THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

Hybrid and Electric Vehicles in India
Current Scenario and Market Incentives

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Introduction

BACKGROUND

Cost concerns have deterred manufacturers from introducing hybrid electric vehicle (HEVs) and battery electric vehicle (BEV) technologies in India until recently, but this seems poised to change following the introduction of incentives to boost the penetration of these vehicles. In FY 2015-16, hybrid and electric passenger vehicles constituted approximately 1.3% of all passenger vehicle sales in India, up from essentially zero in FY 2012-13[1].

The flagship program to boost hybrid and electric technologies in India is the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME)[2] scheme from the Central Government, launched in April 2015. As outlined in Table 1, the scheme earmarks funds under several components for a two-year period across FY 2015-16 and FY 2016-17. Demand incentives, which are available as a direct subsidy on the retail price of eligible vehicles to consumers, are the most significant component of the scheme.[3]

Table 1. Components and Outlay Under FAME Scheme[3]

Component under FAME Scheme	FY 2015-16 Million INR (Million USD)	FY 2016-17 Million INR (Million USD)
Technology Platform	700 (10.5)	1,200 (18)
Demand Incentives	1,550 (23.25)	3,400 (51)
Charging Infrastructure	100 (1.5)	200 (3)
Pilot Projects	200 (3)	500 (7.5)
IEC/Operations	50 (0.75)	50 (0.75)
Total	**2,600 (39)**	**5,350 (80.25)**

STUDY OBJECTIVES

Considering that the FAME scheme has been in effect for one year, and that various other incentive mechanisms are also available, the objectives of this study are:

1. To examine the utilization of the demand incentive allocations under the FAME scheme for FY 2015-16, based on vehicle segment and technology.
2. To examine the fuel-efficiency benefits of models currently registered under the FAME scheme.
3. To examine additional central- and state-level incentives available for the vehicle segments and technologies that received

1 Sales data obtained for FY 2015-16 from Segment Y Automotive Intelligence Pvt. Ltd.

2 Notification S.O. 830(E). of The Gazette of India, Ministry of Heavy Industry and Public Enterprises, March 13, 2015, http://www.fame-india.gov.in/ViewNotificationDetails.aspx?RowId=5

3 Distribution of national level incentives in early stage markets of Electrical Vehicle Initiative (EVI) countries across 2008-2012 was: consumer incentives ~ 27%; charging infrastructure ~ 7%; and RD&D activities ~ 66%. In comparison, the outlay under India's FAME scheme is weighted toward consumer incentives instead of RD&D components. This makes sense as India stands to gain from technological advances already made in RD&D globally. However, the relative outlay for charging infrastructure deployment is lower under the FAME scheme compared with early stage global programs.

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demand incentives from FAME in FY 2015-16. For the purpose of this study, the NCT of Delhi is considered a benchmark state.

4. To examine the relative contribution of all incentives considered, including demand incentives from FAME, in making hybrid and electric technologies cost-competitive in the Indian market.
5. To understand policy implications going forward, based on the current scenario of available incentives.

It is important to note that because consumers do not always make purchasing decisions using structured cost-comparison methods, the objective of this analysis is not to comment on what the "correct" level of incentives should be, but rather to help readers understand the relative contribution of various incentives in making hybrid and electric technologies cost-competitive with conventional options on the market. Further, because the overall goal of such incentives is to influence the market in favor of socioeconomic outcomes such as domestic energy security and climate change mitigation, this analysis also aims to inform readers on such contextual benefits available through hybrid and electric technologies. For perspective, crude oil imports constitute more than 30% of India's primary energy supply,[4] and the majority of this oil consumption is from refined petroleum products used in the transport sector[5]. Since hybrid and electric technologies are inherently more fuel efficient than conventional technologies, they play an important role in reducing India's dependence on foreign energy imports

Table 2. Range of Demand Incentives Available Across Vehicle Segments and Technologies Under FAME Scheme

