time acquisition taxes such as a value-added tax (VAT), an excise tax, a registration tax, a luxury tax for vehicles over certain price levels, and a regularly payable tax for owning a vehicle. Tax subsidies refer to the one-time bonus payment consumers receive when purchasing BEVs, PHEVs, and more-efficient vehicles. We include fuels or electricity consumed as part of vehicle operation cost but exclude from consideration any fees spent on necessary goods or services for the vehicle at purchase or during operation, such as an inspection fee, license plate fee, insurance, or tolls. We also focus on the effect of fuel prices, rather than fuel taxes, on consumer ownership costs, because an insufficient amount of publicly available information on fuel tax structures is available for each country. Additionally, we focus on the effects of vehicle taxation policies instead of other benefits that influence the overall costs of EVs, such as lower maintenance fees or cheaper license plates.

The following section provides an overview of the vehicle taxation schemes of the 18 Asian and Asia-Pacific countries. Section 3 compares the consumer ownership costs of selected gasoline, hybrid, and battery electric vehicles in these countries over a 6-year ownership period to identify the policies and countries providing the largest incentives for more efficient vehicles or EVs. Section 4 provides case studies detailing the taxation and subsidy policies of five selected markets. Finally, Section 5 summarizes best practices and areas of improvement that we identify from the quantitative analysis and case studies. We conclude with recommendations for governments to better promote electrification and improve vehicle fuel efficiency using fiscal incentives.

2. TAX POLICIES FOR PASSENGER VEHICLES IN THE ASIAN AND ASIA-PACIFIC REGIONS

This section provides an overview of the existing taxation and fees that the largest 18 Asian and Asia-Pacific passenger vehicle markets levied on these vehicle sales as of January 2021. Figure 2 depicts these markets. The section first introduces the vehicle taxation types that these countries have implemented and then summarizes key parameters used to determine the tax values.

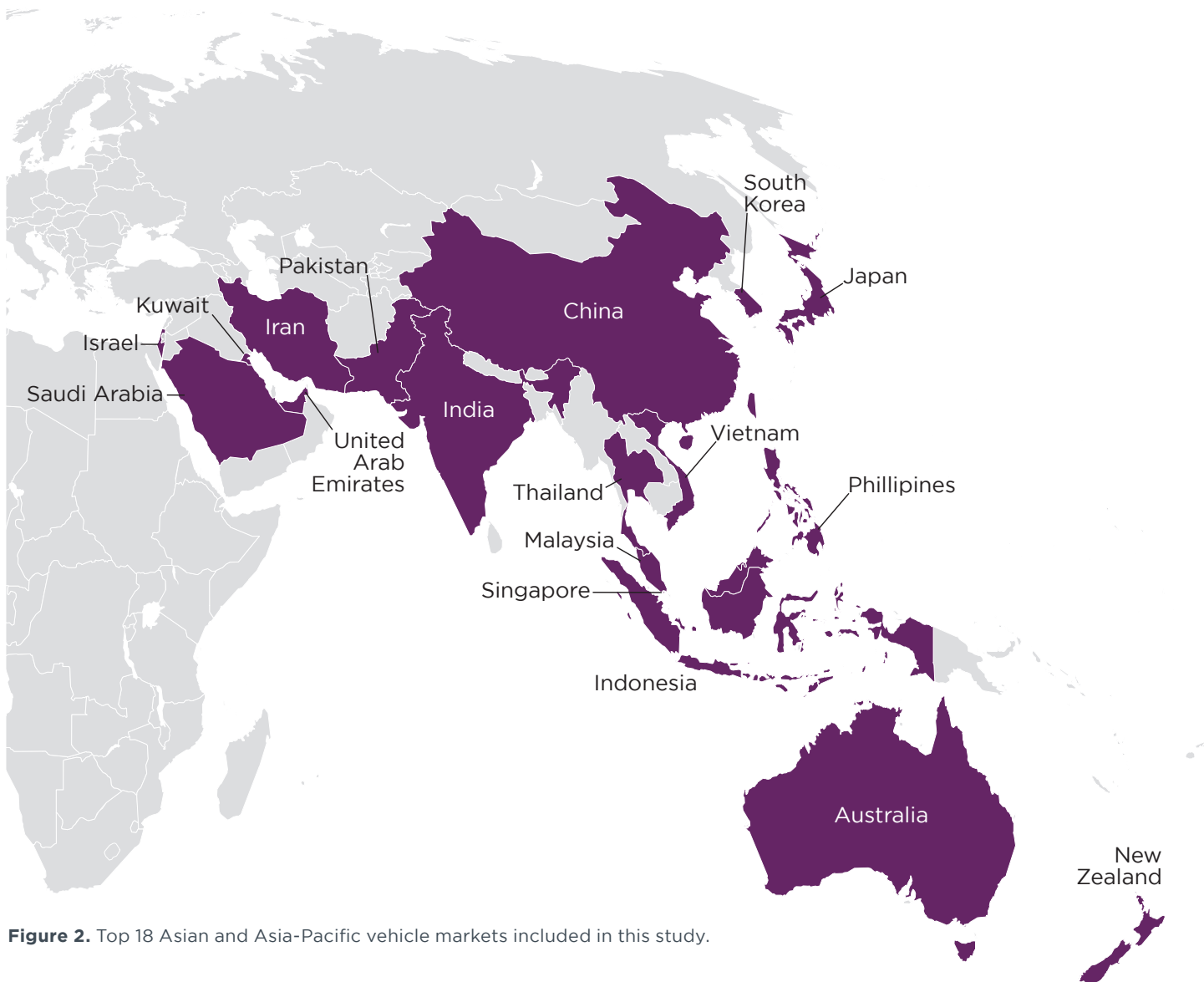


Figure 2. Top 18 Asian and Asia-Pacific vehicle markets included in this study.

2.1 TAX TYPES

Passenger vehicle taxes in Asian and Asia-Pacific markets can be divided into one-time taxes paid at the time of acquisition of the vehicle and recurring taxes levied during use. One-time taxes include import duties, value-added taxes, excise taxes, purchase taxes, registration fees, and environmental taxes. Use-phase taxes typically include the recurring road tax or automobile tax. As noted above, we analyze fuel prices instead of fuel taxes due to limitations on publicly available information.

Import duty

An import duty is levied directly on the cost, insurance, and freight (CIF) price of vehicles shipped into a country from outside of its borders. Fourteen out of the 18 countries levy an import duty. Five countries in this study import all or most of their passenger vehicles: Australia, New Zealand, United Arab Emirates, Saudi Arabia, and Singapore. Out of the 18 countries, Malaysia, Indonesia, and India differentiate between vehicles imported fully assembled (referred to as completely built units [CBUs]) and those imported in parts and assembled locally (referred to as completely knocked down [CKD] products). For example, in Indonesia, the CBU import duty is 50%, but the CKD import duty is only 10%. Some countries provide a tax cut for imports of cleaner vehicles or from countries with which they have trade agreements. For example, Thailand waives the import tax for BEVs manufactured in China, while Iran assesses a 55%–130% import duty on ICE vehicles and a reduced 15% import duty on BEVs and PHEVs. In Section 3, we calculate import duties into the consumer ownership costs of vehicles in these countries.

Value-added tax (VAT)

All Asian and Asia-Pacific markets except for Japan levy a VAT. The VAT amount ranges from 5% in Kuwait and United Arab Emirates to 28% in India. Although the different markets provide EVs with multiple tax cuts in different markets, they usually apply the same VAT rate for EVs as for ICE vehicles. India, Iran, and Pakistan are the only three countries that lower the VAT rate for EVs. In India, the goods and services tax (GST, equivalent to VAT) rate for BEVs is 5%, reduced from 28% for other vehicles, including PHEVs and HEVs. Iran waives the 9% VAT for BEVs and PHEVs, and Pakistan lowers the 17% VAT rate to 1% for BEVs.

Excise tax

Excise tax, also called individual or special consumption tax in some of the analyzed countries, is imposed on the sales of specific goods or services. Thirteen of the 18 countries levy an excise tax on vehicles. Several countries, including Australia and Israel, levy a luxury tax for cars above certain price thresholds, which we categorize as an excise tax in this study. The rate of excise tax varies significantly between countries, from a 3% tax on 1.5-liter (L) vehicles in China to a 75% tax in Malaysia.

Purchase tax

Purchase tax is charged to the consumer at the time of sale, and it is levied in six of the 18 countries. For example, South Korea levies an acquisition tax, Malaysia assesses a sales tax, and Indonesia charges a transfer tax, all of which we consider under the umbrella of a purchase tax. In some countries where both an excise tax and purchase tax are assessed, like China and South Korea, the list price of the vehicle usually includes the excise tax but excludes the purchase tax.

Registration fee

Consumers in five out of the 18 markets pay a registration fee when purchasing vehicles. The fee is usually a small, fixed amount, with the exception of Singapore, where the registration fee can cost 2–3 times the vehicle price.

Environmental performance tax

Japan's environmental performance tax and Singapore's Vehicular Emission Scheme differentiate vehicles with different emission levels of CO₂ or air pollutants. In the 18 markets we reviewed, these are the only two taxes titled to indicate their focus on environmental performance. In Japan, the environmental performance tax rate ranges from 0% to 2%. In Singapore, BEVs receive a rebate of up to 25,000 SGD (18,614 USD)¹ at acquisition, and the highest emitters pay up to an additional 25,000 SGD.

Use phase tax

Use phase taxes mainly refer to the recurring road tax or automobile tax for owning a vehicle, which 13 out of the 18 markets assess. Some countries, such as Japan, Indonesia, New Zealand, and Singapore levy multiple use phase taxes.

Subsidies

In addition to taxes, subsidies also affect the upfront cost that consumers spend on vehicles. As of January 2021, among the markets studied, the four countries that make up 84% of the total passenger vehicle sales (China, Japan, India, and Korea) and Singapore offer direct, national subsidies to lower-emission vehicles, which include BEVs, PHEVs, and fuel cell electric vehicles (FCEVs). Below, we summarize the details of vehicle subsidies in these countries:

- » **China:** Calculates subsidies based on various technological parameters, including electric range, battery capacity, battery energy density, electric energy consumption, and ownership type. From 2021, China is gradually phasing out its subsidies.
- » **Japan:** Offers range-based subsidies for BEV, PHEV, FCEV, and clean diesel vehicles (see: Next Generation Vehicle Promotion Center, 2021).
- » **India:** Offers 137 USD/kWh subsidies for BEVs, PHEVs, and strong HEVs² cheaper than 20,455 USD.
- » **Korea:** Sets different subsidy rates for each eligible model listed on the website of the Korea Environment Corporation, ranging from 2,869 USD to 6,976 USD (Korea Environment Corporation, 2021)
- » **Singapore:** Waives 45% of the additional registration fee, capped at 20,000 SGD (14,849 USD).

Table 1 summarizes the taxes and subsidies in the 18 selected markets. The tax rates depicted are the basic tax rates before any additional benefits apply. Under some circumstances, HEVs, PHEVs, and/or BEVs are taxed at lower rates, resulting either from efficiency-based calculations that determine the main tax rate or from policies that provide additional fiscal incentives to low-emission vehicles. We show lower tax rates that apply to BEVs and PHEVs only in green and lower tax rates that apply to both EVs and fuel-efficient ICE vehicles in blue.

Out of the 18 markets studied, seven markets offer tax benefits exclusively to BEVs and PHEVs, and seven other markets provide tax benefits to BEVs, PHEVs, and efficient ICEs. Saudi Arabia, United Arab Emirates, and Kuwait do not waive taxes or offer tax benefits for EVs. From October 2021, Indonesia has a new tax program that waives the luxury tax on EVs, which could have been as high as 70%.

¹ Appendix C lists the currency exchange rates used in this paper.

² "Strong HEVs" refers to hybrid electric vehicles with a stop-start arrangement, electric regenerative braking system, and a motor drive. The motor alone is able to propel the vehicle from a stationary condition.

Table 1. Overview of taxes and subsidies for passenger cars in the selected countries.

2019 sales rank	Country	Acquisition						Use phase	
		VAT	Excise tax	Purchase tax	Import duty	Environmental tax	Registration fee	Annual automobile tax	
1	China	13%	1%-40% (ES)	10%	15%			9-833 USD (ES)	Yes
2	Japan		10%		0%	0%-2% (FC)		104-1,061 USD (ES) 0-365 USD (VW, VA, FC)	Yes
3	India	28%		1%-22%, (VL, FT, ES)	15%-100%		28.46 USD	4%-12% in Delhi (ES, FT, VBS)	Yes
4	South Korea	10%	6.5% ^a	2%-7% (VT)	8%			0.095 USD-0.238 USD/cc (ES)	Yes
5	Australia	10%	33% (FC, LV) ^b		5%		0 USD-8,245 USD in ACT (CO ₂ , VBS) ^c	74 USD in ACT (VBS)	
6	Iran	9%	0.5%-1.5% (LV)		55%-130% (ES)				
7	Malaysia	6%	75%-105% (ES)	10%	10%-30%			5-1,526 USD in Peninsular Malaysia (VBS)	
8	Indonesia	10%	10%-125% (ES, VT)	12.5% in Jakarta ^d (VBS)	50%			9.83 USD 2% in Jakarta (VBS)	
9	Saudi Arabia	15%			5%			26 USD	
10	Thailand	7%	11%-44% ^e , (ES, FT, CO ₂)		80%			10 USD-348 USD ^f (VS, ES, VA, VW)	
11	Vietnam	10%	35%-150% (ES)		0%-80%		12% + 10.41 USD	67 USD	
12	Israel	17%	20% for the part above 90,019		10%-83% (CO ₂ , VE)	7%			
13	Philippines	12%	4%-50% (ES)		40%			0.03 USD-0.05 USD/kg	
14	United Arab Emirates	5%			5%			109 USD	
15	Pakistan	17%	63-1743 ^g in Punjab (VBS, ES)				1%-4% in Punjab (VBS)		
16	New Zealand	15%			0%		53 USD-166 USD (ES)	78-167 USD (FT, VT) 53/1,000 km for non-petrol, CNG or LPG vehicles	
17	Kuwait	5%			5%				
18	Singapore	7%	20%		0%	18,614 USD rebate-18,614 USD (CO ₂ , VE)	15,107 USD-86,830 USD (VP) ^h	Min. 117.4 USD (ES or PR) Special road tax for diesel vehicle (FT)	Yes

Note. The countries are ranked based on their PV sales in 2019. All tax rates are basic tax rates before applying tax benefits to certain type of vehicles. Under most circumstances, the tax base to which tax rates apply is the base price or, for imported vehicles, the cost, insurance, and freight price (CIF). The tax base can also be the sum of the base price and a few other taxes. In parentheses are the parameters used to determine the tax rate, if any. Tax items in green provide beneficial tax rates to EVs. Tax items in blue provide beneficial tax rates to EVs, HEVs, or fuel-efficient vehicles. cc = cubic centimeter; CO₂ = carbon dioxide; ES = engine size; FC = fuel consumption; FT = fuel type; LV = for luxury vehicles only; PR = power rate; VA = vehicle age; VBS = vary by state; VE = vehicle emission; VL = vehicle length; VP = vehicle price; VS = vehicle seat number; VT = vehicle type; VW = vehicle weight.

a Includes the 5% individual consumption tax and an additional 30% education tax on the individual consumption tax.

b Applies to vehicles over 52,833 USD. For cars with fuel consumption of less than 7 L/100 km, the 33% luxury car tax is applied to vehicles over 53,128 USD.

