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Passenger car taxation in India: Shifting to an emissions-linked structure

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Keywords: Goods and Services Tax (GST), GST cess, fleet-average emissions, vehicle taxation

Background and study objectives

India is the third largest light vehicle market in the world by volume, and is poised to become the world's largest market by 2028, according to the Union Minister of Road Transport and Highways.[1] In fiscal year (FY) 2022–23, sales of new passenger cars (PCs) grew to 3.89 million, a 26.7% increase from 3.06 million in the prior year.[2] India established corporate average fuel consumption standards for its PC fleet in FY 2015–16.[3] Phase 1 of the standards took effect at the start of FY 2017–18 and set fleet-average emissions at 130 g CO_2/km. Phase 2 applies from the beginning of FY 2022–23 and is slated to bring average emissions to 113 g CO_2/km. However, India's PC emission standards lag those of other leading auto markets in both current level of stringency and future targets.[4]

1 Ketan Thakkar, "India Overtakes Japan as the Third Largest Car Market," *Autocar India*, January 4, 2023, https://www.autocarindia.com/industry/india-overtakes-japan-as-the-third-largest-car-market-426816#:~:text=India%20has%20overtaken%20Japan%20as,%2Dmile%20deliveries%2C%20post%20pandemic.&text=The%20light%20vehicle%20sales%20include,vans%20up%20to%206%20tonnes.; HT Auto Desk, "India to Become World's Largest Automobile Market by 2028, Says Nitin Gadkari," *HT Auto,* June 4, 2023, https://auto.hindustantimes.com/auto/news/india-to-become-worlds-largest-automobile-market-by-2028-says-nitin-gadkari-41685851144749.html.

2 Passenger cars include cars, vans, and multipurpose vehicles classified as "M1" under Indian regulations and do not include light-commercial vehicles; Shubhangi Bhatia, "PV Sales Analysis FY23: Indian OEMs Inch Closer to Sell 1 of every 4 cars sold in the Country," *ETAuto,* April 22, 2023, https://auto.economictimes.indiatimes.com/news/passenger-vehicle/pv-sales-analysis-fy23-indian-oems-inch-closer-to-sell-1-of-every-4-cars-sold-in-the-country/99600398.

3 Fuel consumption is directly correlated with tailpipe CO_2 emissions and the terms "fuel consumption reduction" and "emissions reduction" are used interchangeably in this report.

4 "Passenger Vehicle Greenhouse Gas Emissions and Fuel Consumption," International Council on Clean Transportation, accessed October 20, 2022, https://theicct.org/pv-fuel-economy/; Ashok Deo and John German, "Fuel Consumption From New Passenger Cars in India: Manufacturers' Performance in Fiscal Year 2020-21," (ICCT: Washington, D.C., 2021), https://theicct.org/wp-content/uploads/2021/12/India-PV-FC-workingpaper-FINAL.pdf; Ashok Deo, "Stringent Efficiency Targets Can Be an Industrial Policy for Atmanirbhar Bharat," *International Council on Clean Transportation* (blog), May 13, 2021, https://theicct.org/stringent-efficiency-targets-can-be-an-industrial-policy-for-atmanirbhar-bharat/.

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Prior ICCT studies established how vehicle taxation can influence the cost feasibility and adoption of low-emission technologies in a market.[5] So, while India has the potential to make its emission standards more stringent to push the market toward lower-emission cars, it is also important to analyze complementary policy levers like taxation that can make such vehicles more cost competitive and thereby create a pull effect.

Key consumer PC taxes in India include the Goods and Services Tax (GST), an additional GST cess, tax collected at source (TCS), and the road tax.[6] While vehicle registration charges also apply, they are a negligible fraction of the vehicle purchase cost. India levies a uniform 28% GST on automobiles but offers a preferential 5% GST for battery electric vehicles (BEVs). The GST cess is levied on the base price and determined by vehicle length, fuel type, engine displacement, and ground clearance. Based on the vehicle specifications, the GST cess rate is 1%, 3%, 15%,17%, 20%, or 22%. BEVs are exempt from the cess. Cars priced higher than ₹10 lakhs (US$13,490) are subject to the TCS at a flat 1% rate.[7]

BEVs are not excluded from the TCS. The road tax is levied at the state level and there are regional variations in the tax structure and rates. On average, road tax rates range from 6%–14%. Several states offer partial or full road-tax exemptions to BEVs.

Compared with other Asian markets, automobiles in India are subject to higher levels of GST and generally higher overall taxation. A prior ICCT paper analyzing taxation as a lever for emissions reductions across auto markets in Asia showed that countries with high levels of taxation would benefit from shifting to emissions-linked taxes.[8] In this context, this study examines opportunities to shift to emissions-linked taxation for vehicles in India and the optimal design structures of such taxes.

Scope, assumptions, and methodology

This study explores the cess levied on GST as a central government tax policy opportunity to promote PC fuel-efficiency improvements in India. While other tax heads additional to GST might offer similar opportunities, we limit our analysis to this one central government tax. Taxes and fees associated with the operation of PCs such as taxes on fuel, congestion or toll charges, and parking charges are outside of our scope.

For a high-volume market like India, the high base level of taxation through GST on the auto sector helps limit externalities such as carbon dioxide (CO_2) emissions, pollution, and congestion. Additionally, India's large GST discount to BEVs offers substantial upfront and total cost benefits and signals a long-term transition to electric vehicles

5 Sandra Wappelhorst, Peter Mock, and Zifei Yang, "Using Vehicle Taxation Policy to Lower Transport Emissions: An Overview for Passenger Cars in Europe," (ICCT: Washington, D.C., 2018), https://theicct.org/wp-content/uploads/2021/06/EU_vehicle_taxation_Report_20181214_0.pdf; Zhinan Chen, Zifei Yang, and Sandra Wappelhorst, "Overview of Asian and Asia-Pacific Passenger Vehicle Taxation Policies and their Potential to Drive Low-Emission Vehicle Purchases," (ICCT: Washington, D.C., 2022), https://theicct.org/wp-content/uploads/2022/01/Asia-Vehicle-Tax_whitepaper_final.pdf; Peter Mock, "Optimizing to the Last Digit: How Taxes Influence Vehicle CO_2 Emission Levels," (ICCT: Washington, D.C., 2015), https://theicct.org/wp-content/uploads/2021/06/Tax_Step_Analysis_201510.pdf; Murat Şenzeybek, Peter Mock, "Vehicle Registration Tax as Policy Instrument to Help Reduce CO_2 Emissions and Fuel Consumption in Turkey," (ICCT: Washington, D.C., 2019), https://theicct.org/sites/default/files/publications/Registration_Tax_in_Turkey_EN_20190429.pdf.

6 Collections from the GST cess are approved to be used to temporarily compensate states (until March 2026) that faced a revenue deficit after India migrated to a uniform GST tax regime in 2017. For this reason, the cess is termed as "compensation cess" by the Government of India. In this document, we refer to the additional cess on GST as "GST cess" throughout the report. All these taxes are charged upfront on vehicle purchase for cars in personal use. For commercially operated cars, road tax is levied on an annual basis instead of an upfront tax.

7 In our calculation, we use the 2020 average exchange rate of US$1 = ₹74.13, https://www.exchangerates.org.uk/USD-INR-spot-exchange-rates-history-2020.html#:~:text=This%20is%20the%20US%20Dollar,INR%20on%2015%20Jan%202020.

8 Chen et al., "Overview of Asian and Asia-Pacific Passenger Vehicle Taxation Policies."

(EVs).[9] This study thus builds on the assumption that India will continue to tax the auto sector at a high base rate through GST and provide preferential benefits to zero-emission technologies in the short and medium term.

After GST, the GST cess is the second largest pool of taxes collected on PCs.[10] Given the structural complexity of the GST cess, investigation of its effectiveness in promoting fuel efficiency in the internal combustion engine fleet is warranted. In 2018, as part of the draft National Auto Policy (hereafter "draft NAP, 2018"), the Government of India considered a proposal to redesign GST cess rates by linking them to CO_2 emissions and vehicle length.[11] However, as of May 2023, there had been no update regarding the proposal.[12]

Until March 2026, collections from the GST cess are approved as a "compensation cess," and the objective is to compensate any state revenue deficits that arise due to the implementation of the GST regime, which began on July 1, 2017.[13] The central government collects the cess and distributes proceeds among all Indian states in amounts computed using a predetermined formula.[14] We assume that even after the expiry of the compensation cess, vehicles will be taxed with an additional cess to GST; this view is also reflected under the draft NAP, 2018. We do not make any assumptions regarding how collections from such a cess would be used under an emissions-linked structure after 2026. However, use of any excess revenue to incentivize fuel-efficient and zero-emission vehicle (ZEV) technologies could be considered.

Our study analyzes the three GST cess structure scenarios summarized in Table 1. In the baseline scenario, we consider GST cess structure as levied under the compensation cess on PCs in India in FY 2020–21. This structure is not directly linked to CO_2 emissions. The two other scenarios are linked to emissions. In Scenario A, we consider the emissions-linked GST cess structure as proposed under the draft NAP, 2018. In Scenario B, we construct a hypothetical continuous linear function for an emissions-linked GST cess. We model a linear function because it is the simplest of all continuous functions. Despite the merits of more complex continuous functions (curves), those are out of the scope of this study. Further, we model our linear function assuming revenue neutrality, (i.e., total government revenue collection from such a structure is the same as revenue collection under the baseline scenario). While our analysis does not focus on revenue balancing and forecasting, going forward, continuous functions could also be modeled to be revenue positive or negative to the baseline.

Each of these scenarios and their underlying structures are described in detail in subsequent sections of the report.