Vehicle Segment	Mild Hybrid INR (USD)	Strong Hybrid INR (USD)	Plug-In Hybrid INR (USD)	Battery-Operated Electric INR (USD)
Two-Wheelers	1,800 – 6,200 (27 – 93)	—	13,000 – 18,000 (195 – 270)	7,500 – 29,000 (112.5 – 435)
Three-Wheelers	3,300 – 7,800 (49.5 - 117)	—	25,000 – 46,000 (375 – 690)	11,000 – 61,000 (165 – 915)
Passenger Cars	11,000 – 24,000 (165 – 360)	59,000 – 71,000 (885 – 1,065)	98,000 – 1,18,000 (1,470 – 1,770)	76,000 – 1,38,000 (1,140 – 2,070)
Light-Commercial Vehicles	17,000 – 23,000 (255 – 345)	52,000 – 62,000 (780 – 930)	73,000 – 1,25,000 (1,095 – 1,875)	1,02,000 – 1,87,000 (1,530 – 2,805)
Buses	30,00,000 –41,00,000 (45,000 – 61,500)	51,00,000 – 66,00,000 (76,500 – 99,000)	—	—

* Demand incentives are also available for retrofitment kits across all vehicle segments and technologies for up to 15% to 30% of kit price depending on the amount of fuel consumption reduced, as well as price of the kit

as well as in achieving climate and air-quality benefits resulting from reduced fuel consumption.

Further, the scope of incentives considered in this analysis is limited to the direct fiscal benefits available at a national and state level. Other incentive mechanisms and promotional initiatives, both fiscal and non-fiscal in nature, including at a city and utility level, are also known to play an important role in the promotion of hybrid and electric vehicle deployment[6]. Examples of such incentive mechanisms and initiatives include state- and city-level technology deployment goals and schemes; state- and city-level incentives for creation of publicly accessible charging infrastructure; city-level workplace charging programs; state-, city-, and utility-level outreach and consumer awareness programs; and preferential and off-peak tariffs at utility level. Such incentive mechanisms warrant further investigation for their potential to impact deployment of hybrid and electric technologies in India.

MARKET INCENTIVES IN PLACE

The FAME scheme offers a subsidy on the retail price of passenger cars. These subsidies range as follows: for mild hybrids, from INR 11,000 (USD 165) to INR 24,000 (USD 360); for strong hybrids, from INR 59,000 (USD 885) to INR 71,000 (USD 1,065); and for electric vehicles, from INR 60,000 (USD 900) to INR 1,34,000 (USD 2,010). Subsidies are also available for two-wheelers, three-wheelers, light-commercial vehicles, buses, and for retrofit kits. A summary of the available demand incentives across vehicle segments is outlined in Table 2. The scheme has built-in performance criteria in terms of fuel-efficiency improvements for each vehicle segment and technology category to qualify for these incentives. The scheme also indicates minimum fuel-efficiency improvements over a non-hybrid or non-electric base model, if a base model exists.

The subsidy from the FAME scheme is not the only incentive mechanism that impacts the market for hybrid and electric vehicles in India. In addition

4 The Energy and Resources Institute, "Global Oil Markets and India's Vulnerability to Oil Shocks," TERI-NFA Working Paper Series No. 18 (2014). http://www.teriin.org/projects/nfa/pdf/working-paper-No18-Oil-volatility.pdf

5 Print Release on All India Study Report to Petroleum Planning and Analysis Cell on Sale of Diesel and Petrol, Press Information Bureau, Government of India (January 28, 2014). http://pib.nic.in/newsite/PrintRelease.aspx?relid=102799

6 Nic Lutsey, Stephanie Searle, Sarah Chambliss, Anup Bandivadekar, *Assessment of Leading Electric Vehicle Promotion Activities in United States Cities* (ICCT: Washington DC, 2015). http://www.theicct.org/sites/default/files/publications/ICCT_EV-promotion-US-cities_20150729.pdf

to FAME, the Central Government of India and some state governments, such as the Government of National Capital Territory of Delhi (NCT of Delhi), provide tax incentives that treat hybrid and electric vehicles preferentially over conventional technologies. For example, the Central Government of India levies an excise duty of up to 30% on conventional car technologies[7] (determined by vehicle dimensions and engine capacity) while hybrid and electric vehicles are subjected to flat duties of 12.5% and 6%, respectively[8]. In the national FY 2016-17 budget, the Central Government of India also subjected conventional motor vehicles to an infrastructure cess[9] ranging from 1% to 4% of the vehicle price and exempted hybrid and electric vehicles from this cess. On the state government side, the NCT of Delhi has reduced its state Value Added Tax (VAT) rate from 12.5% for conventional vehicles to 5% for hybrid and electric vehicles in its FY 2016-17 budget[10]. Manufacturers are passing on some or all of these benefits to the consumer, which should encourage greater sales of hybrid and electric vehicles.