- c Registration fee refers to stamp duty in Australia. The tax rate, calculation method, and EV tax cut all differ from state to state. Australian Capital Territory (ACT), as an example, has a CO₂-based stamp duty that is waived for models emitting less than 130 g/km CO₂. The estimated upper limit of stamp duty in ACT assumes a maximum vehicle price of 200,000 AUD (153,182 USD).
- d Refers to transfer tax. The national law requires that transfer tax rates should be set by the local governments and be lower than 20%. In Jakarta, the rate is 12.5%.
- e Includes the 10%-40% excise tax and an additional 10% interior tax on excise tax.
- f For Thailand's automobile tax, we assume the vehicle is between 600 cc and 4,000 cc and is less than 7 seats.
- g This number refers to the combination of withholding tax, token tax, professional tax, and income tax. In Pakistan, all vehicle taxes except for VAT are determined at the local level.
- h In Singapore, the registration fee refers to the combination of a registration fee of SGD 220 (165.5 USD) and an additional registration fee which can be 2-3 times the vehicle's open market value (OMV). We calculate the range of additional registration fee assuming the OMV to be between 20,000 SGD and 80,000 SGD (between 14,949 USD and 59,396 USD). If the vehicle retires before 10 years of usage, 50%-75% of the additional registration fee is returned.

2.2 PARAMETERS THAT DETERMINE TAX RATES

As shown in Table 1, different variables such as engine size, fuel consumption, and vehicle weight determine the basic tax rates. The selection of parameters that decide the tax rates, combined with the significance of their impact, could influence consumer purchase choice. A detailed description of these taxation parameters is provided below.

The CO₂ emissions or fuel consumption of vehicles determines certain tax rates in five markets: Japan, Thailand, Israel, Singapore, and Australia (the Australian Capital Territory [ACT]). Singapore and Israel also take into account the **emissions level of other criteria pollutants** to set the tax rate, which usually increases the tax burdens of diesel vehicles due to their higher emissions of nitrogen oxides (NO_x) and particulate matter (PM). In Japan, the difference between a vehicle's fuel efficiency and the country's 2020 fuel economy standard determines the rate of the country's environmental performance tax. In Thailand, the CO₂ emission value, together with the vehicle type and engine size, determines the excise rate, which ranges from 0% to 50%. Singapore has five vehicular emissions tiers with their own fee and rebate rates. In Israel, vehicle purchase tax rate is calculated based off the vehicle's CO₂ and criteria pollutant emissions. Fuel consumption, though not included in the function that determines the basic tax rate, can also affect the final tax rate: In China, fuel efficient vehicles smaller than 1.6 L receive a 50% discount for the annual vehicle and vessel tax. Similarly, in the Philippines, HEVs are only charged half of the automobile excise tax.

Japan, Thailand, and Singapore levy **age**-based taxes to encourage the retirement of older vehicles. In all three countries, the tax rate increases as vehicles get older. Scrappage programs differ from other tax items that directed at consumers' new vehicle purchase decisions by encouraging the phase-out of cars with older technologies, which will likely be replaced by vehicles with advanced efficiency technologies if the countries are pushing hard for vehicle efficiency improvement.

Three markets—Iran, Israel, and Australia—take account of vehicle price and levy additional (luxury) taxes on more expensive vehicles. The progressive tax starts when the vehicle price reaches 23,750 USD in Iran, 52,833 USD in Australia, and 90,539 USD in Israel.

Engine size is the most commonly used variable to calculate tax rates in the selected markets. Thirteen out of the 18 countries have taxes determined by engine size either in the acquisition stage or the use phase. In six countries, engine size is the only factor that affects tax rates.

Fuel type is included in the calculation of vehicle taxes in India, Thailand, New Zealand, and Singapore. Singapore has an additional tax that specifically targets diesel vehicles, and New Zealand's road-user charges apply to non-gasoline vehicles.

Vehicle type affects tax rates in South Korea, New Zealand, and Indonesia. In South Korea and New Zealand, vehicle type refers to private or public vehicles (e.g., taxis and municipal vehicles). Indonesia applies different tax rates to 2-wheel drive and 4-wheel drive vehicles.

Table 2 provides a concise list of variables used in the calculation of the main tax rate. Some countries also levy taxes on specific vehicle features or apply variables to calculate vehicle taxes that are not listed in the table. They have minor impacts on the consumer ownership costs and are not represented in the findings of this paper. For example, New Zealand has a one-time 17 USD synthetic greenhouse gas levy if the vehicle uses refrigerant hydrofluorocarbon (HFC)-134a in the air conditioning system. Israel has a safety accessories tax reduction that provides different tax benefits to vehicles with different safety levels determined by variables such as number of airbags installed. Queensland, Australia charges a registration fee and a stamp duty based on the number of cylinders. In India, vehicle length is a further parameter that affects the purchase tax.

Table 2. List of variables used in the main tax rate calculation.

	CO ₂ /fuel consumption	Emissions of other pollutants	Weight	Age	Price	Engine size	Fuel type
China						◆▲	
Japan	◆▲		▲	▲		▲	
India						◆	◆
South Korea						▲	
Australia	◆		◆		◆	◆	
Indonesia						◆	
Iran					◆		
Malaysia						◆	
Thailand	◆			▲		◆▲	◆
Saudi Arabia							
Philippines			◆				
Israel	◆	◆			◆		
United Arab Emirates							
Vietnam						◆	
Pakistan						◆	
New Zealand						◆	◆▲
Kuwait							
Singapore	◆	◆		◆		◆▲	▲

Note. ◆ = the tax is levied at the acquisition phase. ▲ = the tax is levied at the use phase.

3. QUANTITATIVE ANALYSIS OF TAX SYSTEMS

In this section, we compare the consumer ownership costs of selected vehicle models across the 18 markets we review. Then, we quantify the impact of tax benefits in reducing the cost of efficient vehicles and EVs and identify opportunities to use taxation systems to drive decarbonization of the passenger vehicle fleet.

3.1 METHODOLOGY

For our analysis, we select three vehicle models for cost comparison: a 1.8-L gasoline Toyota Corolla, a 1.8-L hybrid Toyota Corolla, and a 40-kWh BEV Nissan Leaf. In this study, we define consumer ownership costs as the combination of vehicle base price, VAT, one-time tax, recurring tax, fuel cost, and national-level subsidies. In countries with mostly imported vehicles (i.e., United Arab Emirates, Saudi Arabia, Australia, Singapore, New Zealand, and the Philippines), we also include import tax. We discount the recurring tax and fuel cost to present values using an annual discount rate of 4% and assume that payments are made at the beginning of each year. The consumer ownership costs exclude those like license plate fees, insurance, maintenance and inspection fees, and loan interests. Table 3 shows the specifications of the three vehicle variants we selected.

Table 3. Variants of selected vehicle models.

	Fuel type	Engine size (cc)	Horsepower (PS)	Curb weight (kg)	Fuel efficiency (WLTC, km/l)	Range (WLTC, km)/l
Corolla GX	Gasoline	1,797	140	1,250	14.6	—
Corolla Hybrid GX	Hybrid vehicle	1,797	98	1,330	29	—
Nissan Leaf S	Battery electric vehicle	—	150	1,490	—	270

Note. cc = cubic centimeter; PS = metric horsepower; WLTC = Worldwide Harmonized Light Vehicles Test Cycles.

The variants we select represent popular models in Asian and Asia-Pacific markets. Additionally, in order to compare reasonably the consumer ownership costs of different fuel type and technologies, we select models similar to each other in vehicle performance.

Nevertheless, two challenges complicated the selection of the three vehicle models. First, unlike the Volkswagen Golf in Europe, no qualifying model is sold in all Asian and Asia-Pacific countries that is available in all three fuel types. This disparity was due in part to the different development levels and consumer preferences in the 18 markets. In particular, a very limited set of BEV models are available in some Southeast and South Asian markets, and no one gasoline model is popular in all 18 countries. While Chinese consumers prefer Volkswagen gasoline cars such as the Laida and the Jetta, small Japanese models perform well in Southeast Asian markets, and domestic makes are among Korea’s top-sellers. Therefore, we selected models that are more familiar to global consumers rather than popular local brands. The Nissan Leaf, for example, is a typical EV model that researchers have used in similar vehicle ownership costs analyses in Asian countries (Mustapa, Ayodele, Mohamad Ishak, & Ayodele, 2020; Kara, Li, & Sadjiva, 2017). Moreover, the displacement and horsepower of the selected vehicles are representative of the preferences of Asian consumers. While the models we select are not currently sold in all of the markets we study, they can still reflect the effect of tax policies on consumer ownership costs.

Second, across the 18 countries, the selected models have different specifications and prices, which are needed in the tax calculation. Take the gasoline Corolla as an example. As shown in Appendix B, although the Corolla models are available in all of the countries in this study except for India and Korea, the 1.2 L and 1.5 L versions are sold in China but not in Japan. Likewise, the 1.8 L version is sold in both countries but does not have the same curb weight and gross weight. In our analysis, we therefore uniformly apply the specifications and prices of the basic variant of the 2020 models sold in Japan instead of the actual variants in each country. These specifications are used to make judgements on whether these models will receive tax benefits and subsidies in the 18 countries. Because we use the same base price for the same model in across all countries, the difference in consumer ownership costs will directly reflect the impact of the taxation system and fiscal incentives.

We apply several additional assumptions, captured in Table 4. As mentioned above, the consumer ownership cost calculation only includes national-level taxes and subsidies. Since this study explores the effects of taxation policies on the cost of vehicles, other costs such as insurance, license fees, and inspection fees are excluded. As for the fuel and electricity price, we use the gasoline price in April 2021 (GlobalPetrolPrices.com, 2021) and electricity price from September 2020 (GlobalPetrolPrices.com, 2020) based on data availability for all countries.

The annual miles traveled differ from country to country; after comparing studies in different Asian and Asia-Pacific countries, we use 10,000 km as the annual distance travelled for all 18 countries. A 2020 study on vehicle consumer ownership costs in India (Kumar & Chakrabarty, 2020) uses 10,000 km as one of the annual distance traveled inputs for passenger vehicles. In China, the consumer-reported annual distance travelled was 14,755 km, and the number is declining over the years (Mao et al., 2018). A similar study in Indonesia (Kimura, Suehiro, & Doi, 2018) assumed passenger vehicles travel 10,000 km annually.

We assume a discount rate of 4% for all 18 markets. Previous ICCT studies used a discount rate of 6% for the European Union (Wappelhorst et al., 2018), 5% for India (Dash, Wappelhorst, & Bandivadekar, 2021), 3% for the United States (Miller & Lutsey, 2017), and 5% for China (Lutsey, Cui, & Yu, 2021). There is no discount rate that's appropriate for all 18 markets at different stages of economic development. Research on the discount rates in each country, especially Southeast Asia and Middle Eastern countries, is also limited. Therefore, based on prior discount rates in ICCT studies, we chose to apply 4% to all 18 markets.

The charging conditions of electric vehicles and electricity pricing mechanisms also differ between the countries. We assume the EVs are always charged at home at the rate of the average household electricity price.

Table 4. Assumptions in the consumer ownership cost calculation.

Variable	Assumption
Vehicle price	Each model has the same base price across all countries
Vehicle specifications	All models use vehicle specifications of 2020 models in Japan
Fuel price	Gasoline prices on April 26, 2021 (GlobalPetrolPrices.com, 2021)
Electricity price	Average household electricity price in September 2020 (GlobalPetrolPrices.com, 2021)
Ownership	6-Year
Discount rate	4% (We assume annual payments are made at the beginning of each year)
Annual miles traveled	10,000 km
Exchange rate	Exchange rate as of February 2021. See Appendix C for all exchange rates used in the report
Consumer ownership cost calculation	Country-level taxes, fees, and subsidies

3.2 RESULTS: COMPARISON OF COSTS

Figures 3a, 3b, and 3c show the consumer ownership cost of the three selected models for each country. Although we assume the base price of each model to be the same across all countries, different taxation policies and subsidies create significant differences in the consumer ownership cost.