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9 Shikha Rokadiya, Anup Bandivadekar, and Aaron Isenstadt, "Estimating Electric Two-Wheeler Costs in India to 2030 and Beyond," (ICCT: Washington, D.C., 2021), https://theicct.org/publication/estimating-electric-two-wheeler-costs-in-india-to-2030-and-beyond/; Nibedita Dash, Sandra Wappelhorst, and Anup Bandivadekar, "Updated Analysis of Incentives for Electrifying India's Four-Wheeler Ride-Hailing Fleet," (ICCT: Washington, D.C., 2021), https://theicct.org/publication/updated-analysis-of-incentives-for-electrifying-indias-four-wheeler-ride-hailing-fleet/.

10 The GST, GST cess, TCS, road tax, and registration fee accounted for an estimated 63.9%, 20.4%, 0.5%, 15% and 0.2%, respectively, of the total tax revenue generated from purchase-related passenger car taxes in India in FY 2020–21.

11 Ministry of Heavy Industries and Public Enterprises, Government of India, "National Auto Policy (Draft Version 2,)" March 2018, https://www.readkong.com/page/national-auto-policy-draft-version-2-4655505.

12 Based on our review of online media reports and publicly available documents on the website of the Ministry of Heavy Industries and Public Enterprises, Government of India, as of June 20, 2023.

13 The compensation cess is governed by the Goods and Services Tax (Compensation to States) Act, 2017. Initially intended to be implemented for a period of five years (i.e., to July 2022), the validity of the cess has been extended until March 2026, with the caveat that proceeds from the compensation cess are to be used only for repayment of loans taken by state governments.

14 The compensation cess amount to be disbursed to each state in a financial year is computed as the difference between the actual revenue collected by the state in the relevant FY and the projected revenue in the same FY. Projected revenue is the tax revenue that a state could have earned from the state value added tax, central sales tax, entry tax, octroi, local body tax, taxes on luxuries, taxes on advertisements, etc. in a particular FY if the GST was not implemented. Projected revenue is computed by taking FY 2015–16 as the base revenue year and a growth rate of 14% per annum is applied for each state.

Table 1. Tax scenarios for GST cess considered in the study.

Scenario	GST cess structure
Baseline	• GST cess structure as levied under the "compensation cess" in FY 2020–21
Emissions-linked Scenario A	• GST cess structure as proposed under the draft National Auto Policy (NAP), 2018
Emissions-linked Scenario B	• Modeled continuous linear function • Revenue neutrality assumed with total baseline scenario collection

We adopt a two-fold approach to analyzing these scenarios. First, we focus on the consumer cost perspective to understand how effectively each GST cess structure distributes the tax levy across vehicles with varying levels of emissions. Second, given that consumer response to an emissions-linked tax system should, in turn, increase the market competitiveness of original equipment manufacturers (OEMs) with fuel-efficient fleets, we analyze how OEMs' fleet-average emissions levels under India's corporate average fuel consumption standards compare to the average sales tax incurred by consumers of their vehicles. For fleet-average emissions values, we use the sales-weighted CO_2 performance data for OEMs in FY 2020–21 from our prior studies.[15]

We conducted our analysis using new PC sales data for India in FY 2020–21, and this includes cars, vans, and multipurpose vehicles classified as "M1" under Indian regulations. Detailed summaries of data inputs, sources, and data processing assumptions are provided in the Appendix.

Baseline scenario assessment

Currently, PCs in India are levied a compensation cess ranging from 0% to 22%. The amount is determined by four parameters: fuel type, engine displacement, vehicle length, and ground clearance. The various tax slabs determined from these parameters are summarized in Table 2.

Table 2. Compensation cess structure for PCs in India.

Fuel	Length (in meters)	Engine displacement (in cubic capacity)	Ground clearance (in millimeters)	Tax rate	Market Share
Electric	—	—	—	0%	0.20%
Hybrid gasoline (small)	≤ 4 m	≤ 1,200 cc	—	0%	0.00%
Hybrid gasoline	> 4 m	> 1,200 cc	—	15%	0.04%
Hybrid diesel (small)	≤ 4 m	≤ 1,500 cc	—	0%	0.00%
Hybrid diesel	> 4 m	> 1,500 cc	—	15%	0.00%
Gasoline/CNG/LPG	≤ 4 m	≤ 1,200 cc	—	1%	62.97%
Diesel	≤ 4 m	≤ 1,500 cc	—	3%	8.13%
Gasoline/CNG/LPG/diesel	> 4 m	≤ 1,500 cc	—	17%	17.28%
Gasoline/CNG/LPG/diesel	> 4 m	> 1,500 cc	< 170 mm	20%	6.38%
Gasoline/CNG/LPG/diesel	> 4 m	> 1,500 cc	≥ 170 mm	22%	
All other vehicles	—	—	—	15%	5.00%

Note: For vehicles longer than 4 m and with engine displacement greater than 1,500 cc, this study considers an average compensation cess rate of 21% (the average of the 22% and 20% in the table) because vehicle ground clearance information was not available. Hybrid vehicles refer to strong or "full" hybrid vehicles. Mild hybrid vehicles are taxed at the rate corresponding to their respective conventional fuel.

15 CO_2 performance data was computed without considering the impact of flexibility mechanisms; Deo and German, "Fuel Consumption from New Passenger Cars in India in Fiscal Year 2020-21."

Figure 1 demonstrates the variability between the GST cess amount per vehicle (₹ lakh) and the vehicle's CO_2 emissions for new PC sales in FY 2020–21 for those PCs subject to a cess below ₹0.3 lakh (US$405); these cars were approximately 69% of the PC fleet that year.[16] Each scatter point represents a model variant. The circle size of the scatter points denotes sales volume for each model variant. CO_2 emissions for such vehicles vary from 50 g/km to 150 g/km.

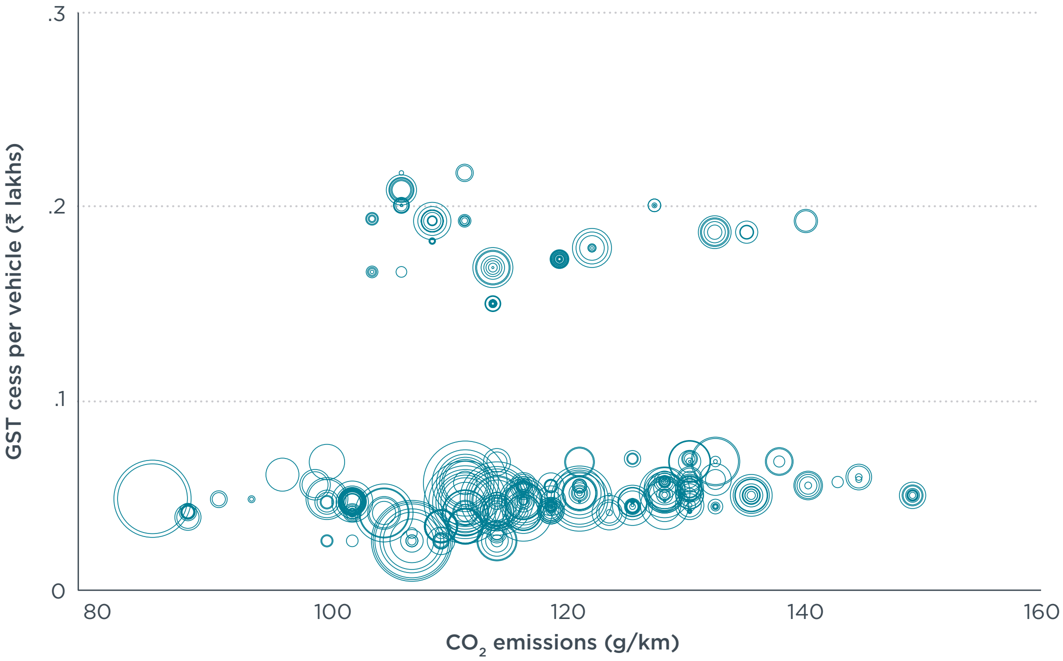


Figure 1. GST cess amount per vehicle versus CO_2 emissions under the baseline scenario.

Even beyond the representative sample shown in Figure 1, there is wide variability in the distribution of emissions versus the tax amount. For example, PCs with CO_2 emissions ranging from 160 g/km to 165 g/km incur cess amounts ranging from ₹0.9 lakhs (US$1,192) to ₹22.5 lakhs (US$30,364). Additionally, around 10% of PCs that incur cess amounts between ₹0.7 (US$951) and ₹1.0 lakhs (US$1,349) have CO_2 emissions that range from 104 g/km to 198 g/km.

Figure 2 presents the GST cess amount and the corresponding CO_2 emissions of the top-selling 15 PC models in FY 2020–21.[17] Each scatter plot represents a PC model and is color coded to represent the cess rate applicable to the corresponding vehicle model. Vehicles with similar emissions are subject to widely varying cess levels. For example, the Maruti Alto and the Maruti Ertiga have approximately the same emissions, but their cess varies by about ₹1.1 lakh (US$1,526). Likewise, vehicles subject to similar cess amounts display varying emissions. For example, the Maruti Dzire and the Tata Nexon have approximately the same cess of ₹0.05 lakh (US$71), but their emissions vary by 24 g/km. Additionally, 8 of the 15 highest-selling models in the fleet are subject to a 1% tax rate, meaning these are cars under 4 m in length with engine displacement less than 1,200 cc. These cars' emissions levels vary widely, as seen by the spread of blue dots in Figure 2.

16 CO_2 emission values have been calculated based on the test fuel consumption values declared by vehicle manufacturers, which are the type-approval values. The impact of flexibility mechanisms has not been considered in this calculation. The test cycle used for passenger cars in India is the Modified Indian Drive Cycle (MIDC).