APPROACH & KEY ASSUMPTIONS

- **Fuel-efficiency evaluation:** Fuel-efficiency benefits are evaluated in terms of fuel-consumption reductions of registered hybrid and non-electric models under the FAME scheme, in comparison with their non-hybrid or non-electric base models or appropriate reference benchmarks from the segment. Further, for passenger cars, fuel-consumption levels of the registered models are also evaluated in perspective of India's recently implemented fuel-consumption standards for passenger cars that are to be enforced from FY 2017-18[11], as well the proposed passenger car fuel-efficiency labeling program. Life-cycle greenhouse gas (GHG) emissions are also estimated for a five-year use period for all passenger cars eligible for subsidy under the FAME scheme and their base models. The following life-cycle stages are included in the boundary of the analysis as applicable for the model under consideration[12]:
  - Electricity consumption from Indian grid[13]
  - Refinery emissions for gasoline or diesel from Indian refineries[14,15,16]
  - Distribution emissions for gasoline or diesel from Indian refineries[17]
  - Emissions due to fuel consumption from vehicle operation[18,19]
- **Incentive analysis:** One way to understand the effectiveness of the various incentives is in terms of a total cost of ownership (TCO) analysis of hybrid and electric technologies when compared with conventional base models both with and without incentives. For the purpose of this analysis, TCO calculations are conducted over a five-year period for one example across each vehicle segment and technology that received demand incentives under the FAME scheme in FY 2015-16. The TCO calculations are based on the retail price of vehicles in the NCT of Delhi considering the various subsidies and taxes in place, finance costs for vehicle procurement, fuel and energy costs, maintenance costs, insurance costs, and loss in value from depreciation. While the Regional Transport Office (RTO) charges have been included in the TCO analysis, we have not separated the road tax component in this analysis.

7 The Central Excise Tariff 2016-17, Section XVII, Chapter 86-87, Central Board of Excise and Customs, Government of India. http://www.cbec.gov.in/resources//htdocs-cbec/excise/cxt-2016-17-new/chap86-87.pdf

8 General Exemption No. 48 to The Central Excise Tariff 2016-17, Central Board of Excise and Customs, Government of India. http://www.cbec.gov.in/resources//htdocs-cbec/excise/cxt-2016-17/cx-gen-exemptn-48-52.pdf

9 D.O.F. No. 334/8/2016-TRU of The Department of Revenue, Ministry of Finance, Government of India, February 29, 2016, http://www.cbec.gov.in/resources//htdocs-cbec/ub1617/do-ltr-jstru1-revised.pdf

10 Budget 2016-17 of The Government of NCT of Delhi, http://delhi.gov.in/wps/wcm/connect/DoIT_Planning/planning/budget+of+delhi/budget+2016-17

11 Notification S.O. 1072(E). of The Gazette of India, Ministry of Power, April 23, 2015, https://beeindia.gov.in/sites/default/files/ctools/Notification%2023.4.2015.pdf

12 Upstream emissions are not included in this analysis.

13 Central Electricity Authority, Ministry of Power, Government of India, "CO2 Baseline Database for the Indian Power Sector," User Guide Version 11 (2016). http://cea.nic.in/reports/others/thermal/tpece/cdm_sco2/user_guide_ver11.pdf

14 Indian Oil Corporation Limited, "Sustainability Report 2014-15," https://www.iocl.com/download/Sustainability_Report_2014-15.pdf

15 Bharat Petroleum Corporation Limited, "Sustainable Development Report 2015-16," https://bharatpetroleum.com/images/files/BPCL_SDR%202015_2016.pdf

16 Hindustan Petroleum Corporation Limited, "Sustainability Report 2014-15," http://www.hindustanpetroleum.com/documents/pdf/HPCL_SustainabilityReport_2014-15.pdf

17 Emission factors estimated based on petroleum product distribution emissions from pipeline, road, and rail modes as reported by Hindustan Petroleum Corporation Limited in Expert Workshop organized by Petroleum Federation of India in October 2015.