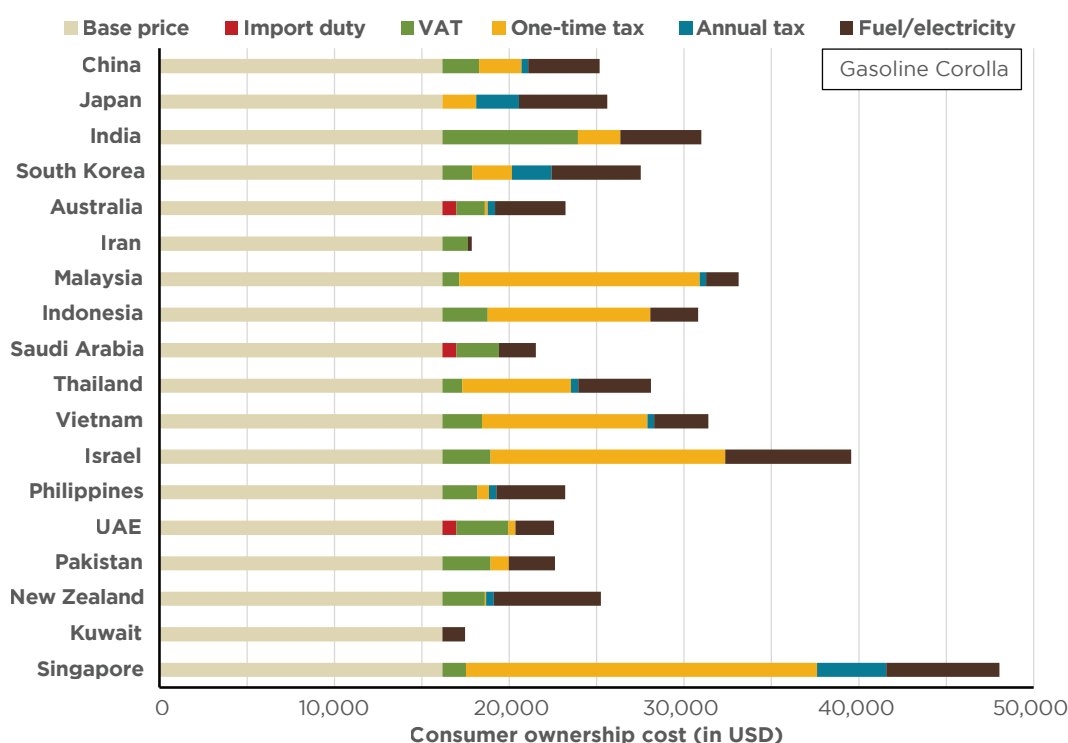


Figure 3a. Consumer ownership cost comparison for the 1.8-L gasoline Corolla.

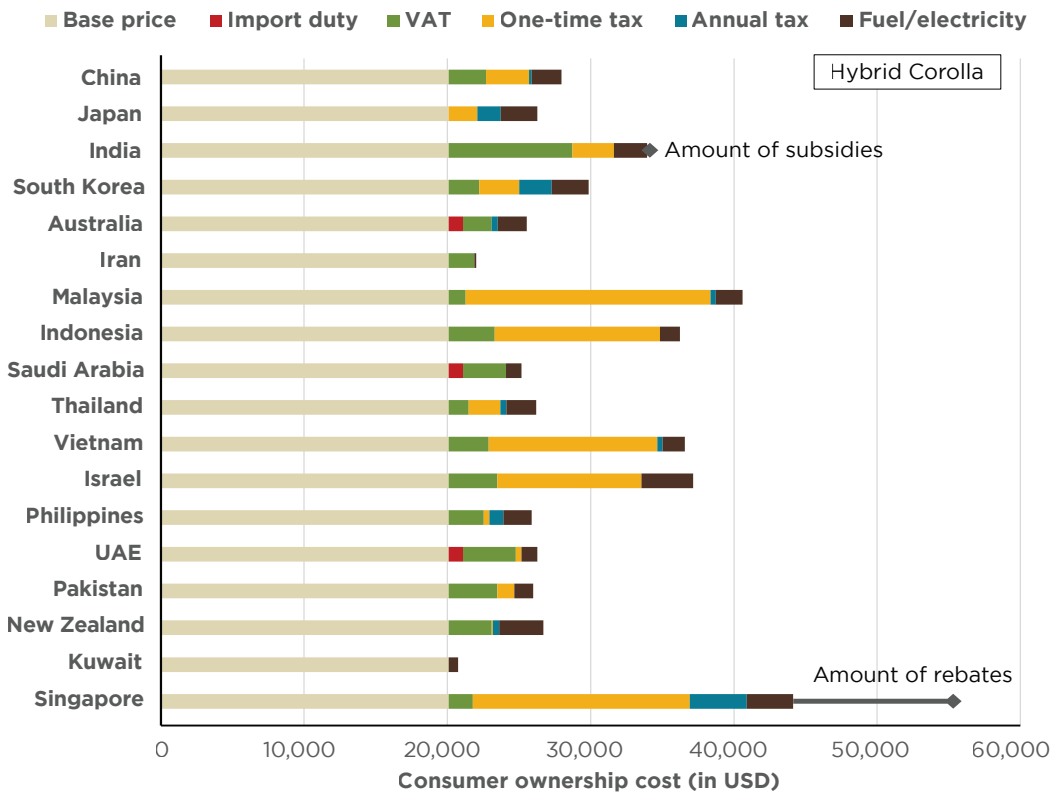


Figure 3b. Consumer ownership cost comparison for the 1.8-L hybrid Corolla.

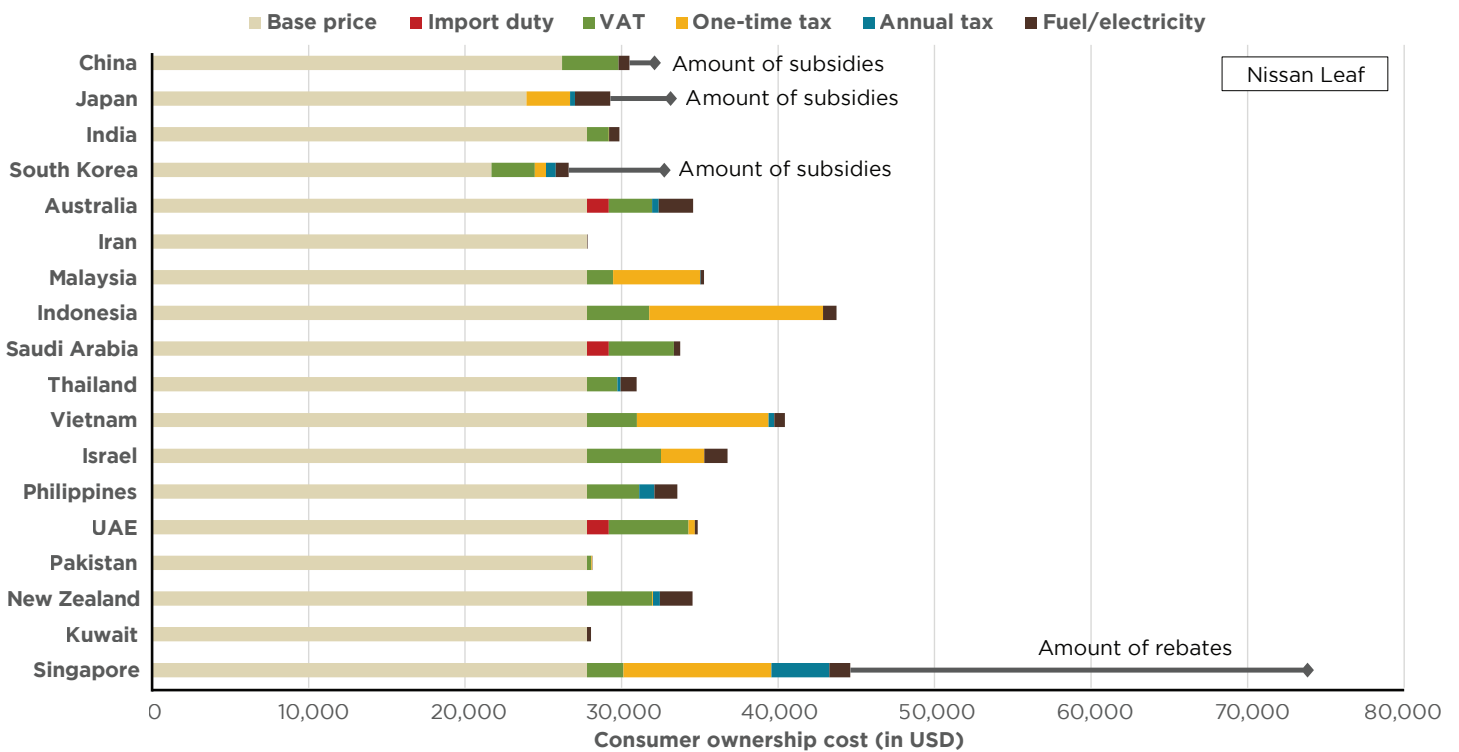


Figure 3c. Consumer ownership cost comparison for 40 kWh Nissan Leaf. In addition to China, Japan, South Korea and Singapore, India also offers subsidies to BEVs, but the Nissan Leaf we selected does not qualify for India's subsidy under the FAME policy. Therefore, it is not reflected in this figure. As for Singapore, the rebates include two parts: the Vehicular Emission Scheme and the EV Early Adoption Incentive. Both of them help reduce the high Additional Registration Fee instead of the base price. Therefore, the base price of Nissan Leaf is not lowered in Singapore after rebate.

We draw four core conclusions from the results.

Conclusion 1: Across the 18 countries, there is significant variability of the consumer ownership cost in relation to the base price of the gasoline and hybrid vehicles.

- » The respective consumer ownership costs of gasoline and hybrid vehicles in **Singapore** are 297% and 220% of the base prices. The high costs come from the progressive, price-based registration fee and the emissions-based Vehicular Emissions Scheme.
- » The ownership costs of gasoline and hybrid vehicles in **Israel** are 245% and 185% of the base prices. Israel levies a purchase tax as high as 83% for ICE vehicles. Fuel cost in Israel is also higher than in other countries. In 2019, the average gasoline price in Israel reached 1.77 USD/ L, which is approximately twice as much as the world's average price of 0.91 USD/L (International Energy Agency, 2020).
- » The ownership costs of gasoline and hybrid vehicles in **Malaysia** are 205% and 202% of the base prices, respectively. Vehicle owners in Malaysia pay 75%-105% of the base price as excise duty at vehicle acquisition. The excise tax rate increases as engine displacement increases.
- » The ownership costs of ICE vehicles in **Iran** and **Kuwait** are only 3%-14% higher than the base price. Iran only levies VAT, and Kuwait does not tax vehicles. Both countries also have comparably lower fuel prices.

Conclusion 2: The impact of various taxes on consumer ownership costs varies across countries. A high one-time tax is usually the main driver of high consumer ownership costs.

- » **One-time tax:** This tax—the yellow bars in Figure 3a-3c—accounts for the largest share of taxes and fees, followed by fuels cost and VAT. The level of each type of cost varies significantly across countries. In Singapore, the one-time tax for gasoline vehicles is 133% of the base price, followed by 87% in Israel and 85% in Malaysia. In addition to these three countries, the one-time tax is also relatively high in Indonesia, Thailand, and Vietnam, and singly places the vehicle price in these southeast Asian countries at mid- to high-range across the 18 markets studied.
- » **VAT:** India levies a higher VAT than all other countries, at 28% for ICE vehicles. Only BEVs in India receive a lower VAT rate of 5%. All hybrids are charged the same 28% rate as ICE vehicles.
- » **Use phase taxes:** Most countries either charge a small use phase tax or charge none at all. For gasoline vehicles, the annual tax in Singapore is higher than other markets, constituting 23% of the base price.
- » **Fuel and electricity:** As noted above, fuel prices in Israel are notably high. New Zealand and Singapore also have higher fuel costs. In contrast, the gasoline cost in the four oil-producing countries of Iran, Saudi Arabia, United Arab Emirates, and Kuwait is significantly lower than in the other countries. Electricity prices are lowest in Iran and Kuwait and highest in Japan and Australia. In general, the difference between electricity costs in these countries is smaller than the difference between gasoline costs.
- » **Import Duty:** Although not included in the consumer ownership cost calculation, the upper limits of customs duty for each vehicle in India (100%), Iran (130%), Thailand (80%), and Vietnam (80%) are relatively high. For this reason, most vehicles sold in these countries are domestically produced or assembled. The import duty is low among the countries that mainly import their vehicles, which

include Australia (5%), Saudi Arabia (5%), United Arab Emirates (5%), New Zealand (0%), and Singapore (0%).

Conclusion 3: Countries with a higher tax level for ICE vehicles can more effectively reduce the consumer ownership cost of efficient vehicles through a fuel consumption/CO₂-based tax.

- » More efficient vehicles tend to have higher upfront costs because they incorporate fuel-efficient technologies.
- » The base price of the selected 1.8-L hybrid Corolla is 24% higher than the 1.8-L gasoline Corolla (shown in the blue line in Figure 3a–3c).

Figure 4 compares the consumer ownership cost differences between the gasoline and hybrid models in the 18 markets, sorted from the highest to the lowest. As shown, among the five countries with fuel consumption/CO₂-based tax in place, three taxation mechanisms (in Singapore, Israel, and Thailand) make the hybrid Corolla cost-competitive with the gasoline Corolla over a 6-year ownership period. Although Australia also has a CO₂-based stamp duty in the ACT, the duty is insufficient to create significant tax benefits for fuel-efficient vehicles. While India’s subsidies for vehicle purchase offer benefits to HEV buyers these subsidies do not result in significant cost reductions of the hybrid Corolla. The three Association of Southeast Asian Nations countries—Malaysia, Indonesia, and Vietnam—provide the fewest tax benefits for fuel-efficient vehicles.