17 The CO_2 emissions and the cess correspond to the highest-selling variant of the represented vehicle model. The top 15 models constituted 63% of the passenger car market in FY 2020-21.

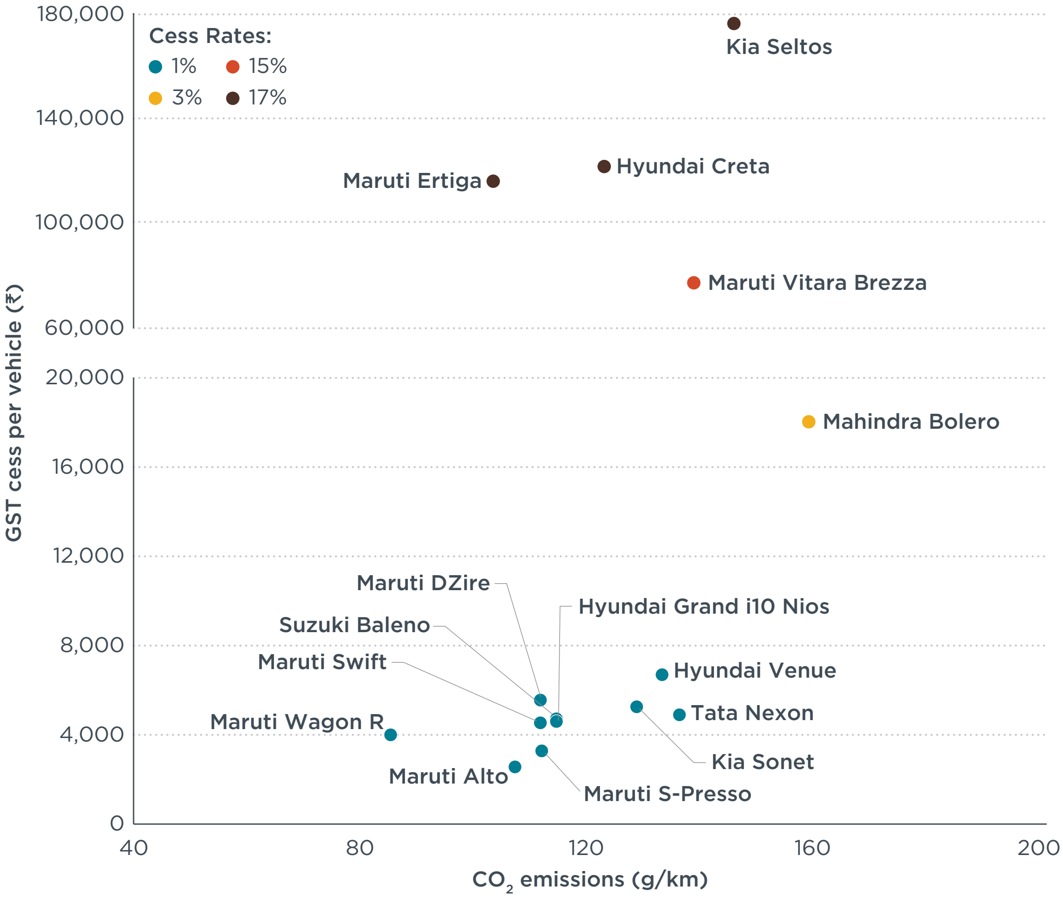


Figure 2. Baseline scenario of GST cess amount per vehicle versus CO_2 emissions of the top 15 passenger car models (the highest-selling variant) in FY 2020–21 in India's PC fleet.

We also find that engine displacement is not a good predictor of fuel consumption under the baseline tax structure. Figure 3 shows that for models with similar engine displacement, both CO_2 emissions level and cess amount can vary greatly. For example, in the under 1,200 cc engine displacement category, the Toyota Glanza and the Kia Sonet both have engine displacement of 1,197 cc, but the Glanza has CO_2 emissions of 99.6 g/km and cess of ₹6,659 (US $90) while the Sonet's corresponding numbers are 128.8 g/km and ₹5,300 (US $71).[18] For PCs from 1,200 cc to 1,500 cc engine displacement, the Mahindra Bolero and the Hyundai Creta both have engine displacement of 1,493 cc, but the Bolero has CO_2 emissions of 158.6 g/km and cess of ₹17,980 (US$243), and the Creta's respective numbers are 124.3 g/km and ₹1,21,267 (US$1,636). Likewise, in the engine displacement category for PCs above 1,500 cc, the MG Hector and the Tata Harrier have equal engine displacement of 1,956 cc, but the Hector has CO_2 emissions of 151.3 g/km and a cess of ₹2,24,000 (US$3,022) and the Harrier's CO_2 emissions are 161.5 g/km and its cess is ₹2,02,860 (US$2,737).

18 The engine displacement and CO_2 emissions of vehicle models in these examples pertain to the highest-selling variant of the corresponding model.

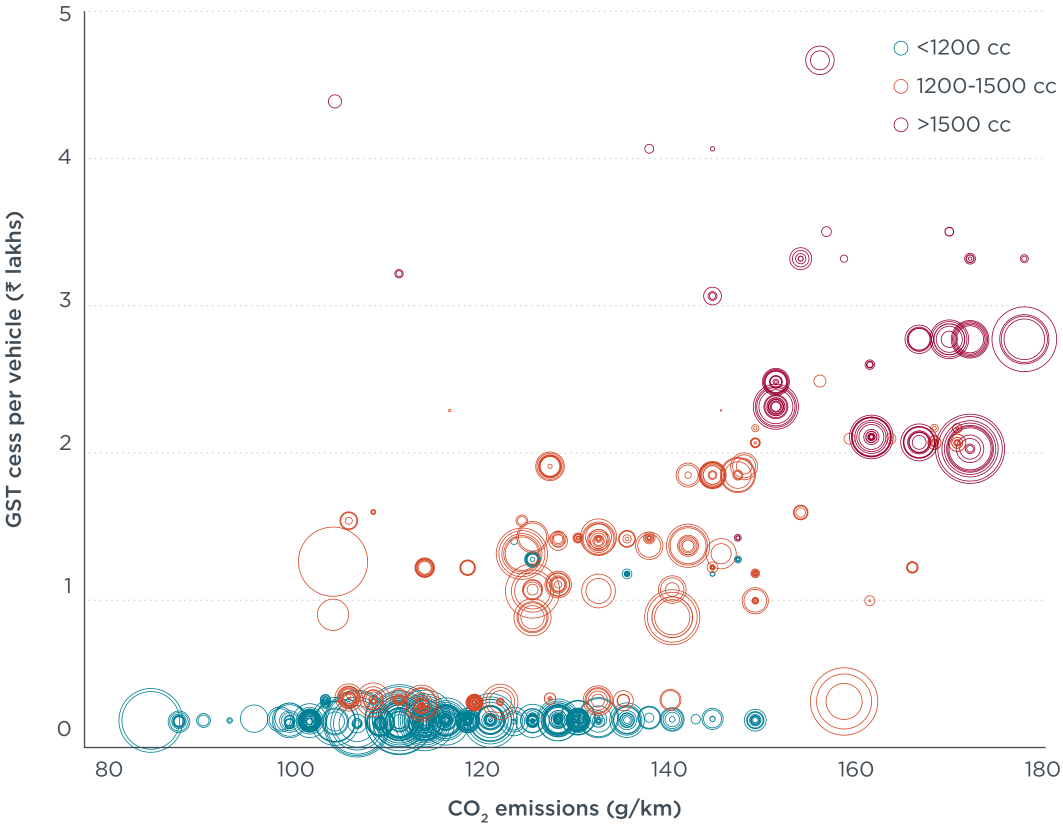


Figure 3. Sales-weighted average GST cess versus CO_2 emissions, by engine displacement (measured in cubic capacity [cc]).

Note: Each scatter point represents a PC model variant in the FY 2020–21 India PC fleet. For illustrative purposes, the graph only includes model variants with cess amounts below ₹5 lakh (US$6,745) and CO_2 emissions between 80 g/km and 180 g/km. Such variants accounted for 98% of the total India PC fleet for the study period of FY 2020–21. The circle size denotes sales volume for each variant. Different color schemes denote different vehicle engine displacement, with maroon indicating vehicles with engine displacement larger than 1,500 cc, orange for vehicles with engine displacement between 1,200 cc and 1,500 cc, and blue indicating vehicles with engine displacement less than 1,200 cc.

Figure 4 compares the sales-weighted CO_2 emissions of top-selling passenger car OEM groups operating in India to their fleets' sales-weighted cess amounts.[19] The bubble size represents each OEM's sales share in the Indian PC fleet in FY 2020–21. As shown, OEM groups with more fuel-efficient fleets do not necessarily incur lower tax burdens, and vice versa. For example, while both Maruti and Tata's fleets are subject to sales-weighted cess amounts of approximately ₹24,000 (US$324), their sales-weighted CO_2 emissions varied by 14 g/km.