18 Notification S.O. 1072(E). of The Gazette of India, Ministry of Power, April 23, 2015, https://beeindia.gov.in/sites/default/files/ctools/Notification%2023.4.2015.pdf

19 "Expert Workshop on Carbon Emission Management jointly with World Petroleum Council," Petroleum Federation of India, accessed October 3, 2016, http://www.petrofed.org/index.php/expert-workshop-on-carbon-emission-management-jointly-with-world-petroleum-council

Utilization of Demand Incentives under FAME Scheme for FY 2015-16

While the FAME scheme provides incentives for all market segments, presently only passenger car and two-wheeler models appear to be taking advantage of the scheme. A summary of the registered models under the FAME scheme is outlined in Table 3.

Based on the sales data for the above models for FY 2015-16, the outflow from demand incentives under the FAME scheme for FY 2015-16 is presented in Table 4 and Figure 1, and stands under-utilized at 47% of the allocated amount.

Table 4. Utilization of Demand Incentives Under FAME Scheme

Total outlay available for FY 2015-16 in INR Million (USD Million):	1,550 (23.25)
Total outflow basis FY 2015-16 sales in INR Million (USD Million):	733.3 (11)
Total outflow to date in INR Million (USD Million)[21]:	821.6 (12.32)

Passenger cars constituted 81.3% of the total demand incentive utilization in FY 2015-16; two-wheelers were the remaining 18.7%. Within the outflow to passenger cars, 73% of the funds were utilized by mild hybrid cars, 11% by strong hybrid cars, and 16% by battery-operated electric cars. All the two-wheelers registered under the scheme are battery-operated electric models. There are no eligible models registered under the scheme across other vehicle segments. Going forward, hybrid buses hold potential to gain significantly under FAME, as the allocations available cover a significant portion of the technology costs.[22,23]

20 As per The Department of Heavy Industries, Government of India, data shared via press-conference (2016).

21 "Total Incentive Amount Utilized Under FAME-India," National Automotive Board, Government of India, accessed August 17, 2016, http://fame-india.gov.in/#

Table 3. Number of Models Currently Eligible under FAME Scheme and Unit Sales for FY 2015-16[20]

Vehicle Category	Mild Hybrid Eligible Models (Units sold)	Strong Hybrid Eligible Models (Units sold)	Plug-In Hybrid Eligible Models (Units sold)	Battery-Operated Electric Eligible Models (Units sold)
Two-Wheelers	—	—	—	24 (17,836)
Three-Wheelers	—	—	—	—
Passenger Cars	2 (33,394)	1 (911)	—	2 (790)
Light-Commercial Vehicles	—	—	—	—
Buses	—	—	—	—
Retrofitment kits	—			

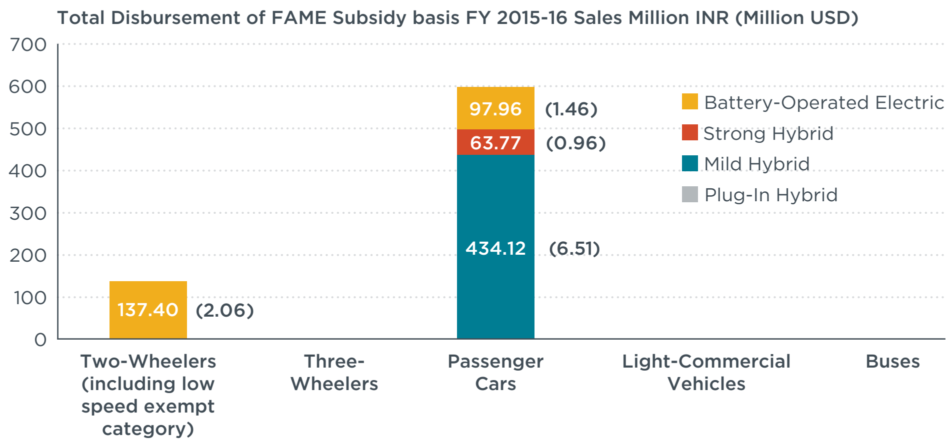

Figure 1. Utilization of Demand Incentives Under FAME Scheme by Vehicle Segment – FY 2015-16