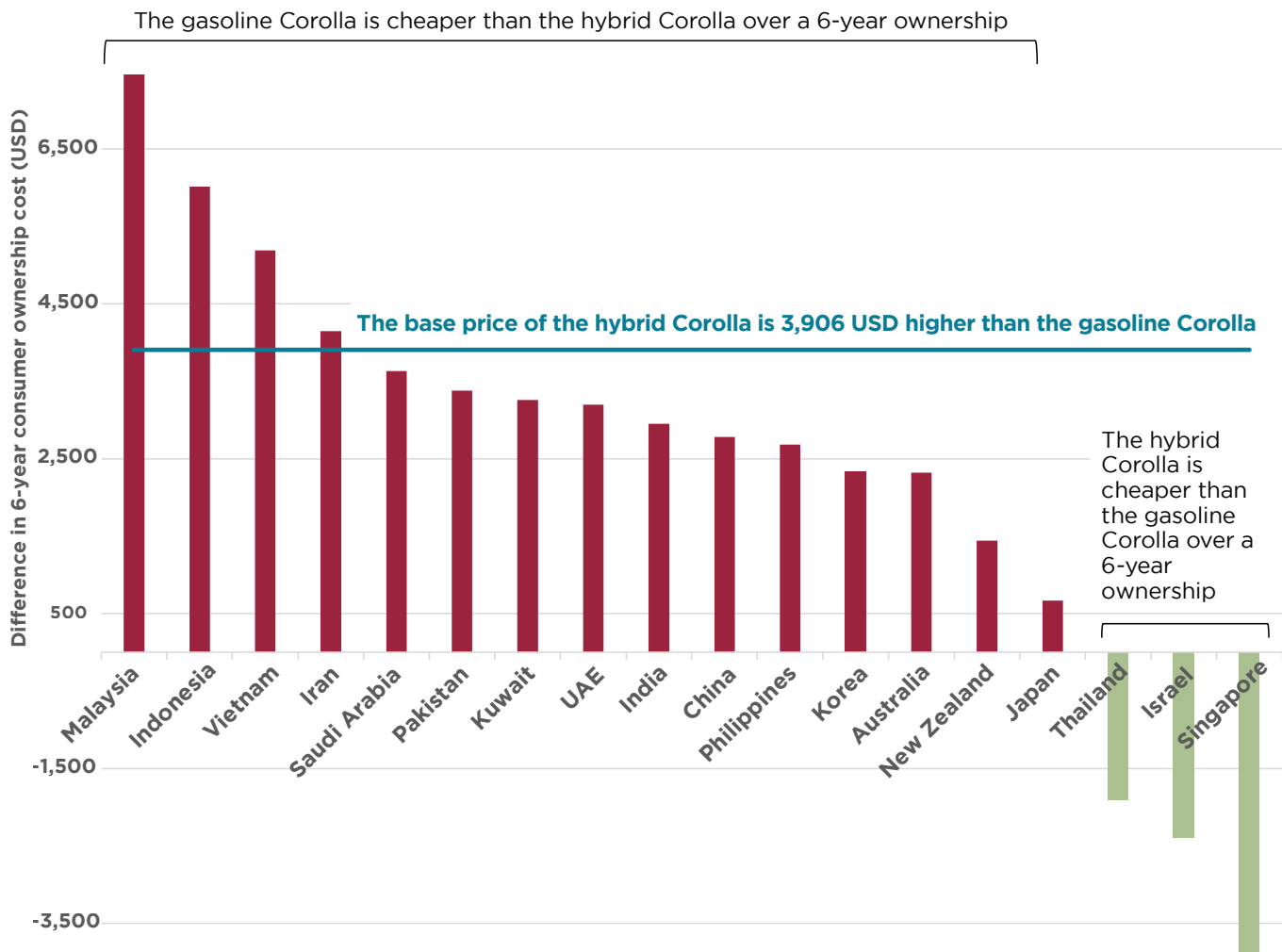


Figure 4. Consumer ownership cost differences between the 1.8-L gasoline Corolla and the 1.8-L hybrid Corolla.

Below we provide an analysis of the cost competitiveness between the hybrid and gasoline Corolla in a handful of the 18 countries:

- » In **Singapore**, owning a hybrid Corolla is 3,904 USD cheaper than owning a gasoline Corolla over a 6-year ownership period. Owners of vehicles emitting 90–125 g/km CO₂ (the hybrid Corolla) save 11,177 USD compared to those buy vehicles emitting 125–160 g/km CO₂ (the gasoline Corolla).
- » In **Israel**, owning a hybrid Corolla saves consumers 2,394 USD compared to owning its gasoline counterpart. In 2021, the rates of purchase tax for hybrid and gasoline vehicles are 50% and 83%, respectively. However, from 2022 onward, the purchase tax rate for HEVs and gasoline vehicles will be the same, as Israel moves gradually to phase out the benefits it provides to HEVs in order to encourage EV purchases.
- » **Thailand** levies a 10% purchase tax on HEVs with CO₂ emissions lower than 100 g/km and a 35% purchase tax on gasoline vehicles with CO₂ emission of 150–200 g/km. As a result, the 6-year ownership period of the hybrid Corolla is 1,901 USD cheaper than the gasoline Corolla.
- » The gasoline Corolla does not meet **Japan's** 2020 fuel economy standard, but the hybrid version exceeds Japan's weight-based target by more than 150%. As a result, the hybrid Corolla is levied a lower environmental performance tax, vehicle weight tax, and automobile tax in Japan.
- » Although the ACT in **Australia** also has a CO₂-based stamp duty, both the gasoline and hybrid Corolla fall into “above average” performance groups. As a result, the rate of stamp duty is 1% for the gasoline Corolla and 0% for the hybrid version, which saves the HEV owner about 200 USD upon acquisition.
- » **India's** one-time subsidies on car purchase would reduce the hybrid Corolla's upfront cost by 180 USD, which is marginal compared to its base price. The hybrid Corolla is not available in India; if it were to enter the Indian market, it would cost more than the market price in Japan and would not be eligible for the subsidy.
- » In **Israel** and **Singapore**, where the gasoline price is high, the fuel-efficient hybrid Corolla provides significant cost benefits to consumers.

Countries that plan to improve the fuel efficiency of gasoline vehicles can do so through CO₂-based tax schemes. In countries like Israel and Japan, whose taxation policies encourage the purchase of efficient vehicles, the adoption rates of HEVs are relatively high, as shown in Figure 1. The consumer ownership cost reduction is more significant for countries that already levy high taxes on less efficient vehicles.

Conclusion 4: Direct subsidies and a properly designed EV tax cut can effectively lower the consumer ownership cost of EVs

The base prices of BEVs and PHEVs are usually much higher than comparable ICE models. EVs are less affordable when taxes proportionate to the base price are added to the upfront cost. The cost difference at acquisition is so significant that a lower fuel cost is insufficient to help EVs achieve cost competitiveness.

As discussed in Section 2, 14 out of the 18 Asia and Asia-Pacific countries offer tax benefits for EVs. However, not all of these tax benefits effectively reduce the consumer ownership cost of EVs, as shown in Figure 5. In India, Korea, Singapore, and Israel, the tax benefits of the Nissan Leaf make it cost comparable with the gasoline Corolla over a 6-year ownership period. The four countries without any EV tax cut or EV subsidies are the countries in which EVs have no cost benefits. Although EV fiscal incentives are available in Australia, the consumer ownership cost of the Nissan Leaf over a 6-year ownership period is still about 10,000 USD or more than the gasoline Corolla.

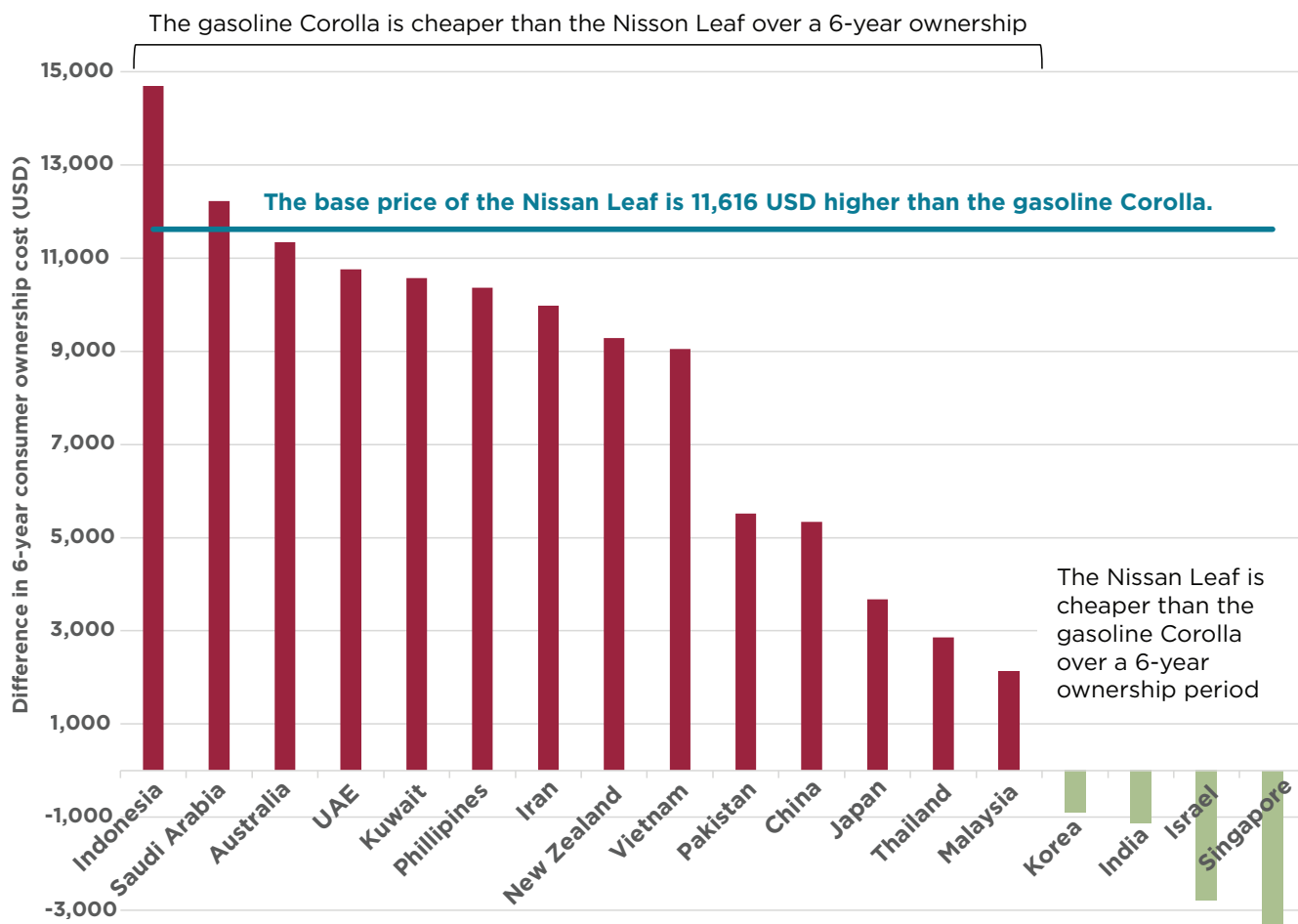


Figure 5. Consumer ownership cost differences between the 1.8-L gasoline Corolla and the 40-kWh BEV Nissan Leaf.

- » **Singapore, Korea, Japan, and China** reduce the Nissan Leaf’s upfront cost by offering direct subsidies of 10,600 USD, 6,105 USD, 3,860 USD, and 1,602 USD, respectively (Figure 3c). In Singapore, the 6-year consumer ownership cost of the Leaf is 3,426 USD lower than that of the gasoline Corolla as a result of a significant rebate (18,623 USD) and subsidy (10,600 USD) upon acquisition.
- » **Israel, India, Malaysia, and Thailand** greatly lower EV consumer ownership cost through tax reduction in either the acquisition or use phase. In Israel, the 6-year consumer ownership cost of the Nissan Leaf is 2,783 USD lower than that of the gasoline Corolla, where BEVs are levied a 10% purchase tax while ICE vehicles are levied an 83% purchase tax. In India, the GST and compensation tax are 48% for the gasoline Corolla but only 5% for the Leaf. The state-assessed 10% road tax is also waived for the Leaf in Delhi.³ As a result, consumers purchasing the Leaf save an estimated 1,135 USD compared to the gasoline Corolla over the 6-year ownership period. Malaysia reduces its excise duty to 10% for the Leaf from 75% for the gasoline Corolla. Similarly, Thailand waives the 35% excise tax on the gas-powered Corolla for the Leaf.

³ The waiving of the road tax results in significant tax benefits because the taxable amount of road tax is the sum of the base price, GST, and compensation cess. Together, the road tax, GST, and cess account for 62.8% of the gasoline Corolla’s base price but only 5% of the Leaf’s base price.

- » In **Indonesia**, the 6-year consumer ownership cost of the Leaf is 18,255 USD higher than the gasoline Corolla. Indonesia levied a 40% luxury tax on both ICE vehicles and EVs before its tax reform in October 2021; the luxury tax created a significant EV tax burden in addition to EVs' high market prices. **Saudi Arabia** offers no tax benefits for EVs and applies the 15% VAT to all vehicles. There, the 6-year ownership cost of the Leaf is 12,224 USD higher than the gasoline Corolla.
- » Japan, Thailand, Israel, and Singapore, the four countries with a CO₂-based tax scheme, also simultaneously provide tax benefits to EVs and reduce the consumer ownership cost of EVs. However, only Singapore and Israel make EVs cost-competitive with gasoline counterparts due to high gasoline prices and through substantial additional subsidies (Singapore) or a tax cut (Israel).

4. CASE STUDIES

In this section, we summarize taxation policies for five markets in detail: Japan, Singapore, China, India, and Indonesia. Each of these markets represents a large share of passenger vehicle sales in Asian and Asia-Pacific markets; has implemented a CO₂- or fuel efficiency-based taxation scheme; or has implemented tax reforms that improve the cost-competitiveness of lower emission vehicles. Their size, effective tax policies, and commitment to transport emissions reduction make them suited for identifying lessons and recommendations for other countries to accelerate EV adoption and support the transition to lower emission vehicles.

4.1 JAPAN

In October 2019, Japan underwent a major vehicle taxation reform, replacing its original acquisition tax with a fuel efficiency-based environmental performance tax and extending the tax reduction for electric and fuel-efficient vehicles. Japan now levies a 10% **excise tax**, an **environmental performance tax** upon acquisition, an **annual automobile tax**, and a **vehicle weight tax** paid at vehicle inspection.

Japan also has one of the most complex vehicle taxation systems among the major Asian and Asia-Pacific markets. This complexity comes from its method for calculating the taxes. In general, vehicles in Japan are divided into two groups based on whether the engine displacement exceeds 660 cc. Vehicles in the two groups are assigned different tax rates. Japan also categorizes BEVs, FCEVs, natural gas vehicles, clean diesel vehicles,⁴ and those that meet the 2020 fuel efficiency standard as “Eco Cars” and gives them special tax benefits.