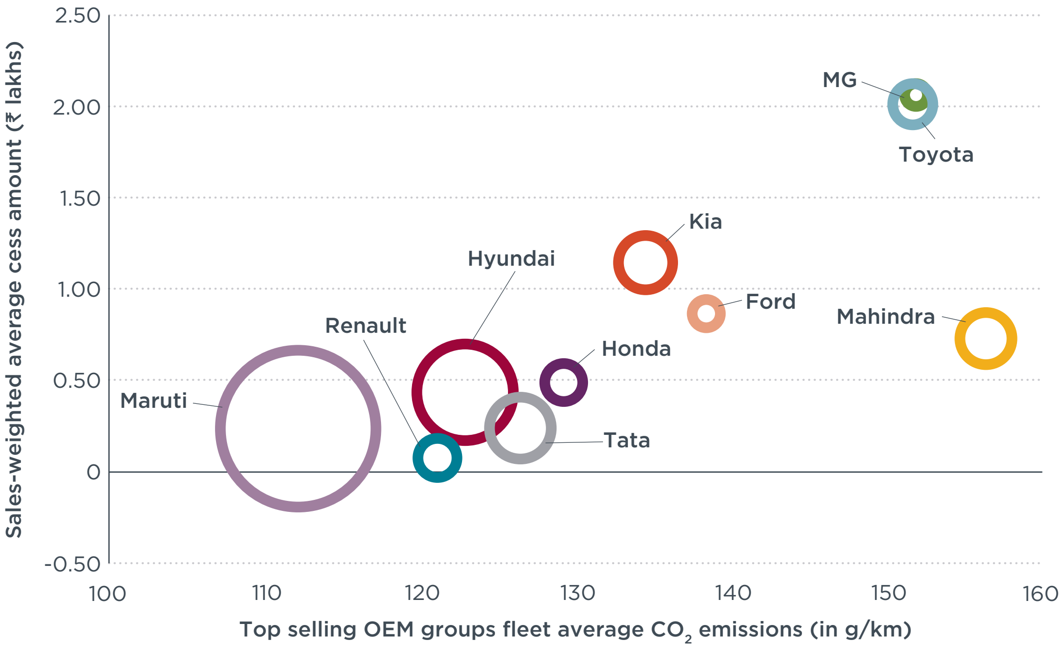


Figure 4. Comparison of sales-weighted CO_2 emissions and sales-weighted GST cess for passenger car OEM groups in India. Bubble size represents the market share of each OEM in the PC fleet in FY 2020–21.

Emissions-linked scenario assessment – Scenario A

The aim of the draft NAP, 2018 is "to provide a long-term, stable and consistent policy regime and to have a clear roadmap for the automotive industry"; among the objectives is "to promote clean, efficient and sustainable mobility" in the country, with the larger goal of protecting the environment.[20]

In the draft's proposed dual-parameter cess framework, while the base GST rate for passenger cars remains 28%, the cess structure is redesigned to index the cess rate to vehicle length and CO_2 emissions. The proposed framework is a four-quadrant cess structure and is not designed in the form of a continuous function. Vehicles shorter than the 4-m threshold incur a lower tax rate and vehicles greater than 4 m are taxed at a higher rate. Likewise, vehicles with CO_2 emissions below the specified threshold applicable in the given year are taxed at a lower rate, and vice versa. The policy provides for progressive tightening of the CO_2 emissions threshold every 2 years for a decade, starting from 155 g/km and going down to 110 g/km.

Figure 5 illustrates this proposed GST cess structure alongside the GST cess rates in the policy. The "E" value represents the CO_2 emissions threshold applicable in the given year for cess rate determination. The progressive CO_2 emissions thresholds are presented in Table 3.

19 The combined market share of these top-selling passenger car OEM groups in FY 2020–21 was 99.1%.

20 Ministry of Heavy Industries and Public Enterprises, Government of India, "National Auto Policy (Draft Version 2)," 16.

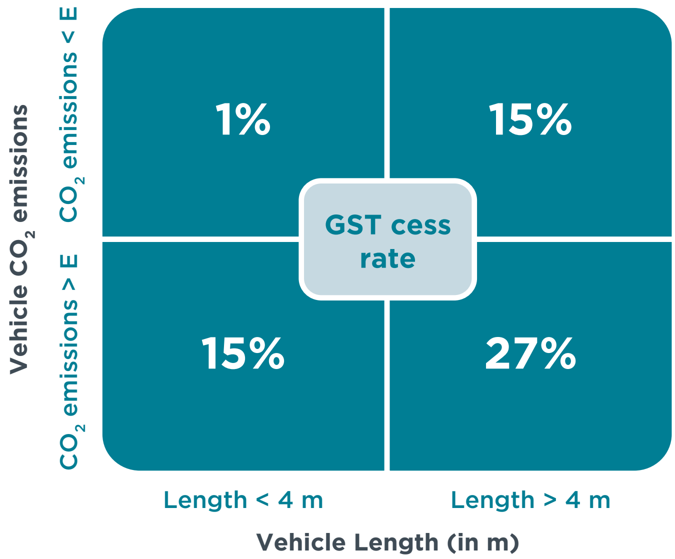


Figure 5. GST cess structure for passenger cars proposed under the draft National Auto Policy, 2018.

Table 3. CO_2 emissions thresholds specified under the draft National Auto Policy, 2018, to be tightened progressively every 2 years for a decade.

CO_2 emissions thresholds	Threshold 1	Threshold 2	Threshold 3	Threshold 4	Threshold 5	Threshold 6
Value of E (g/km)	155	150	140	130	120	110

Figures 6 and 7 depict the CO_2 emissions versus cess amount for all PC models under the proposed cess structure at the highest and lowest E value thresholds. The bubbles represent individual PC models in the fleet. For illustrative purposes, the figures only depict model variants with a cess fee below ₹5 lakh (US$6,745) and CO_2 emissions between 80 g/km and 180 g/km. These variants were 98% of total PC sales in FY 2020–21. These figures are supplemented by tables indicating the percentage of the total fleet that would fall under the different tax brackets at the two emissions thresholds.

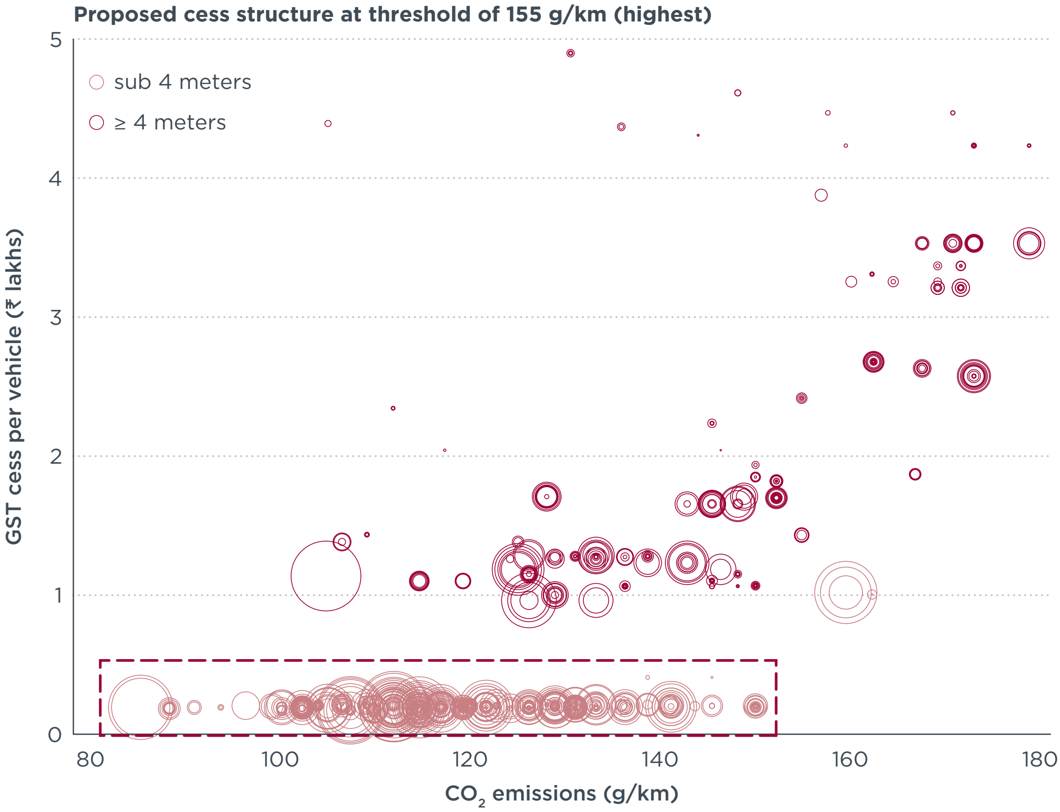


Figure 6. CO_2 emissions versus cess amount at CO_2 emissions threshold of 155 g/km under draft National Auto Policy, 2018 proposal.