22 Sameer Contractor, "Volvo Delivers India's First Hybrid Bus to Navi Mumbai," *NDTV*, February 15, 2016, http://auto.ndtv.com/news/volvo-delivers-indias-first-hybrid-bus-to-navi-mumbai-1277618

23 Tata Motors, "Tata Motors Bags for 25 Hybrid Buses from MMRDA," Press Release, March 16, 2016, http://www.tatamotors.com/press/tata-motors-bags-order-for-25-hybrid-buses-from-mmrda/

Fuel Efficiency and Life-Cycle Emissions Evaluation of Vehicles Registered under FAME Scheme

PASSENGER CARS

In the passenger car segment, there are two diesel-based mild hybrid models from Maruti Suzuki, one gasoline-based strong hybrid model from Toyota, and two battery electric vehicle models from Mahindra & Mahindra that are currently eligible to receive demand incentives under

Table 5. Passenger Cars Currently Eligible for Demand Incentives Under FAME Scheme

Vehicle	Technology	Segment[25]	Curb Weight (kg)	Length (mm)	Displacement (cc)	Price Range (INR Lakhs)[26]	Gasoline Equivalent Fuel Consumption[27] (liter/100 km)	Life-Cycle CO_2e Emissions (Tonnes/5 years)
Maruti Ciaz SHVS	Mild Hybrid (Diesel)	Midsize	1,115	4,490	1,248	8 to 10.5	3.98	6.73
Maruti Ertiga SHVS	Mild Hybrid (Diesel)	Utility Vehicle (UV1)	1,235	4,265	1,248	7.5 to 9.5	4.55	7.71
Toyota Camry Hybrid	Strong Hybrid (Gasoline)	Premium	1,635	4,850	2,494	28 to 32	5.22	8.12
Mahindra e2o	Battery-Operated Electric	Mini	830	3,280	NA	4.5 to 7.5	0.86	5.06
Mahindra eVerito	Battery-Operated Electric	Midsize	1,140	4,277	NA	9.5 - 10	1.47	9.94

the FAME scheme[24]. A summary of the specifications and fuel consumption of these models is presented in Table 5. There are a few imported units such as the Toyota Prius (gasoline-based strong hybrid) and the BMW i8 (gasoline-based plug-in hybrid) also available on the Indian market, however demand incentives under the FAME scheme are available only to vehicles manufactured (assembled) in India.

The Maruti Ciaz SHVS and Ertiga SHVS are based on lead-acid batteries, while the Toyota Camry Hybrid, Mahindra e2o, and Mahindra eVerito are based on advanced lithium ion battery technologies.