Unlike most markets in this study, passenger vehicle consumers in Japan do not pay a VAT or customs duty. When purchasing the vehicle, consumers pay an additional 10% of the base price as excise tax and 0%–2% of the base price as an environmental performance tax. Compared to the previous acquisition taxes of 2% on vehicles with engine displacement no greater than 660 cc and 3% for those with displacement above 660 cc, the new environmental performance tax reduces the tax burden for all vehicle owners. The tax rate is determined by the difference between the vehicle’s fuel economy performance and Japan’s 2020 fuel economy standard, which is a weight-based system and sets different values for gasoline and diesel vehicles. More fuel-efficient vehicles pay a lower environmental tax. After the new tax phase in period from October 2019 to March 2021, Japan implemented a 1% tax increase for some vehicle groups (Japan Vehicle Taxation Reform Website, 2021).

Vehicle owners also pay an automobile tax and vehicle weight tax during the use phase of the vehicle.⁵ The annual basic tax rate for the automobile tax ranges from JPY 10,800 (98 USD) to JPY 100,000 (910 USD) before benefits for more efficient vehicles apply. For example, a 1.6-L vehicle that meets the 2020 fuel economy standard by no more than 10% pays JPY 36,000 (328 USD). The rate of the weight tax before tax benefits apply ranges from JPY 2,500 (23 USD) to JPY 37,800 (348 USD) depending on the weight, vehicle age and fuel efficiency. A 1,500 kg passenger car that meets the 2020 fuel consumption standard would need to pay JPY 7,500 (69 USD) weight tax annually. For both taxes, cars using alternative fuels or achieve higher fuel efficiency receive a tax reduction. For example, BEVs, FCEVs, PHEVs, LNG vehicles, and clean diesel vehicle only pay 25% of the original automobile tax. These vehicles, and those

4 Clean diesel vehicle refers to those in compliance with 2009 exhaust gas regulations or 2018 exhaust gas regulations.

5 Both taxes are calculated on an annual basis. Consumers pay the automobile tax every year, while they pay the first three years’ worth of the weight tax at the time of acquisition, followed by payments once every two years.

that achieve the 2020 fuel efficiency standard by more than 40%, are exempt from a weight tax.⁶

Out of the four taxes levied in Japan, EVs and more efficient vehicles receive beneficial rates for automobile tax, weight tax, and environmental performance tax. In addition, electric vehicles also receive range-based subsidies that further reduce their costs (Next Generation Vehicle Promotion Center’s Website, 2021). In addition to national subsidies, municipal-level subsidies and special subsidies for elderly people are also available for EV consumers. For example, a Nissan Leaf receives 420,000 JPY (3,832 USD) from the national government and an additional 300,000 JPY (2,732 USD) in Tokyo (Nissan, 2021).

As shown in Figure 6, the lower use phase tax, lower fuel cost, and subsidies greatly compensate for the high upfront cost of BEVs in Japan. For example, a gasoline Corolla owner would pay 2,432 USD in automobile tax and weight tax annually, while a Leaf owner would only pay 313 USD. The base price of the Leaf is 11,616 USD higher than the gasoline Corolla, but through tax benefits and national subsidies, the Leaf’s consumer ownership costs over 6 years are only 3,672 USD higher than the gas-powered Corolla. If local subsidies are taken into account, owning a Leaf for 6 years in Japan is only 940 USD more expensive than owning a gasoline Corolla. The fuel efficiency-based tax scheme also lowers the consumer ownership cost of hybrid vehicles in Japan. Although the hybrid Corolla is 24% more expensive than the gasoline version, the consumer ownership cost of the hybrid vehicle is only 3.7% higher than the gasoline model.

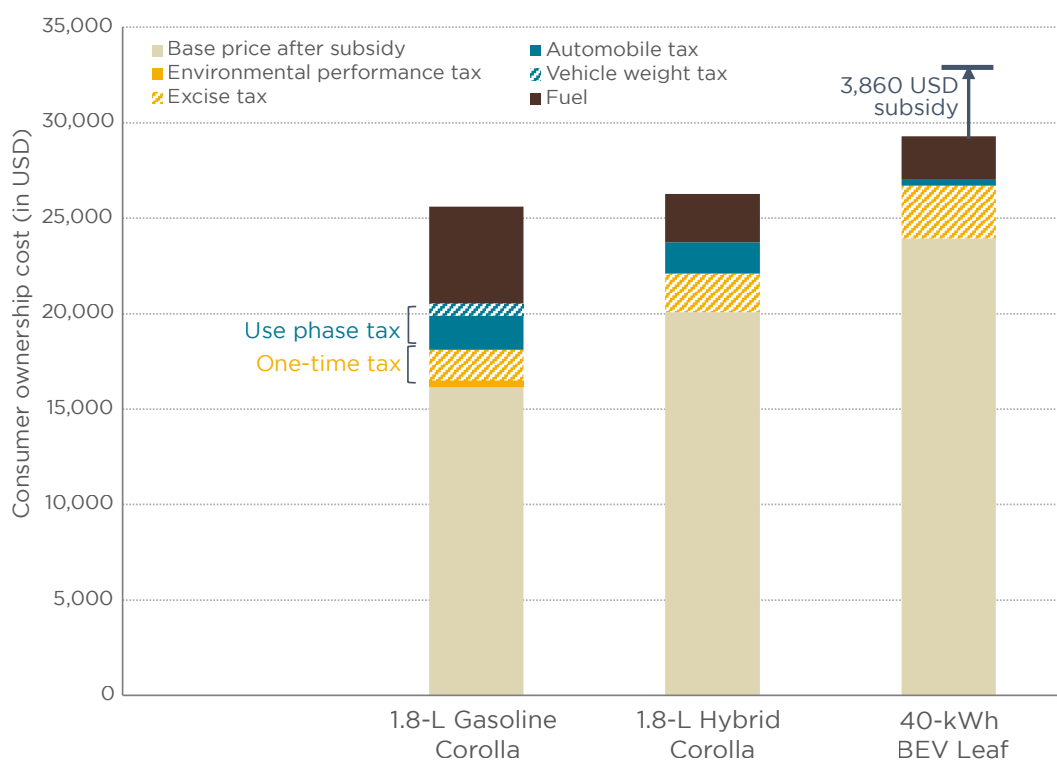


Figure 6. Consumer ownership cost comparison in Japan. The calculation only includes national-level taxes and subsidies. When the weight tax is discounted to the current value, we assume that the first two years of weight tax is paid at acquisition, the following two years are paid at the end of the third year, and the subsequent two years are paid at the end of the fifth year.

⁶ The exemption only applies to vehicles purchased between May 1, 2019, and April 30, 2021. If a consumer had the vehicle’s first inspection performed during that period, the weight tax is only waived once the vehicle exceeds the 2020 fuel efficiency standard by 90%.

Although Japan has multiple taxes that favor efficient vehicles, their impact is minor. HEVs appear cost-competitive with gasoline vehicles primarily due to Japan's high fuel costs: More efficient vehicles save on fuel costs over many years. Not coincidentally, Japan has a high share of HEVs, as shown in Figure 1. After April 2021, the criteria for receiving tax benefits in Japan grew more limited to BEVs, with the intention of accelerating the pace of transport electrification.

Because EVs cost more, a lower tax rate is insufficient to reduce their costs significantly. In Japan, with the help of both national and local subsidies, an EV can be cost-competitive with its gasoline counterpart during a 6-year ownership period. Nevertheless, the impact of Japan's EV subsidies is not yet measurable through market changes. As shown in Figure 1, BEVs and PHEVs still accounted for less than 1% of new sales in 2019.

Japan's complex taxation system and its many tax breaks and subsidies for consumers make it important to inform consumers of the tax benefits at hand. In Japan, passenger cars are sold with labels detailing their fuel efficiency information, but these do not link to the tax level of each model. Therefore, consumers are not fully aware of the tax benefits of electric or hybrid vehicles by checking their labels. After the October 2019 tax reform, the Ministry of Economy, Trade and Industry intuitively lists its tax structure on one website dedicated to vehicle taxation information.

4.2 SINGAPORE

Passenger vehicles sold in Singapore are significantly more expensive than in other Asian and Asia-Pacific countries due to Singapore's special tax and fee scheme. For example, the market price of a 1.8-L hybrid Corolla in the country is 125,888 SGD (95,007 USD) (Toyota Singapore, 2021),⁷ while a similar model is listed as 2,403,500 JPY (23,136 USD) in Japan (Toyota Japan, 2021). However, when this hybrid Corolla is imported into Singapore, its Open Market Value (OMV), which is the price that Singapore Customs assesses, is only 29,414 SGD (22,157 USD) (One Motoring, 2021). During vehicle acquisition, Singapore levies a 20% **excise tax**, a 7% **GST**, a 220 SGD **registration fee**, and a progressive **additional registration fee (ARF)**, which can be 2–3 times the vehicle's OMV and adds significantly to the vehicle's upfront cost.⁸

From 2019 to 2020, the market share of BEVs, PHEVs, and HEVs in Singapore increased from 0.4% to 2.5% of the total new passenger car registrations (Marklines, 2020). In February 2020, Singapore announced its goal to phase out gasoline and diesel vehicles by 2040 (Reuters, 2020). To accelerate its electrification process, from January 2021, BEV consumers started to receive a tax deduction capped at 20,000 SGD that waives up to 45% of the ARF, according to Singapore's Electric Vehicle Early Adoption Incentive (EEAI). Between 50% and 75% of the ARF is returned if the vehicle is deregistered before it is 10 years old. We do not assume when these vehicles deregister; therefore, our consumer ownership cost calculation does not take this scrappage scheme into account.

7 In addition to taxes, the list price also includes the dealer's margin and the estimated price of the Certificate of Entitlement (COE), which gives purchasers the right to use the vehicle. The COE cost 39,000 SGD (29,433 USD) for the Corolla Hybrid in November 2020 (One Motoring, 2020).

8 The ARF = 100% * (the first \$20,000 of OMV) + 140% * (the 20,001 SGD to 50,000 SGD portion of OMV) + 180% * (the portion of OMV that exceeds 50,000 SGD).

In addition, the Enhanced Vehicular Emissions Scheme (VES) offers a rebate or surcharge that further adjusts the amount of ARF. The minimum amount of ARF after an EV discount and VES is 5,000 SGD (3,773 USD). VES is an advanced vehicle labelling and feebate system based on vehicles' CO₂ emissions and four other pollutants shown in Table 5. Compared to other Asian and Asia-Pacific countries, Singapore's VES has several advantages:

It focuses on greenhouse gases as well as air pollutants. The pollutant with the highest emission value will determine the vehicle's category. In this way, even if a diesel vehicle has good fuel economy performance, it may still be charged a punitive fee for its air pollutant emissions.

BEVs and PHEVs do not automatically receive the highest rebate. Instead, VES uses an emission factor of 0.4 g CO₂/Wh to calculate vehicles' emission levels and corresponding band. If a Tesla Model X, which is tested as 236 Wh/km under the Worldwide Harmonized Light Vehicle (WLTP) standard (Tesla, 2020) enters Singapore's market, it will fall into A2, the second-best band, instead of A1, the band for vehicles with lowest emissions.

The rebate and surcharge difference between bands is substantial, which provides an incentive for technology improvement. The feebate rates are adjusted over time. For example, on January 2021, the rebate amounts for A1 and A2 vehicles each increased 5,000 SGD (3,730 USD) and the surcharge for C1 and C2 categories increased 5,000 SGD (3,730 USD). The new rebate rates began in January 2021 and the surcharge rates entered into effect beginning in July 2021.

Despite these advantages, the band range is too wide to provide incentives for continuous technology improvement. For example, some vehicles can be just slightly adjusted and achieve a large change in the rebate/surcharge amount. Some vehicles in the middle of a band lack an incentive to improve into the next band. Therefore,

Table 5. Rebate and surcharge rates in Singapore's Vehicular Emissions Scheme, from January 2021.

Band	CO ₂ (g/km)	HC (g/km)	CO (g/km)	NO _x (g/km)	PM (mg/km)	Rebate	Surcharge
A1	A1 ≤ 90	A1 ≤ 0.020	A1 ≤ 0.150	A1 ≤ 0.007	A1=0	25,000 SGD	—
A2	90 < A2 ≤ 125	0.020 < A2 ≤ 0.036	0.150 < A2 ≤ 0.190	0.007 < A2 ≤ 0.013	0.0 < A2 ≤ 0.3	15,000 SGD	—
B	125 < B ≤ 160	0.036 < B ≤ 0.052	0.190 < B ≤ 0.270	0.013 < B ≤ 0.024	0.3 < B ≤ 0.5	0 SGD	0 SGD
C1	160 < C1 ≤ 185	0.052 < C1 ≤ 0.075	0.270 < C1 ≤ 0.350	0.024 < C1 ≤ 0.030	0.5 < C1 ≤ 2.0	—	15,000 SGD
C2	C2 > 185	C2 > 0.075	C2 > 0.350	C2 > 0.030	C2 > 2.0	—	25,000 SGD

Singapore can improve VES by implementing a continuous and linear feebate rate line (German & Meszler, 2010).

Road tax is the only annual tax that vehicle owners pay in Singapore. However, the state calculates the tax differently for gasoline, diesel, plug-in hybrid, and battery electric vehicles. All vehicle owners pay a basic road tax determined by the engine displacement, for ICE vehicles, or the power rating, for electric cars. Diesel and diesel-compressed natural gas vehicles pay an additional special tax. The rate of the special tax is higher for diesel cars that comply with pre-Euro IV standards. EV owners also pay an additional annual road tax that will gradually increase to 700 SGD/year in 2023.