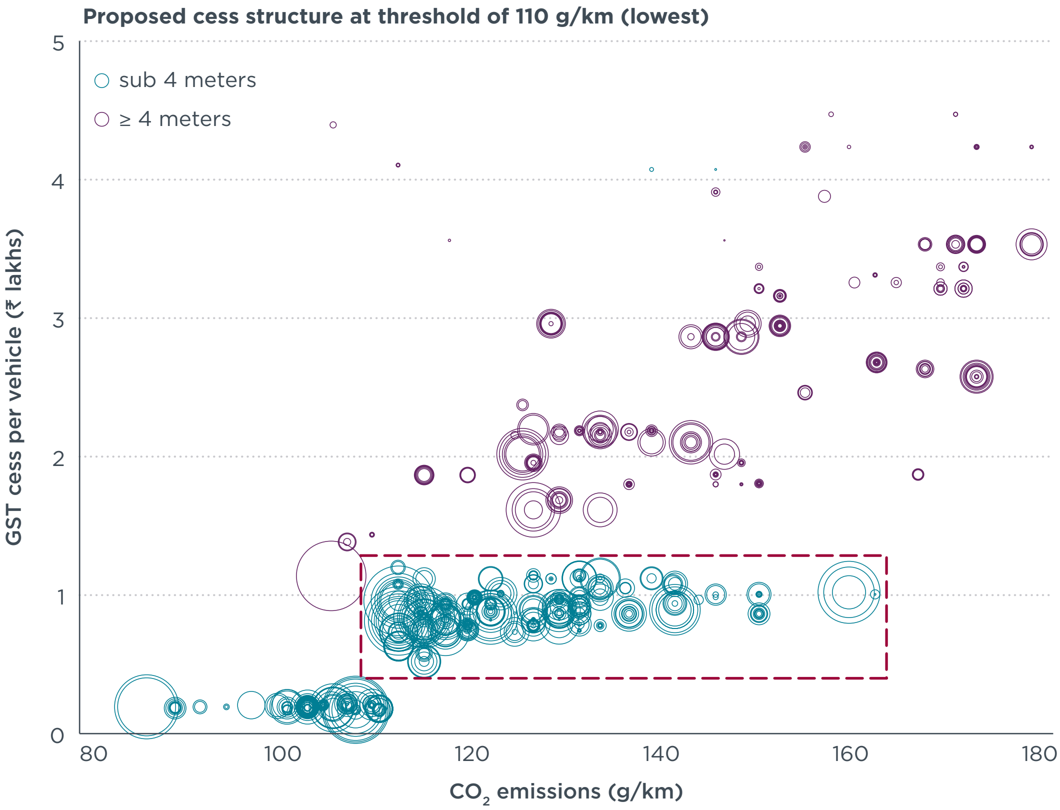


Figure 7. CO_2 emissions versus cess amount at CO_2 emissions threshold of 110 g/km under the draft National Auto Policy, 2018 proposal.

Table 4. Percentage of FY 2020–21 PC fleet falling under each cess rate bracket at CO_2 emissions thresholds of 155 g/km and 110 g/km under the draft National Auto Policy, 2018 proposal.

Vehicle length and CO_2 emissions	Cess rate	Percentage of passenger car fleet	
		CO_2 emissions threshold 1 (E = 155 g/km)	CO_2 emissions threshold 6 (E = 110 g/km)
Length < 4 meters & CO_2 emissions < E	1%	74%	20%
Length > 4 meters & CO_2 emissions < E	15%	18%	2%
Length < 4 meters & CO_2 emissions > E	15%	2%	56%
Length > 4 meters & CO_2 emissions > E	27%	6%	22%

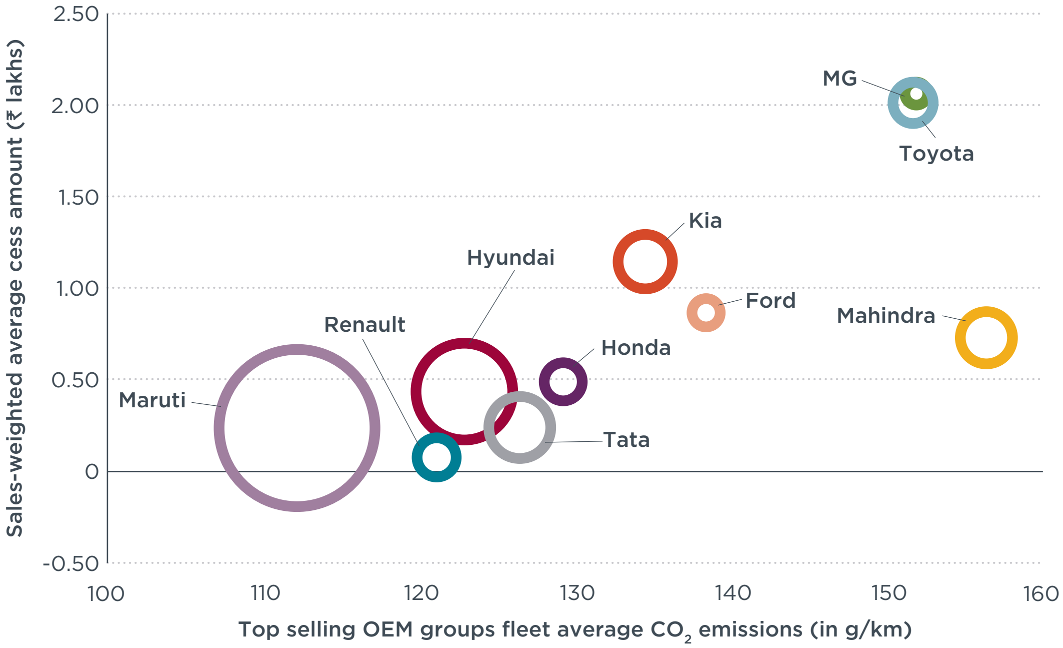
One limitation of the proposed structure is that it involves tax brackets with wide expanses between tax liability levels; this could enable OEMs to position vehicles just below the next higher emissions threshold to avoid higher taxes.[21] Additionally, because the PC fleet's average emissions level in FY 2020–21 was 123.2 g/km, transitioning from an emissions threshold of 155 g/km to 110 g/km over 10 years is a relatively lenient policy proposition and falls far behind global ambition for PC-fleet emission reductions.[22] For perspective, the European Union's "Fit for 55" greenhouse gas reduction regulation requires emissions from new PCs to be 55% lower than a 2021 baseline of 95 g CO_2/km by 2030, followed by a zero-emission mandate from 2035 onward.[23] In Figure 6, at the 155 g/km emissions threshold, vehicles in the red box represent 74% of India's PC fleet and are subject to an average tax of ₹4,712 (US$64), with emission values from 85 g/km to 149 g/km. As observed in Figure 7, tightening the threshold to 110 g/km does not resolve tax stagnation across a wide range of emissions values. For example, at the 110 g/km emissions threshold, the red box accounts for 56% of the PC fleet and vehicles are subject to an average tax of ₹75,071 (US$1,013), with CO_2 emissions values varying between 111 g/km and 161 g/km.

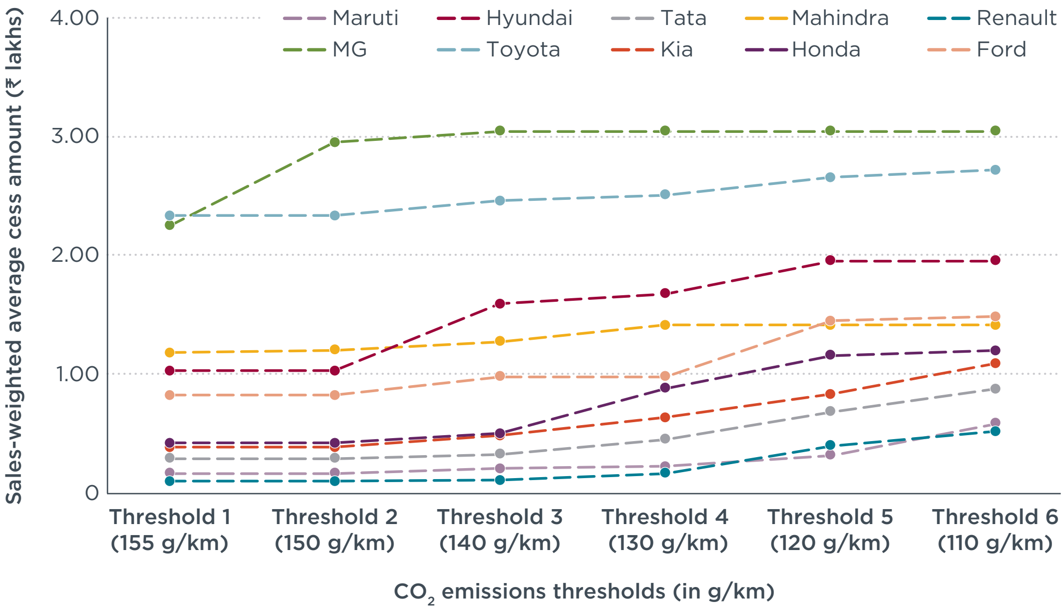
In Figure 8, the top chart depicts the sales-weighted average cess amount under the baseline cess system for the top 10 OEMs with the highest sales and their corresponding sales-weighted CO_2 emissions. The size of the bubbles corresponds to each OEM's share of new sales in FY 2020–21. The bottom chart in Figure 8 tracks the OEMs' cess amount at each CO_2 emissions threshold as specified under the proposed framework in the draft NAP, 2018.

21 Peter Mock, "Optimizing to the Last Digit: How Taxes Influence Vehicle CO_2 Emission Levels," (ICCT: Washington, D.C., 2015), https://theicct.org/wp-content/uploads/2021/06/Tax_Step_Analysis_201510.pdf.

22 "Passenger Vehicle Greenhouse Gas Emissions and Fuel Consumption," International Council on Clean Transportation, accessed October 20, 2022, https://theicct.org/pv-fuel-economy/.

23 Council of the European Union, "'Fit for 55': Council Adopts Regulation on CO_2 Emissions for New Cars and Vans," news release, March 28, 2023, https://www.consilium.europa.eu/en/press/press-releases/2023/03/28/fit-for-55-council-adopts-regulation-on-co2-emissions-for-new-cars-and-vans/.





Note: The x-axis represents the CO_2 emissions thresholds specified under the draft NAP, 2018. The x-axis labels are discrete and non-numeric in nature. The dashed lines in the graph are for indicative purposes only and are meant to depict the movement in cess amount for the OEMs from one threshold to the next. The dashed lines are not mathematical in nature and do not represent any relationship between the emissions and cess amount.

Figure 8. The top chart shows fleet-average CO_2 emissions and cess amount for OEMs under the baseline cess structure. The size of the circle indicates market share. The bottom chart shows the cess at various CO_2 (E value) and vehicle-length-based slabs introduced in the draft National Auto Policy, 2018. Both charts consider new PC sales in FY 2020–21 from top 10 best-selling OEM groups.