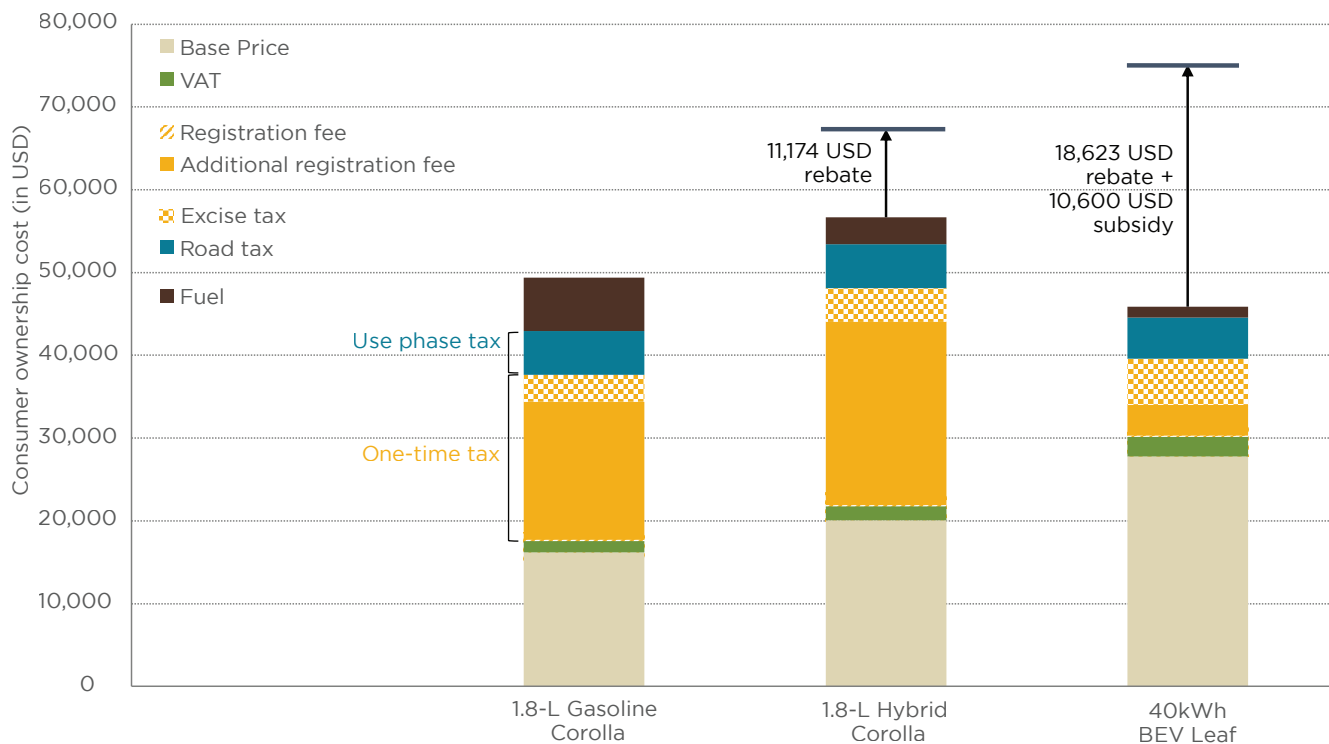


Figure 7. Six-year consumer ownership cost comparison in Singapore.

With the new EEAI and VES rebate, the consumer ownership costs of the Nissan Leaf can be lower than that of the gasoline Corolla in 6 years. Vehicle owners in Singapore also face the Certificate of Entitlement (COE), which in November 2020 ranged in cost from 35,000 SGD (26,109 USD) to 39,000 SGD (29,093 USD) (One Motoring, 2020). COE, which is not included in the scope of this study, gives vehicle purchasers the right to own the vehicle and is acquired through an open bidding process. EVs and HEVs do not receive a special discount when acquiring the certificate. With COE, the upfront cost of all vehicle categories is estimated to increase by around 70%.

With the new tax deduction policy that started in 2021, Singapore is making efforts to achieve its 2040 goal to abandon ICE vehicles. In a country like Singapore, where vehicle taxes and fees are much higher than the vehicle base price, a CO₂-based taxation scheme can effectively reduce the consumer ownership costs of more efficient vehicles. In the future, the existing CO₂-based rebate system can be improved by switching to a rebate policy based on continuous CO₂ emissions. For EVs with a high base price that cost significantly more through taxes, additional rebates are needed before EVs can reach cost parity with ICE vehicles in Singapore.

4.3 CHINA

China is the largest passenger vehicle market in the world. In 2019, 20 million passenger cars were sold in China, constituting 60% of new car sales in all of the Asian and Asia-Pacific countries (International Organization of Motor Vehicle Manufacturers, 2020). In October 2020, China announced a target of 20% of new passenger car sales in 2025 to be new energy vehicles, or NEVs (i.e., BEVs, PHEVs, and FCEVs). With its large market volume, fiscal policies that shape vehicle purchase behavior in China can have profound impacts on transport emissions. The NEV share target incents China to adopt various policy tools, including flexible taxation policies and subsidies, to accelerate the pace of transport electrification.

China currently levies a 10% **vehicle purchase tax**, a 13% VAT, and a displacement-based **excise tax** upon vehicle acquisition that ranges from 1% to 40%. It also charges an annual, displacement-based **vehicle and vessel tax**, the rate of which is determined by the province rather than the central government. Buyers of a 1.6-L passenger car in China pay 5% of the base price as excise tax, but the rate increases to 25% for vehicles greater than 3L and 40% to vehicles greater than 4L. China assesses an additional 10% charge on vehicles with a wholesale price of more than 1,300,000 CNY (201,011 USD), which only applies to a small group of luxury sports cars. Local governments set the annual vehicle and vessel tax amount based on the range legislated by the central government. 1.6-L passenger vehicles cost 300 CNY–540 CNY (46 USD–83 USD), while 4-L vehicles cost between 3,600 CNY and 5,400 CNY (557 USD–835 USD).

BEVs and PHEVs receive multiple tax benefits in China. China waives the 10% vehicle purchase tax for BEVs, PHEVs (including extended-range EVs), and FCEVs. BEVs do not pay an engine displacement-based excise tax or vehicle and vessel tax. PHEVs and energy-saving vehicles only pay half of the vehicle and vessel tax. Energy-saving vehicles are defined as those that do not exceed 1.6 L and that meet weight-based fuel efficiency standard. For example, a 1.6-L, 1,310-kg VW Golf 200 TSI would not qualify for this tax discount, because its 5.3 L/100 km fuel consumption performance is higher than the 4.9 L/100 km requirement for its weight bracket. As a result of the tax deductions, BEV owners in China only pay a VAT upon acquisition. They also receive national subsidies calculated from the electric range, battery capacity, battery energy density, electric energy consumption, and ownership type (Cui & He, 2020). China announced in April 2020 that these subsidies will extend to 2022, but that the amount will gradually decrease from 2020 to 2022.

Figure 10 shows that even with tax deductions and national subsidies, the consumer ownership cost of the Nissan Leaf is still 30% higher than that of the 1.8-L Corolla. The waiving of the excise tax, purchase tax, and vehicle and vessel tax does not mitigate the

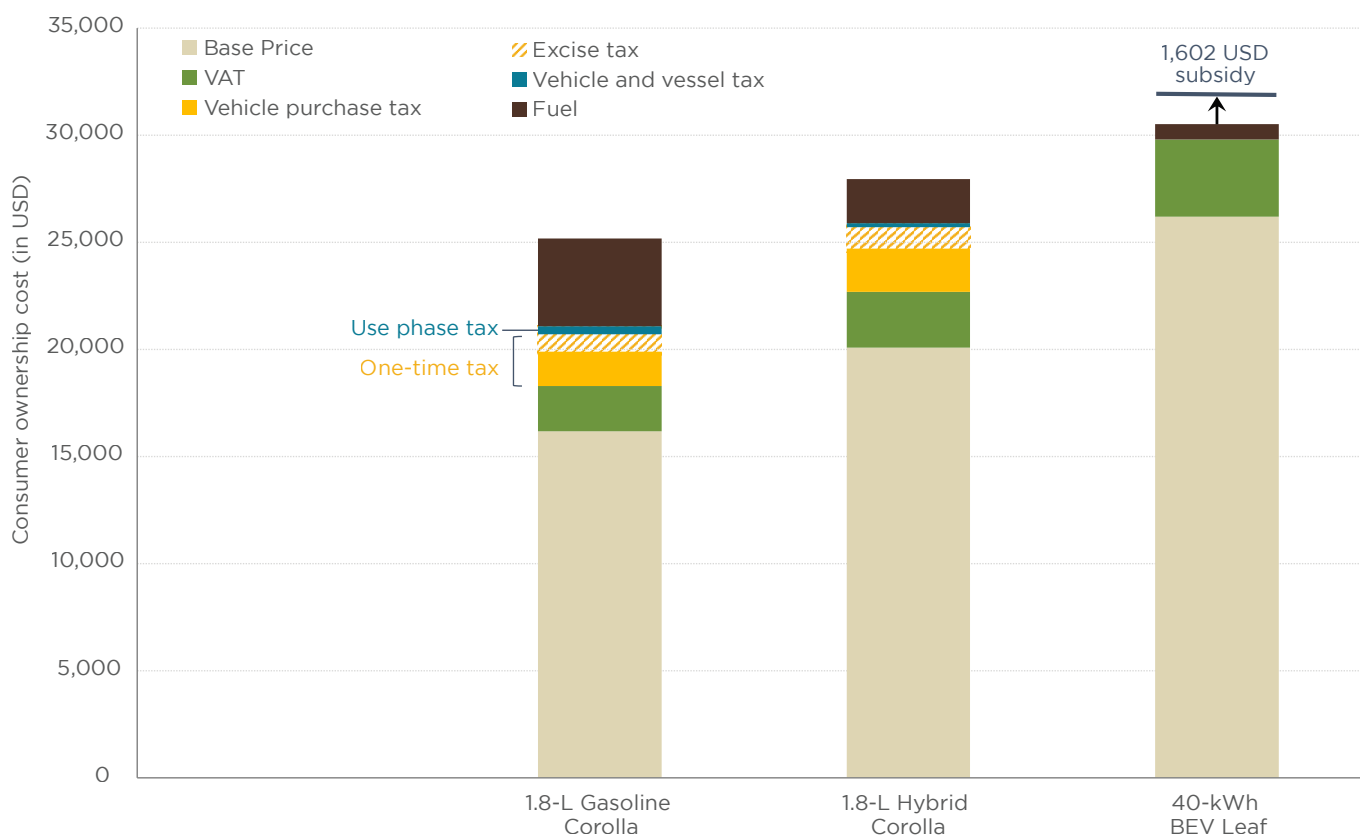


Figure 8. Six-year consumer ownership cost comparison in China.

high upfront cost. Although the Nissan Leaf has not yet entered China's market, the estimated subsidy based on its vehicle specifications would only lower its base price by 4%.⁹

China's vehicle taxation system heavily relies on engine displacement and vehicle price. Although vehicles above 3 L will be charged high punitive taxes, the most common 1.5 L–2 L group that accounted for 81% of all ICE passenger vehicles sold in China in 2019 (China Automotive Technology and Research Center, 2019) won't face considerable tax burdens.

Given the existing tax scheme, the benefit for energy-efficient vehicles is minor, because the vehicle and vessel tax is very low. Revising higher-tax items like the excise tax and VAT to benefit efficient vehicles and increasing the cost of less efficient ICE vehicles through taxation could also improve the cost competitiveness of EVs in China and help achieve the country's 2025 NEV targets.

4.4 INDIA

In 2020, India sold the third-most vehicles among Asian and Asia-Pacific countries, behind China and Japan. India has announced an EV new sales share target of 30% by 2030. To accelerate adoption of EVs and reduce emissions from its large transport sector, India must adopt fiscal incentives to help lower-emission vehicles reach cost parity with ICE vehicles.

India currently levies a **GST**, a **compensation cess (tax)**, a **registration tax**, and a **road tax** on passenger vehicles, all of which it charges at the time of vehicle acquisition. The GST rate is 28% for ICE vehicles and PHEVs, and 5% for BEVs. A compensation cess is levied over the amount of GST; together, these two taxes are categorized as the purchase tax in India. The rate of compensation cess differs by fuel type, engine size, and vehicle length, as shown in Table 6. The cess is waived for BEVs, but all PHEVs and HEVs are supposed to pay a fixed rate of 15%, which is similar to a 1.2–1.5 L gasoline vehicle. All passenger vehicle owners pay a 30 USD registration fee upon acquisition, 21 USD of which is a non-refundable temporary registration fee before the full registration process is completed in the State Road Transport Office. The last tax that vehicle owners pay in India is the road tax, whose rates are determined at the state level. In Delhi, the road tax rate ranges from 4% to 12.5% depending on vehicle price and fuel type, and it is waived for EVs. For each price group, the road tax rate for diesel cars is always 25% higher than for gasoline vehicles. For the vehicles selected in this study, the road tax rate is 10% for gasoline and hybrid vehicles and 0% for EVs, which results in a substantial one-time tax benefit to EVs.

Table 6. Rate of the compensation cess in India.

Vehicle type	Specifications	Cess rate
Vehicles with length < 4 m	Petrol/CNG < 1.2L	1%
	Petrol/CNG > 1.2L	17%
	Diesel < 1.5L	3%
	Diesel > 1.5L	20%
Vehicles with length > 4 m	< 1.5L	17%
	> 1.5L	20%
Vehicles with length > 4 m and ground clearance > 170 mm		22%
PHEV and HEV		15%
BEV		0%

⁹ Calculated by the new WLTP-based methods released in December 2020 (China Ministry of Finance, 2020).

India also has a Faster Adoption and Manufacturing of Hybrid and EV (FAME) scheme that offers subsidies to BEVs, PHEVs, and strong HEVs at 138 USD/kWh capped at 20% of the base price. Vehicles eligible for this subsidy are supposed to have a base price lower than 20,706 USD. In this study, the base price of the selected Nissan Leaf model exceeds the upper limit to receive FAME subsidies, but the hybrid Corolla is eligible. None of the three vehicle models that we study here has yet entered the India market; if and when they become available in India, their base prices are likely to fall above the range eligible for subsidies. The FAME policy is intended to subsidize cheaper, domestic EV brands instead of foreign models.

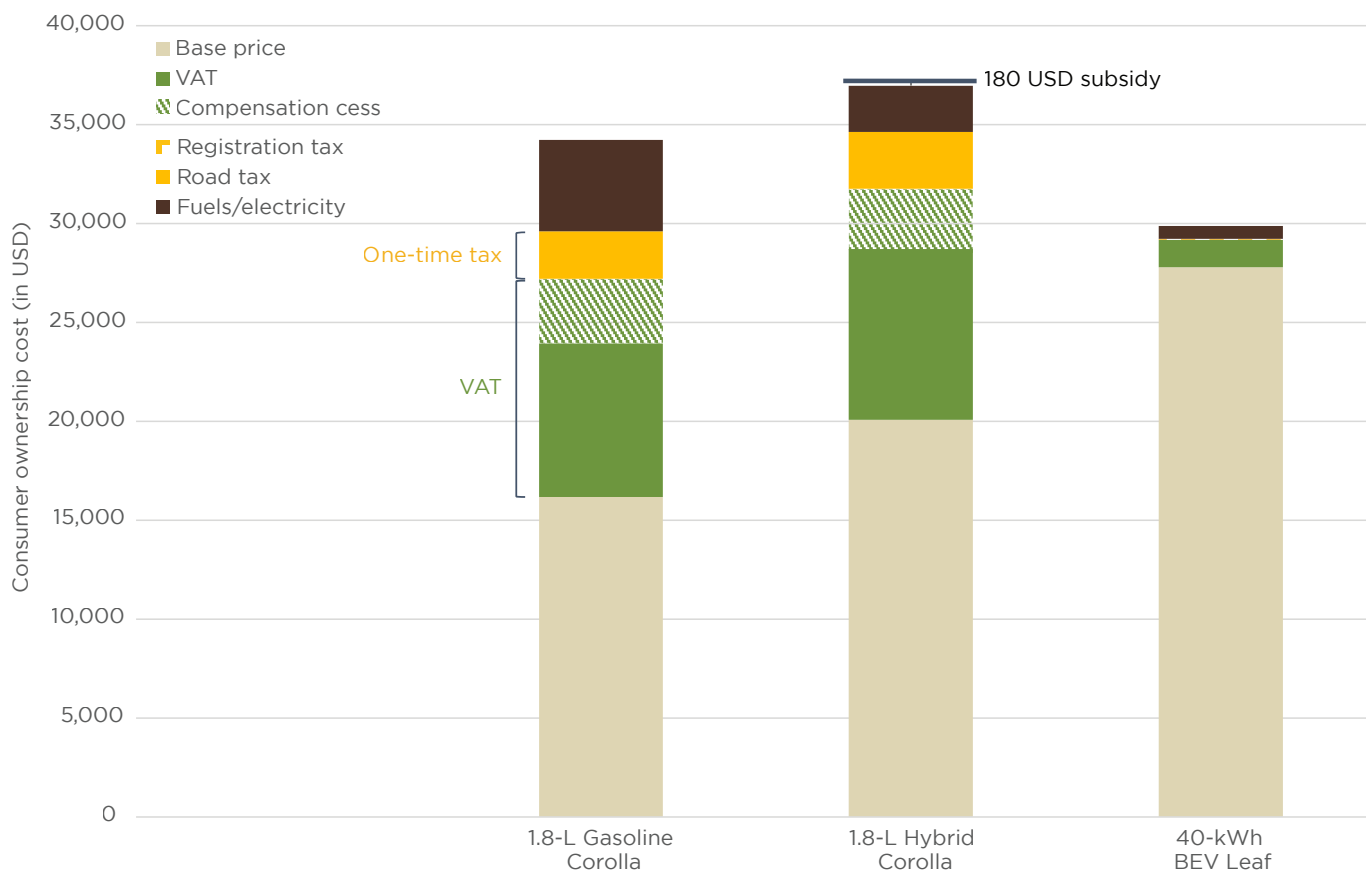


Figure 9. Six-year consumer ownership cost comparison in India.

Figure 9 shows the consumer ownership cost difference between the three selected models in India. Although the hybrid Corolla is eligible for direct subsidies, it receives a small amount of such subsidies considering its 1.3 kWh battery size. India has no specific tax policy that encourages the sale of efficient vehicles. In light of its relatively high tax level—especially due to the GST and compensation cess—India has an opportunity to incent the purchase of more efficient vehicles by restructuring its tax system.

In terms of BEVs, the Nissan Leaf achieves cost parity with the Corolla during a 6-year ownership period as a result of a reduced GST, compensation cess, and road tax. However, although this study assumes the same vehicle base price across all countries, we estimate that the actual price of the Nissan Leaf would be higher once it enters the Indian market in 2021. We base this calculation off our comparison of vehicle prices across the 18 Asian and Asia-Pacific countries: The higher base price will increase the tax amount and result in a large price gap with the gasoline Corolla. Therefore, additional local subsidies will be necessary to make Nissan Leaf cost-comparable.

4.5 INDONESIA

Indonesia currently levies a 10% **VAT**, a 10%–125% **luxury tax**, a 1%–2% **circulation tax**, and a **transfer tax** capped at 20%. Vehicle owners also pay a 2.4 USD **road traffic accident contribution** every year. Indonesia’s provinces determine the rates of the transfer tax and circulation tax, while the other taxes and fees have uniform national rates.

The country’s EV market is still in its early stage of development. As of January 2021, the national official policy documents do not include any favorable tax policies for efficient vehicles or EVs. However, BEVs receive benefits in certain cities and regions. Jakarta, for example, waives the 12.5% transfer tax. Indonesia also lacks a national or local subsidy program to incent the purchase of lower-emission vehicles. From October 2021, however, Indonesia will swap the displacement-based luxury tax for a displacement-based tax incorporating vehicle type and CO₂ emissions.

Before October 2021, Indonesia determined the luxury tax by vehicle type and engine displacement. As shown in Table 7, the luxury tax rates strongly discourage gasoline vehicles of more than 3,000 cc and diesel vehicles of more than 2,500 cc. The luxury tax is waived, however, for vehicles that Indonesia defines as Low Cost Green Cars, which cost less than IDR 95 million (6,460 USD); achieve fuel economy of at least 20 km/L of gasoline equivalent; and have engine capacities of up to 1,200 cc for gasoline vehicles or of up to 1,500 cc for diesel vehicles. The country’s taxation policy does not specify a tax rate for BEVs; when the taxation rule (Government Regulation No.41/2013) was initiated in 2013, no BEVs were available in the country. PHEVs and HEVs are charged the same rates as gasoline vehicles based on their engine displacement. As the nascent EV market starts to develop in Indonesia, a new CO₂-based luxury tax system that reduces the tax rate for HEVs and waives the luxury tax for BEVs and PHEVs was launched in October 2021. The luxury tax rates of the adjusted system are shown in Table 8.

Table 7. Luxury tax rates in Indonesia before October 2021.

Category	Engine capacity (cc)	Fuel type	Tax tariff
4 x 2 PV exclude sedan and station wagon*	≤ 1,500	Gasoline/diesel/electric	10%
4 x 2 PV exclude sedan and station wagon	150–2,500	Gasoline/diesel/electric	20%
Sedan or station wagon and 4 x 4 PV*	≤1,500	Gasoline/diesel/electric	30%
4 x 2 PV exclude sedan and station wagon	2,500–3,000	Gasoline/electric	40%
Sedan or station wagon and 4 x 4 PV	1,500–3,000	Gasoline/electric	40%
	1,500–2,500	Diesel/electric	40%
PV all type	>,3,000	Gasoline/electric	125%
	>,2,500	Diesel/electric	

Note. *Vehicle categories that have the potential to qualify for low cost green car program, therefore exempt from luxury tax. (Adapted from Mahalana & Yang, 2021).

Table 8. Luxury tax rates in Indonesia after October 1, 2021.

Category	CO ₂ ^a (g/km)	Tax tariff based on engine capacity (cc)				
		< 1,500	1,500 (incl.) to 3,000	3,000 (incl.) to 4,000	Above 4,000 (Super car)	
PV (<10 seats)	< 150	15%		40%	95%	
	150–200	20%		50%		
	200–250	25%		60%		
	> 250	40%		70%		
<i>Incentive Program</i>	Low Cost Green Car (LCGC)	≤ 120	3%	—	—	
	Full hybrid	< 100	2%		20%	—
		100–125	5%		25%	—
		125–150	8%		30%	—
	Mild Hybrid	< 100	8%		20%	—
		100–125	10%		25%	—
		125–150	12%		30%	—
	Flexy Engine (E100/B100)^c	—	8%			—
PHEV, BEV, FCEV	≤ 100	0% (15% ^b)				

Note. Adapted from Mahalana & Yang, 2021.

a Equivalent fuel economy targets (km/l) for gasoline and diesel vehicles are also specified in the regulation, which is not presented in this table.

b The tariff is 15% if the production of the vehicles does not meet the minimum local content requirement (e.g., imported EVs).

c Incentives for flexy engine are given to vehicles that run on ethanol (E100) or biodiesel (B100) (Mahalana & Yang, 2021).

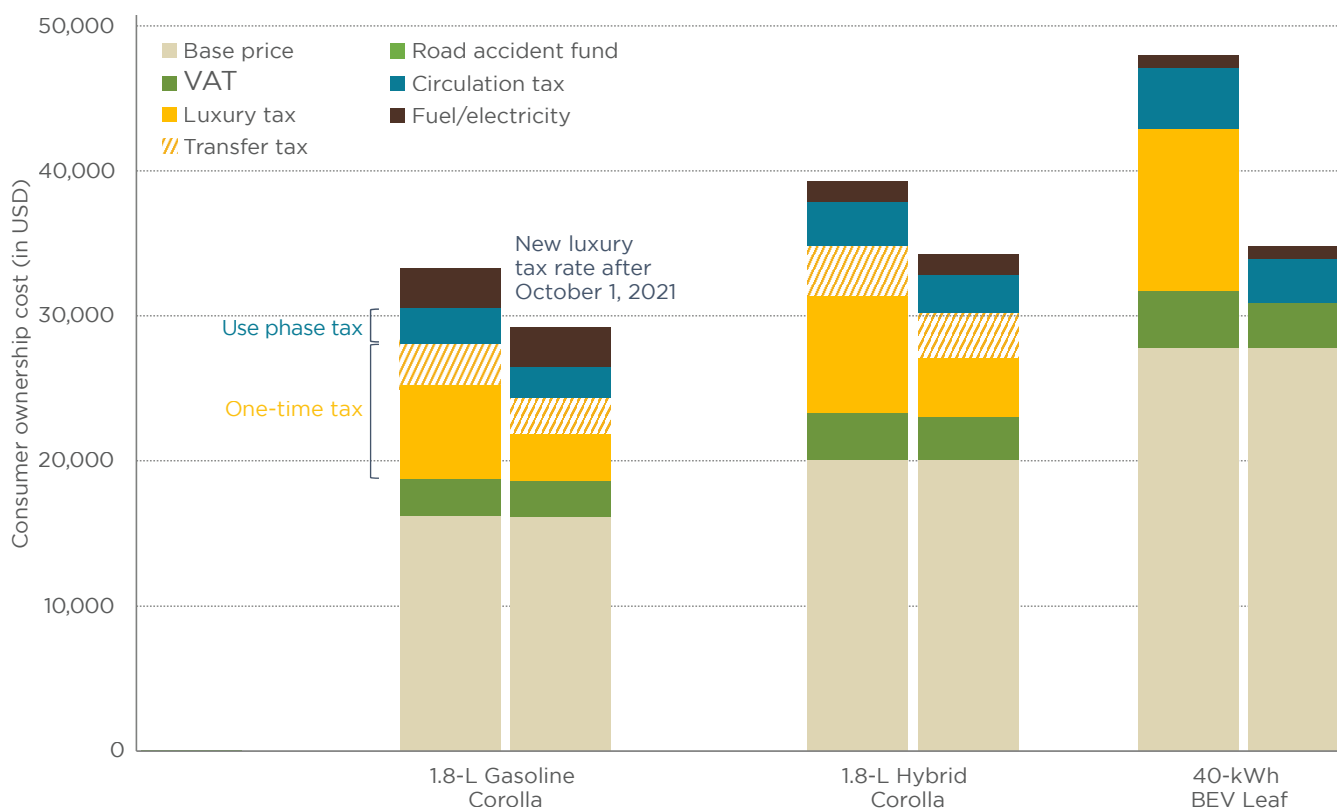


Figure 10. Six-year vehicle consumer ownership cost in Indonesia with luxury tax before and after October 1, 2021.

Figure 10 shows the consumer ownership cost of owning the three selected models in Indonesia. Luxury tax is the highest tax item for all three models. Therefore, the revised luxury tax rate that reduces the tax burden for all models will greatly reduce consumer ownership cost. Under the old rule, the luxury tax rate is 40% for all models. Under the new rule, the rates for gasoline, diesel, hybrid, and electric vehicles are reduced to 20%, 15%, 8%, and 0%, respectively. The cost reduction effect is most significant for the Nissan Leaf, followed by the hybrid Corolla.

Although the new CO₂-based luxury tax lowers the consumer ownership cost for HEVs and BEVs, these vehicles still do not achieve cost parity with their gasoline counterpart over a 6-year ownership period. Although non-hybrid gasoline and hybrid models receive some tax benefits under the new rule, the wide bin of CO₂ emissions that differentiate luxury tax rates fails to provide continuous tax incentives for technology improvement among both of these vehicle types. Given the high base price of EVs, the 10% VAT and 10%–20% transfer tax still results in a greater tax burden for EV consumers. As Indonesia sets a strategy to decarbonize its vehicle fleet and gradually expand the domestic EV market, fiscal incentives like a reduction of the transfer tax for EVs and direct subsidies at the time of acquisition will increase the cost competitiveness of efficient vehicles and EVs.

5. CONCLUSION AND POLICY SUGGESTIONS

In this study, we reviewed the taxation policies in 18 Asian and Asia-Pacific markets. Specifically, we compared the consumer ownership costs of a conventional gasoline vehicle, a gasoline hybrid, and a BEV in each of these countries and carried out case studies for five of the markets to identify best practices and potential lessons for designing vehicle taxation schemes that can increase the adoption of efficient vehicles and reduce transport emissions.