These figures demonstrate that a lenient emissions threshold coupled with a quadrant-style cess structure does not exert continuous pressure on high-emitting OEMs to undertake progressive emissions reduction interventions. Cess levels plateau for certain OEMs. For example, there is no change in MG's cess liability beyond the 140 g/km emissions threshold, for Kia beyond the 120 g/km threshold, or for Mahindra beyond the 130 g/km threshold. Each OEM's PC fleet is already subjected to the highest tax slab at those thresholds; despite progressive tightening of the emissions thresholds under the proposed cess framework, the OEMs would face no incremental increase in the cess amount. Thus, this tax structure undermines the potential of the cess to influence continuous fleet emissions reduction.

Emissions-linked scenario assessment – Scenario B

In exploring the implications of adopting a continuous emissions-linked tax function, we focus on the simplest form of a continuous function, a linear fee schedule. Linear functions are relatively easy to construct and can serve as a good starting reference for other possibilities, including more complex continuous functions.

Prior ICCT studies illustrated how continuous emissions-linked tax structures offer several advantages over stepwise/slab-based systems.[24] Indeed, in the early years of France's feebate emissions-reduction program, fee components were designed as step functions rather than continuous functions. OEMs responded by producing models with emissions levels clustered toward the higher end of the defined slabs and thus avoided the next higher tax liability. France subsequently changed its structure, first by tightening the steps and eventually by implementing a continuous curve for the fee program's malus component.

Here we construct a hypothetical linear emissions-linked tax structure for India's PC fleet by obtaining a sales-weighted fit between emissions and cess amounts applicable to all model variants in the FY 2020–21 PC database.[25] This essentially excluded vehicles with a base price greater than ₹20 lakhs (US$26,980), which constitute about 1% of sales, as outliers from the fit. We further adjusted the fit for no-rebate or negative tax conditions and revenue neutrality with respect to the baseline. Consequently, we obtained the following function with an x-intercept (emission threshold after which tax applies, or "E value") of 110 g CO_2/km, and slope (tax rate) of ₹0.036 lakhs (US$49) per gram of CO_2:

$$\textit{GST cess (INR lakhs)} = \max\{0.036 \times CO_2\ (g/km) - 0.036 \times 110\ ,\ 0\}$$

Our illustrative tax schedule charges ₹0.036 lakhs (US$49) per additional g CO_2/km for vehicles emitting 110 g CO_2/km or more (Figure 9). For example, if a vehicle emits 120 g CO_2/km, a cess of ₹0.036 lakhs (US$49) per gram will apply to the additional emissions over the threshold of 110 g/km (i.e., applicable cess = ₹0.036 lakhs *(120 – 110)). Vehicles with emissions levels below 110 g/km of CO_2 are not subject to the cess.

24 John German and Dan Meszler, "Best Practices for Feebate Program Design and Implementation," (ICCT: Washington, D.C., 2010), https://theicct.org/publication/best-practices-for-feebate-program-design-and-implementation/; Murat Şenzeybek, Peter Mock, "Vehicle Registration Tax as a Policy Instrument to Help Reduce CO_2 Emissions and Fuel Consumption in Turkey," (ICCT: Washington, D.C., 2019), https://theicct.org/sites/default/files/publications/Registration_Tax_in_Turkey_EN_20190429.pdf; Peter Mock, "Optimizing to the Last Digit: How Taxes Influence Vehicle CO2 Emission Levels," (ICCT: Washington, D.C., 2015), https://theicct.org/wp-content/uploads/2021/06/Tax_Step_Analysis_201510.pdf.

25 A step-wise description of the methodology adopted in modeling the linear function is included in the Appendix to this report.

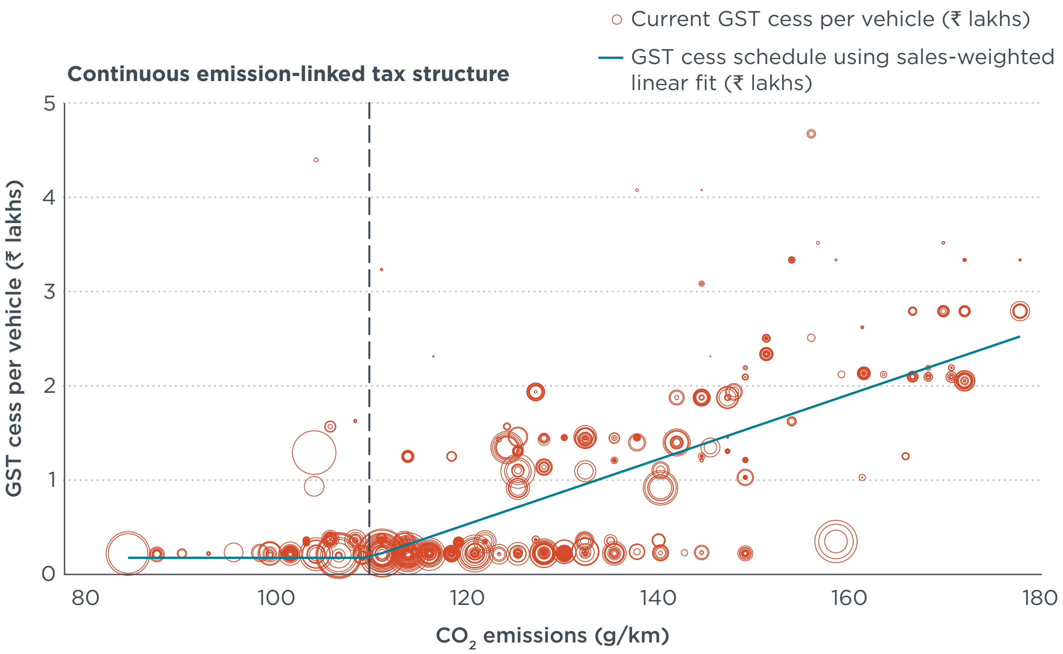


Figure 9. Linear fitting and adjusting the linear GST cess schedule for no rebates and revenue neutrality. The R-squared of the adjusted linear fit is 0.37.

Under the modeled linear cess structure, nearly 80% of the FY 2020–21 PC fleet lies above the threshold and incurs such a tax, and 20% is exempt. This emissions cutoff coincides with the most stringent emissions threshold specified under the GST cess structure proposed in the draft NAP, 2018.

Figure 10 presents the sales-weighted CO_2 emissions rankings of top-selling OEM groups in India and their corresponding sales-weighted cess tax ranking under the modeled linear function. The size of the bubble represents each OEM group's share of new sales in FY 2020–21. Compared to the baseline and proposed cess structure under the draft NAP, 2018, the sales-weighted average tax burden on OEM fleets under the modeled linear function is commensurate with the fleet's sales-weighted average emissions.

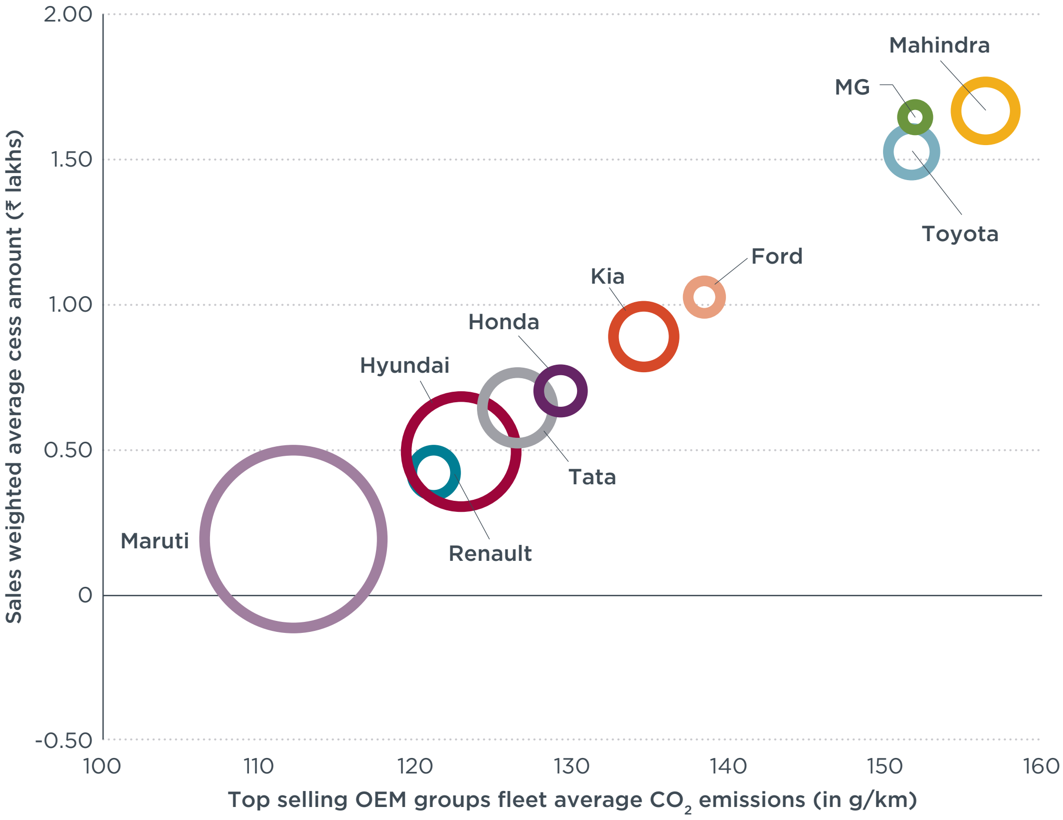


Figure 10. Sales-weighted average CO_2 emissions and sales-weighted average cess amounts on fleets from top-selling OEM groups in India under the modeled linear emissions linked function for GST cess. The size of the bubble represents the sales share of each OEM group in FY 2020–21.