Among the 18 countries, only five—Japan, Thailand, Israel, Singapore, and the ACT in Australia—levy taxes determined by fuel consumption or CO₂ emissions of vehicles. In comparison, 24 out of the 32 European countries studied in previous ICCT research (Wappelhorst et al., 2018) have taxes based on CO₂ emissions or fuel economy standards. None of the five countries in this study adopts continuous CO₂-based tax rates. In total, 14 of the 18 Asian and Asia-Pacific countries we reviewed have various favorable taxation policies for EVs and/or for more efficient vehicles, but only several of these policies significantly reduce the consumer ownership cost of EVs.

By comparing the effectiveness of the fiscal policies in generating cost benefits for HEVs and BEVs, we draw several conclusions:

- » The amount of tax levied on passenger vehicles differs from country to country. The consumer ownership cost of ICE vehicles can be 2-3 times the base price in Singapore, Israel, and Malaysia, whereas it is only slightly higher than the base price in Kuwait and Iran.
- » A high one-time tax is usually the main driver of high consumer ownership cost. For this reason, reductions in one-time taxes carry the greatest potential for creating benefits for efficient vehicles and EVs through tax policy.
- » Among the five countries that have fuel consumption/CO₂-based taxes, efficient vehicles such as HEVs are cost competitive with non-hybrid vehicles in Singapore, Israel, and Thailand. The high tax level in those three countries, paired with their high gasoline prices, result in HEVs achieving cost parity. Ultimately, the high gasoline prices in Singapore and Israel also helped BEVs achieve cost parity with their gasoline counterpart.
- » Only Singapore, Israel, Korea, and India effectively reduce the consumer ownership cost of EVs and make these vehicles cost competitive with ICE vehicles. Fuel consumption/CO₂-based taxes provide some tax benefits to EVs in Singapore and Israel, but Singapore's substantial direct rebate and Israel's generous tax cut further reduce the cost of EVs to approach those of conventional gasoline vehicles.

Based on our findings, we offer some recommendations below for Asian and Asia-Pacific governments seeking to encourage the purchase of low-emission vehicles through taxation policies.

- 1. Most countries, especially those with high taxation levels, would benefit from changing the current displacement- or weight-based taxes to continuous fuel efficiency/CO₂-based tax based on linear metrics.** Taxes based on engine displacement or weight incent the purchase of lighter vehicles and vehicles with smaller engines, but these parameters are not necessarily associated with better environmental performance of the vehicle. As we show in this analysis, a properly designed CO₂-based tax can successfully reduce the consumer ownership cost of more-efficient vehicles, such as in Singapore, Israel, and Thailand. In particular, swapping higher taxes for a CO₂-based mechanism will result in larger tax benefits for efficient vehicles. These CO₂-based taxes should

have linear metrics rather than stepwise metrics to encourage continuous advancement in technology. Countries can implement this tax reform without reducing the total revenue earned from vehicle taxation by tailoring the CO₂-based tax to the performance of the fleet.

- 2. Countries with low taxation levels should consider increasing the tax on higher-emitting vehicles or switch to a feebate system to bridge the gap between ICE vehicles and BEVs.** In Iran, Saudi Arabia, United Arab Emirates, Kuwait, and Pakistan, the tax levels for ICE vehicles are very low and do not provide enough opportunities for tax benefits to support the adoption of low-emitting vehicles and EVs. In China, Asia's largest passenger vehicle market, the Nissan Leaf does not achieve cost parity with the gasoline Corolla even as three out of the country's four vehicle taxes are waived for BEVs. This discrepancy is due to a low tax level for conventional vehicles, which results in a small impact of any tax cut. Increasing the tax on higher emitters would provide relatively lower tax rates for efficient vehicles and EVs. Countries can also consider raising taxes on gasoline, which would increase the consumer ownership cost of gasoline vehicles. Countries could further switch to a feebate system that applies a punitive fee charged to higher-emission vehicles to subsidize more efficient vehicles. This approach can help increase cost competitiveness of efficient and electric vehicles without reducing total vehicle taxation revenues.
- 3. Direct subsidies provided for EVs at the time of acquisition effectively make them cost competitive.** Taxes might further increase EVs' cost disadvantage since most vehicle taxes are proportionate to the vehicle base price. Direct subsidies, a fuel consumption/CO₂-based tax, and a tax cut are required for EVs to attain cost parity with ICE vehicles. Among the 18 markets studied, only China, India, Japan, Korea, and Singapore have national-level subsidies for EVs. The subsidies also apply to HEVs in India and Singapore.
- 4. Directly informing consumers about the tax benefits of efficient vehicles at purchase will maximize the impact of the taxation system.** Taxation design can be difficult for consumers to understand. Because the cost of the vehicle is an important factor in consumers' purchase decisions, informing buyers about the tax benefits available for efficient vehicles will maximize the impact of the taxation system. Vehicle efficiency-related cost and benefit information can be presented on the vehicle label in the showroom, in vehicle advertisements, on manufacturers' websites, and on online vehicle trading platforms. Among the five countries that assess fuel consumption/CO₂-based taxes, only Singapore requires that tax information be presented on the fuel efficiency label of the vehicles. Japan provides fuel efficiency-related information but does not link it to information about the fiscal benefits.

Few Asian and Asia-Pacific countries currently use taxation and other fiscal policies to encourage the purchase of low-emission vehicles. Following the above recommendations could help these countries initiate changes to their vehicle taxation policies to accelerate the transition toward low-emission vehicle fleets. Further study is warranted, however, into how best to design taxation systems that provide continuous fiscal incentives while maintaining stable flows of government revenue from vehicle sales. Additional study into how fuel and electricity taxes can most effectively be developed to encourage the purchase of EVs.

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APPENDIX A. LIST OF POLICY SOURCES

Country	Source	Source type
China	Vehicle Purchase Tax Law (2019); Vehicle and Vessel Tax Law (2019); Value Added Tax Law (Draft) (2019); Excise Tax Regulation (2019); New Energy Vehicle Subsidy Notice (2020); Notice on Vehicle and Vessel Tax Discount Given to Efficient and New Energy Vehicles (2018); Notice on Waived Purchase Tax for New Energy Vehicles (2020)	Official Policy Documents
Japan	Vehicle Taxation Reform Website (2019); Next Generation Vehicle Promotion Center (2021)	Official Government Websites
India	Society of Indian Automobile Manufacturers (2021); Mycarhelpline.com (2021); Scheme for Faster Adoption and Manufacturing of Electric Vehicles in India Phase II (2019)	Third-Party Website; Official Policy Documents
Korea	Enforcement Decree of the Individual Consumption Tax Act (2021); Ministry of the Interior and Safety Acquisition Tax Information (2020); Value Added Tax Law (2020); Education Tax Law (2020); Automobile Tax information (2020); Korea Customs Service (2020); Korea Environment Corporation (2021)	Official Policy Documents; Third-Party Website
Australia	Luxury Tax Information Page (2020); Motor Vehicle Registration Fee Page (2020); Goods and service Tax Information Page (2020); Stamp Duty Information Page (2021); Customs Duty and Luxury Car Tax Information Page (2020)	Official Government Websites
Indonesia	Indonesia National Trade Repository (2020); Ministry of Finance Decree No. 33/PMK.010/2017 (2017); Government Regulation No. 22/2014 (2014); Indonesia Local Taxes and Regional Levies Law (2009); Value Added Tax and Sales Tax on Luxury Goods Law (2009); Government Regulation No. 73/2019 (2019)	Official Policy Documents; Local Contact
Iran	Iran: VAT exemption for hybrid and electric vehicles (2017); Property Tax Information (2019); Financial Tribune (2017)	Third-Party Website
Malaysia	Malaysia Automotive Association (2019); Malaysian Road Tax Rates (2017); Official Portal of the Public Service Department (2012)	Third-Party Website; Official Government Website
Thailand	Thailand Excise Department (2016); KPMG Thailand Tax Profile (2016); Thailand Department of Land Transport (2016); Thailand Import Tariffs (2019)	Third-Party Website; Official Government Website
Saudi Arabia	Saudi Press Agency (2020); Saudi Arabia Customs (2020); Riyadh Traffic Department (2020)	Official Government Website
Philippines	Department of Finance Tax Reform on Motor Vehicle Users Charge (2017); Department of Finance Tax Reform Package 1: Train (2017); Automobile Excise Technical (2017); Embassy of the Philippines in Argentina (2020)	Official Government Website
Israel	Haaretz website (2015); Israel Tax Authority (2019); Israel Tax Authority (2020)	Third-Party Website; Official Government Website
United Arab Emirates	The National News (2018); United Arab Emirates Customs Clearance (2021); Government of Dubai: Apply for Registering a New Vehicle (2021)	Third-Party Website; Official Government Website

Country	Source	Source type
Vietnam	Oto.com website on tax summary (2017)	Third-Party Website
Pakistan	Excise, Taxation and Narcotics Control Department, Government of Punjab (2020); National Electric Vehicle Policy (2019)	Official Government Website; Third-Party Website; Local Contact
New Zealand	New Zealand Government, GST Rate (2021); New Zealand Transport Agency, Licensing (rego) Fees (2020); New Zealand Transport Agency, Registration Fees (2020); New Zealand Car Shipping and Import Guide (2020); New Zealand Ministry of Transport (2020)	Third-Party Website; Official Government Website
Kuwait	Kuwait National Assembly (2018)	Official Government Website
Singapore	One Motoring, Vehicle Tax Structure (2021) One Motoring, Certificate of Entitlement (2020)	Official Government Website Official Government Website

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Korea	Enforcement Decree of the Individual Consumption Tax Act (2021); Ministry of the Interior and Safety Acquisition Tax Information (2020); Value Added Tax Law (2020); Education Tax Law (2020); Automobile Tax information (2020); Korea Customs Service (2020); Korea Environment Corporation (2021)	Official Policy Documents; Third-Party Website
Australia	Luxury Tax Information Page (2020); Motor Vehicle Registration Fee Page (2020); Goods and service Tax Information Page (2020); Stamp Duty Information Page (2021); Customs Duty and Luxury Car Tax Information Page (2020)	Official Government Websites
Indonesia	Indonesia National Trade Repository (2020); Ministry of Finance Decree No. 33/PMK.010/2017 (2017); Government Regulation No. 22/2014 (2014); Indonesia Local Taxes and Regional Levies Law (2009); Value Added Tax and Sales Tax on Luxury Goods Law (2009); Government Regulation No. 73/2019 (2019)	Official Policy Documents; Local Contact
Iran	Iran: VAT exemption for hybrid and electric vehicles (2017); Property Tax Information (2019); Financial Tribune (2017)	Third-Party Website
Malaysia	Malaysia Automotive Association (2019); Malaysian Road Tax Rates (2017); Official Portal of the Public Service Department (2012)	Third-Party Website; Official Government Website
Thailand	Thailand Excise Department (2016); KPMG Thailand Tax Profile (2016); Thailand Department of Land Transport (2016); Thailand Import Tariffs (2019)	Third-Party Website; Official Government Website
Saudi Arabia	Saudi Press Agency (2020); Saudi Arabia Customs (2020); Riyadh Traffic Department (2020)	Official Government Website
Philippines	Department of Finance Tax Reform on Motor Vehicle Users Charge (2017); Department of Finance Tax Reform Package 1: Train (2017); Automobile Excise Technical (2017); Embassy of the Philippines in Argentina (2020)	Official Government Website
Israel	Haaretz website (2015); Israel Tax Authority (2019); Israel Tax Authority (2020)	Third-Party Website; Official Government Website
United Arab Emirates	The National News (2018); United Arab Emirates Customs Clearance (2021); Government of Dubai: Apply for Registering a New Vehicle (2021)	Third-Party Website; Official Government Website

Country	Source	Source type
Vietnam	Oto.com website on tax summary (2017)	Third-Party Website
Pakistan	Excise, Taxation and Narcotics Control Department, Government of Punjab (2020); National Electric Vehicle Policy (2019)	Official Government Website; Third-Party Website; Local Contact
New Zealand	New Zealand Government, GST Rate (2021); New Zealand Transport Agency, Licensing (rego) Fees (2020); New Zealand Transport Agency, Registration Fees (2020); New Zealand Car Shipping and Import Guide (2020); New Zealand Ministry of Transport (2020)	Third-Party Website; Official Government Website
Kuwait	Kuwait National Assembly (2018)	Official Government Website
Singapore	One Motoring, Vehicle Tax Structure (2021) One Motoring, Certificate of Entitlement (2020)	Official Government Website Official Government Website

APPENDIX B. VEHICLE PRICE COMPARISON ACROSS ASIAN AND ASIA-PACIFIC MARKETS

Country	Estimated base price (in USD)	2020 market price (in USD)	Version	Displacement (cc)
Singapore	14,722	73,433	Altis	1,598
Israel	34,353	40,194	Sense	1,500
Indonesia	30,077	33,085	Altis	1,798
Vietnam	20,466	31,519	Altis 1.8 E	1,798
Malaysia	28,161	29,851	2ZR-FE	1,798
Thailand	18,152	26,900	Altis	1,598
Philippines	17,700	20,618	Altis 1.6 E M/T	1,598
Pakistan	17,176	20,096	Altis	1,600
Saudi Arabia	17,461	20,081		1,600
China	17,698	19,999		1,798
New Zealand	17,321	19,920		2,000
Iran	18,015	19,637		1,800
UAE	18,643	19,576	XLI	1,600
Kuwait	18,637	19,569	XLI	1,600
Australia	19,157	19,349	Ascent Sport Manual	2,000
Japan	16,174	18,328	GX 1.8	1,800
India	—	—	—	—
South Korea	—	—	—	—

APPENDIX C. EXCHANGE RATES AS OF FEBRUARY 2021

Country	Exchange rate to USD
China	6.49
Japan	108.81
India	72.36
Korea	1123.6
Australia	1.28
Indonesia	11,492.75
Iran	42,025.28
Malaysia	4.11
Thailand	27.06
Saudi Arabia	3.75
Philippines	20.34
Israel	3.3
United Arab Emirates	3.67
Vietnam	22,727.27
Pakistan	156.03
New Zealand	1.38
Kuwait	0.3
Singapore	1.34