Trade-off analysis

This section explores any potential trade-offs involved in migrating from the baseline cess structure to the emissions-linked tax structure proposed under the draft NAP, 2018 and to the hypothetical linear emissions function constructed for Scenario B.

India is a price-sensitive market, and we examine impacts of any tax restructuring on consumer segments by vehicle price. Following that, we examine the impact of any emissions-linked tax restructuring on the simultaneous objectives of promoting smaller cars and discouraging diesel vehicles. Tables 5, 6, and 7 serve as references for this trade-off analysis and indicate the shift in sales-weighted average cess amounts under the emissions-linked scenarios of the draft NAP, 2018 and the modeled linear function with respect to the baseline.

Consumer tax implications

Table 5. Sales-weighted average tax by consumer price categories.

Vehicle price (₹)	Market share	Sales-weighted average emissions (g CO_2/km)	Sales-weighted average GST cess (₹)			
				Draft National Auto Policy, 2018		Linear function modeled for this study
			Baseline	*E = 155 g/km*	*E = 110 g/km*	*E = 110 g/km, Tax = ₹3,600 per additional g CO_2*
< 5 lakhs	47%	112	4,319	4,379	44,082	18,677
5 lakhs – 10 lakhs	45%	129	58,978	52,092	1,15,658	69,553
10 lakhs – 15 lakhs	6%	150	2,04,227	2,13,896	2,98,096	1,49,811
15 lakhs – 20 lakhs	0%	187	3,90,676	4,73,376	5,02,298	2,75,230
> 20 lakhs (luxury segment)	1%	167	7,11,117	8,38,657	9,30,347	2,19,262

A linear fee schedule of ₹0.036 lakhs (US$49) per additional gram of CO_2 applied to cars emitting more than 110 g CO_2/km balances emissions and tax disparities in the baseline structure without imposing a large tax increase on high-volume cars because 92% of the consumer market is for vehicles priced under ₹10 lakhs (US$13,490). The average tax for consumers paying less than ₹5 lakhs (US$6,745) for a vehicle increases 4.32 times under the modeled linear function and 10.2 times under the draft NAP structure at a similar emissions threshold. Similarly, the average tax for consumers paying between ₹5 lakhs (US$6,745) and ₹10 lakhs (US$13,490) for a vehicle increases 1.18 times under the modeled linear function and by 1.96 times under the draft NAP structure at a similar emissions threshold. Such consumers are not affected much under the draft NAP structure at emissions thresholds of 155 g/km. This is primarily because average emissions for these segments are well under 155 g/km and the draft NAP structure does not address the wide variability in emissions versus tax found in these segments at such a threshold.

However, the modeled linear function reduces the average cess amount for vehicles priced above ₹10 lakhs (US$13,490) because 98% of vehicles priced above that amount are longer than 4 m. Therefore, decoupling vehicle length from the taxation structure benefits cars in those price brackets. We discuss potential solutions for addressing this length-based trade-off later in this section when we discuss structural implications for giving tax advantages to sub-4-m cars.

We define the luxury price segment as cars that cost more than ₹20 lakhs (US$26,980). Such cars comprise about 1% of the fleet.[26] The sales-weighted average tax in the luxury segment is ₹7.1 lakhs (US$9,593) under the baseline cess scenario, ₹9.3 lakhs (US$12,550) under the draft NAP scenario, and ₹2.2 lakhs (US$2,958) under the modeled linear function at similar emissions thresholds. This kind of trade-off in lowering the average tax on luxury cars under the modeled linear function was expected because luxury cars were excluded as outliers in the modeled linear fit. This can be addressed in practice by fitting a separate linear tax function for luxury vehicles. Because such a function would be fitted on the basis of luxury vehicle prices, it would likely have a steeper slope and thus a higher tax schedule per gram of emissions than the modeled function, which is fitted to non-luxury car prices.

26 FY 2020–21 luxury car sales are attributed to the following OEMs: BMW, Jaguar Land Rover, Mercedes-Benz, Volvo, and Ferrari.

Tax advantage for sub-4 m cars

Table 6. Sales-weighted average GST cess based on a 4-m cutoff.

Top 10 OEM fleets by sales		Sales-weighted average CO_2 emissions (g/km)	Sales-weighted average GST cess (₹)			
			Baseline	Draft National Auto Policy, 2018		Linear function modeled for this study
				E = 155 g/km	*E = 110 g/km*	*E = 110 g/km, Tax = ₹3,600 per additional g CO_2*
Cars < 4m	77% share	117.1	11,064	7,468	56,438	33,603
Cars > 4m	23% share	141.48	1,65,553	1,72,301	2,38,681	1,15,465

The average tax on cars longer than 4 m is 15 times that on sub-4m cars under the baseline, 4.2 times higher under the draft NAP structure, and 3.4 times higher under the modeled linear function at similar emissions thresholds. The relative tax on long cars is 23 times that of small cars in the draft NAP structure at an emissions threshold of E = 155 g/km. Thus, we observe a large trade-off in relative tax advantage available to sub-4m cars in a migration toward both the draft NAP structure and the modeled linear function at emissions cutoffs of 110 g/km.

Shifting to a purely emissions-linked function decouples the tax levy from both vehicle price and vehicle length. One potential solution to address the length-related trade-off observed in the modeled linear fit is to introduce an additional length-based component to the emissions-linked tax for cars above the 4-m threshold. For example, a simple linear co-relation between vehicle price and length above 4 m results in a fee of ₹0.011 lakhs (US$15) per mm (Figure 11). While such a fee schedule is hypothetical, the government could decide an appropriate rate in line with overall policy objectives for the sector.

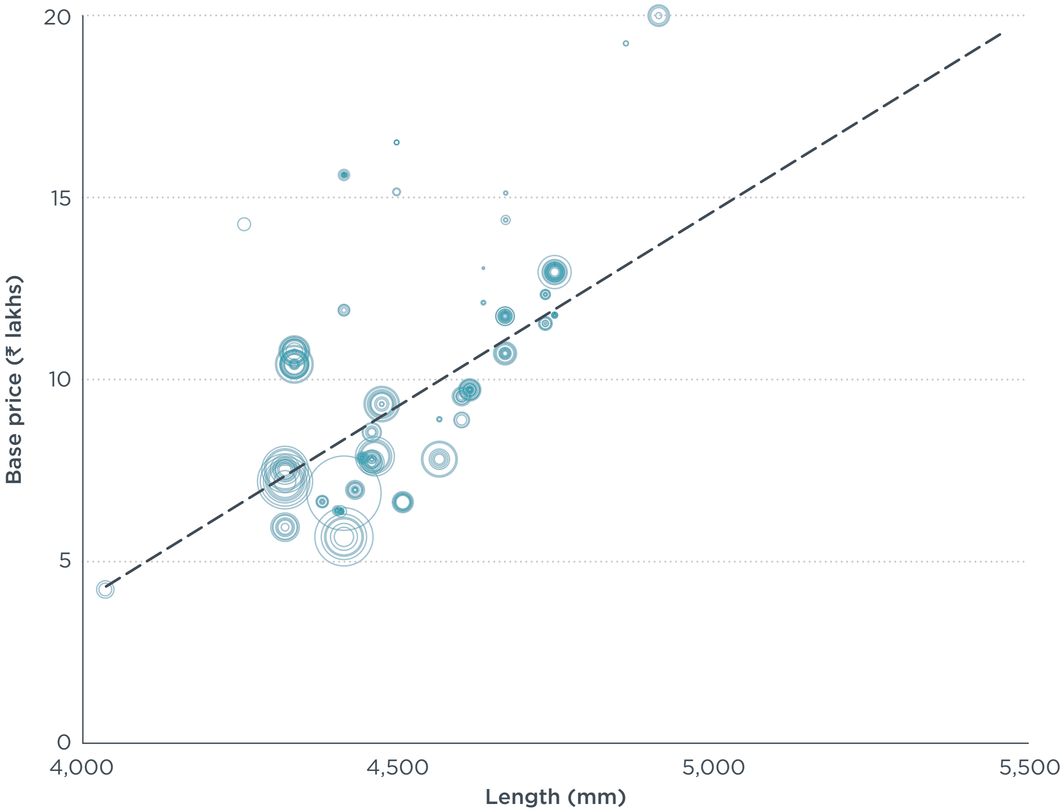


Figure 11. Linear fitting between vehicle price and vehicle length, for cars > 4m and base price < ₹20 lakhs (US$26,980), weighted by sales. The circle size indicates the sales of the model. The slope of the fitted line is 0.011 (₹ lakhs per mm) and the R-squared of the linear fit is 0.38.

Tax implications for diesel cars

Table 7. Sales-weighted average GST cess by fuel type.

Top 10 OEM fleets by sales		Sales-weighted average CO_2 emissions (g/km)	Sales-weighted average GST cess (₹)			
			Baseline	Draft National Auto Policy, 2018		Linear function modeled for this study
				E = 155 g/km	*E = 110 g/km*	*E = 110 g/km, tax = ₹3,600 per additional g CO_2*
Petrol	76% share	120.4	28,843	22,866	81,054	40,863
Diesel	18% share	141.7	1,21,398	1,40,252	1,86,562	1,15,264

The average tax on diesel-fueled cars is 4.2 times that on gasoline-fueled cars under the baseline cess structure, 2.3 times higher under the draft NAP structure, and 2.8 times higher under the modeled linear function at similar emissions thresholds. Therefore, while the relative tax on diesel cars falls under both emissions-linked tax scenarios, the modeled linear function is more effective than the draft NAP structure in maintaining a higher tax differential between gasoline and diesel technologies at similar emissions thresholds; this is in part because diesel cars can be more fuel-efficient. While diesel car sales in India declined sharply after implementation of the BS VI emission standard in April 2020, additional diesel surcharge coefficients can also be specified for all diesel cars in line with government policy objectives.[27] For example, a hypothetical 5% diesel surcharge coefficient would mean diesel cars incur an additional 5% on the applicable per-gram GST cess as per the linear function. While we did not model the impact of any surcharge here, such approaches warrant further investigation and analysis.

Conclusions and policy implications

The analysis shows that the baseline GST cess structure with rates based on vehicle length, fuel type, engine displacement, and ground clearance misses opportunities for distributing a tax levy commensurate with vehicle fuel consumption. Cars with gasoline/compressed natural gas/liquefied petroleum gas fuel systems, length less than 4 m, and engine displacement less than 1,200 cc comprised more than 70% of India's new PC sales in FY 2020–21 and fell under the lowest tax bracket of 1%. Ten of the 15 highest-selling models in the Indian PC fleet fell under this tax bracket and had CO_2 emissions values between 85 g/km and 159 g/km. We also observe wide variability in GST cess burden on cars within the engine displacement-based "tax bins" of less than 1,200 cc, 1,200 cc–1,500 cc, and greater than 1,500 cc. Therefore, the current policy does not serve as a complementary market signal to India's fuel consumption standards.

The quadrant-style emissions- and length-based structure for the GST cess proposed under the draft NAP, 2018 also has limited potential to drive fuel-efficiency improvements in the fleet. The proposed cess structure is a slab-based system with large jumps in tax liability between slabs. Under such a system, OEMs might be incentivized to produce models with emissions levels clustered toward the higher end of the defined slabs while avoiding the next higher tax liability. In addition, an initial threshold of 155 g/km is relatively lenient and misses the opportunity to correct the emissions-versus-tax imbalances that are observed widely across cars with emissions under this threshold, including across sub-4 m cars. Although the emissions threshold would tighten to 110 g/km over 10 years, this pace is misaligned with the potential emissions reduction from India's fleet and also with other markets such as

27 Deo and German, "Fuel Consumption from New Passenger Cars in India in Fiscal Year 2020-21"; Şenzeybek and Mock, "Vehicle Registration Tax as a Policy Instrument in Turkey."

the European Union. Additionally, such a structure does not exert continuous pressure on manufacturers to pursue emissions reductions once they are under the system's maximum tax liability of 27%.

A GST cess function linked to vehicle emissions smooths out the imbalances in tax versus emission levels observed widely across all tax categories in the baseline structure, including cars within the lowest tax bracket of 1%. Our modeled emissions-linked linear GST cess function levies ₹0.036 lakh (US$49) per additional g CO_2/km on cars with emissions higher than 110 g CO_2/km. Such a schedule covers about 80% of the FY 2020–21 fleet. Cars with emissions below this threshold are subject to zero cess. Because the modeled linear function indexes cess amounts directly to emissions levels, it fundamentally decouples the tax from vehicle length and lowers the relative tax advantage available to sub-4m cars. Such a trade-off could be addressed by introducing an additional length-based tax component for vehicles longer than 4 m. Separate linear tax schedules for luxury vehicles could also be designed with a higher tax rate per gram of emissions (slope) and emission cutoff value (x intercept) than the modeled function, and separate diesel surcharge coefficients could be considered to further discourage diesel cars.

The modeled linear function in this study is among several design possibilities to construct a continuous function for India's PC fleet. Continuous emissions-linked functions for the GST cess encourage consumers to purchase vehicles with lower emissions and OEMs to invest in fuel-efficiency improvements. This paper demonstrated a continuous function in the form of a linear tax schedule fit to high-volume cars (those with base price under ₹20 lakhs [US$26,980]). Going forward, emissions reductions should also be encouraged in vehicles under the modeled emissions threshold of 110 g/km.

This structural analysis can serve as the basis for conducting further sensitivity analyses in line with the India's overall strategic objectives. This would include analyzing steps such as varying tax rates per gram and emissions cutoff values and modeling additional length-based components and any diesel surcharge coefficients.

Finally, any structural revisions to the base GST component levied on PC sales in the near to medium term would not support emissions reductions. India levies one of the highest GST rates globally (28%) on PCs and there is a steeply discounted rate (5%) available to BEVs. A high base rate on PC sales allows the government to address externalities from a high-volume sector and it is important for decarbonizing PCs that the relative advantage available to BEVs on the base GST be maintained or increased in the near and mid term.

APPENDIX

Table A1. Key data inputs, sources, and details of data processing.

Key data inputs	Source	Data description and/or processing
New sales for FY 2020–21	Segment Y Automotive Intelligence Pvt. Ltd.	New sales database is organized primarily on the basis of vehicle manufacturer, model, and variant. Variants with sales of less than 10 units in the baseline year were excluded from the analysis; these account for 0.05% of the total PC sales.
Engine displacement	Segment Y Automotive Intelligence Pvt. Ltd.	The sales database offers vehicle model engine displacement data, measured in cubic centimeters (cc).
Length	Segment Y Automotive Intelligence Pvt. Ltd.	The sales database offers vehicle model length data, measured in meters. For PCs with length greater than 4 m and engine displacement greater than 1,500 cc, a 21% uniform average GST cess rate has been considered for the analysis since ground clearance information was not available in the database.
Fuel type	Segment Y Automotive Intelligence Pvt. Ltd.	The sales database includes classification of all vehicles according to the following fuel systems: • gasoline • diesel • compressed natural gas (CNG) • electric • hybrid: gasoline/electric (corresponding to strong hybrids with gasoline power train)
Test fuel consumption	Segment Y Automotive Intelligence Pvt. Ltd.	The sales database includes test fuel consumption values (in km per liter) declared by vehicle manufacturers. Government-authorized vehicle testing agencies in India include the International Centre for Automotive Technology (iCAT) and the Automotive Research Association of India (ARAI). The test cycle used for passenger cars in India is the Modified Indian Drive Cycle (MIDC). Of the 1,193 model variants listed in the database, fuel consumption values are not provided for 148. These model variants account for 2.34% of PC new sales and were excluded from the analysis.
CO_2 emissions	Segment Y Automotive Intelligence Pvt. Ltd.	We convert the fuel consumption values (in km per liter) from the sales database to CO_2 emissions using the following method: For internal combustion engine vehicles, we use the conversion factors from the Gazette of India (No.837), as shown below (fuel consumption is in L/100 km, CO_2 emission is in g/km): $FC_{petrol} = 0.04217 \times CO_2$ $FC_{diesel} = 0.03776 \times CO_2$ $FC_{LPG} = 0.06150 \times CO_2$ $FC_{CNG} = 0.03647 \times CO_2$ India's approach to assigning CO_2 emissions to electric vehicles (EVs) involves converting BEVs' electrical energy consumption to equivalent gasoline consumption (and emissions), using the following equation:[28] *CO_2 emissions from electrical operation of EV (g/km)* = *electrical energy consumption (kWh/100km)* × 0.1028 + 23.7135
Vehicle price	Third-party vehicle information websites including cardekho.com, autocarindia.com, cartrade.com, and carwale.com	(1) *Price extrapolation to attain completeness of the dataset.* The price of the "best-selling variant" was applied to all variants of the vehicle model with the same fuel type. "Best-selling variant" is the vehicle model variant with the highest sales among all the available same-fuel variants of the model. For example, the Hyundai Aura is available in three fuel types (gasoline, diesel, and CNG). For each fuel type, the variant with the highest sales was considered for price extrapolation (i.e., the price of this highest-selling variant was considered to be the price of all variants of the model with the same fuel type for this analysis). "Best-selling variants" account for 28.5% of total PC sales. After price extrapolation, 99.4% of the fleet is covered. In case a PC model has more than one same-fuel variant with equal highest sales, then the variant with the lower ex-showroom price has been considered as the "best-selling variant." (2) *Exclusion of EV subsidy.* No purchase subsidy is considered for computation of the ex-showroom price of EVs, as private passenger cars are not covered under the scope of the central government's EV purchase subsidy scheme. (3) *Exclusion of extremely high-priced models.* Models with prices greater than ₹500 lakh (US$6,74,491) have been excluded from the analysis.

28 Shikha Rokadiya, Zifei Yang, and Anup Bandivadekar, "Incentivizing Electric Vehicles to Meet Fuel Consumption Standards for Passenger Cars in India," (ICCT: Washington, D.C., 2019), https://theicct.org/publication/incentivizing-electric-vehicles-to-meet-fuel-consumption-standards-for-passenger-cars-in-india/.

Table A2. Methodology for constructing linear function.

Step	Description	Details
1.	**Linear regression**	• We produce a best-fit line using linear regression between the baseline GST cess amount and the corresponding CO_2 emissions for all models in the PC fleet. • We remove the effect of outliers by generating a sales-weighted linear regression, which removes approximately the top 1% most expensive models from the fit. • As a result, we obtain the following linear cess function with an E value of 108 g CO_2/km and tax rate of ₹0.036 lakhs (US$49) per gram of CO_2: *GST cess (₹ lakhs) = {0.036 × CO_2 (g/km) – 0.036 × 108}*
2.	**No rebate adjustment**	• The negative y-intercept of the best-fit line indicates a rebate of ₹3.88 lakhs (US$5,234) for zero-emission vehicles, which we then set to zero, while keeping the tax rate (slope) constant, to assume no rebates in the schedule.
3.	**Revenue neutrality adjustment**	• Because removing rebate payouts from the total revenue results in a revenue surplus for the government, we further shift the cess line along the x-axis to increase the E value until resulting revenues equalize with baseline revenues.