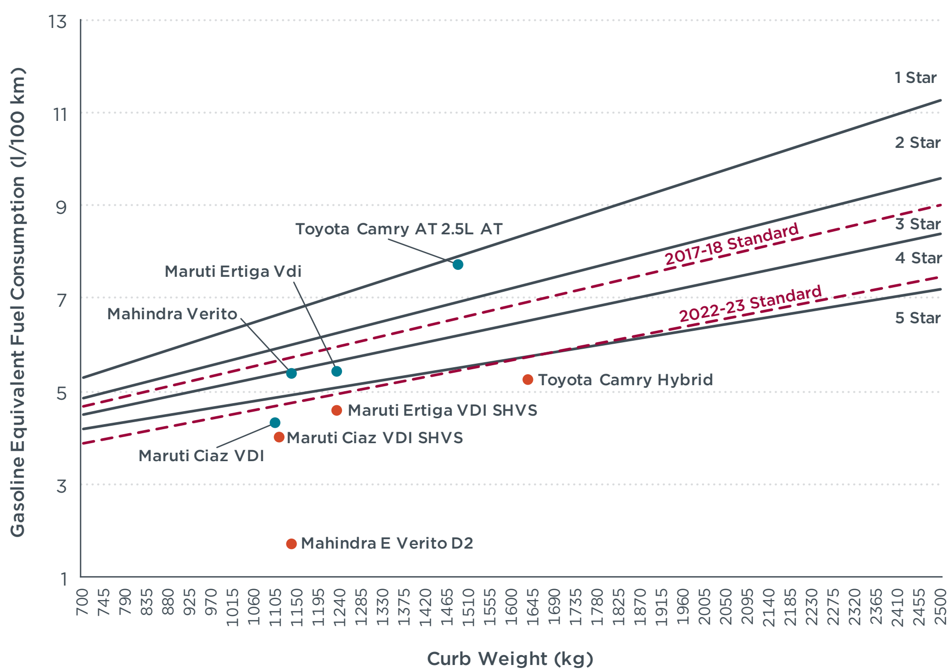

Figure 2. Fuel Consumption of Hybrid and Electric Models and Their Base Models

Fuel Efficiency Evaluation

In 2015, the Government of India announced corporate average weight-based fuel-consumption standards for passenger cars, with phase-wise targets declared for FY 2017-18 to FY 20121-22, and FY 2022-23 onward. As depicted in Figure 2, the fuel consumption for the eligible models under the FAME scheme all come well under the 2017-18 standard limit of about 5.5 gasoline equivalent liters/100 km (or 130 g/km when expressed in terms of CO_2 emissions). All of the above models also fall under the 5-star fuel efficiency label as per the star labeling methodology proposed by the government's Bureau of Energy Efficiency (BEE).[28] Efficiency gains of the registered hybrid and electric models under the

24 "Models Available Under the FAME Scheme," National Automotive Board, Government of India, accessed August 17, 2016, http://fame-india.gov.in/ModelUnderFame.aspx

25 As per classification mechanism adopted by Society of Indian Automobile Manufacturers

26 Retail price in Delhi (1 INR lakh ~ USD 1,500)

27 As per fuel economy values under test conditions certified by Automotive Research Authority of India

28 A star label rating of 5 corresponds to being among the most energy-efficient option on the market for the vehicle weight and a rating of 1 corresponds to the least energy efficient.

FAME scheme compared with their base models are presented in Table 6.

Sales of hybrid and electric passenger cars in India in FY 2015-16 resulted in fuel-consumption reductions of approximately 2.97 million gasoline equivalent liters. This is based on the assumption that a unit sale of a hybrid or electric model displaced a unit sale of a corresponding base model from the market.[29]

Life-Cycle Emissions Analysis

As can be seen in Figure 3, emissions for electric models are due to electricity consumption from the Indian grid (including transmission and distribution efficiencies), while for the gasoline- and diesel-based models, the majority of the emissions are on account of fuel consumption during vehicle operation.

As outlined in Figure 4, the current Indian grid is powered by predominantly thermal sources with coal-fired power plants forming the majority of the total installed capacity.

The current electricity mix in India is coal heavy, however India has announced its intent to reduce the carbon intensity of its grid by scaling up renewable power generation

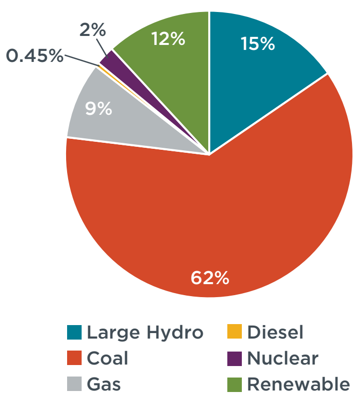

Figure 4. Composition of Indian Grid by Source as of FY 2014-15[30]

Table 6. Fuel Consumption Savings of Models Under FAME Scheme Compared with Base Models.

Technology	Hybrid/Electric Model (BEE Fuel Efficiency Star Rating)	Non-Hybrid/Non-Electric Base Model (BEE Fuel Efficiency Star Rating)	Gasoline Equivalent Fuel Consumption Reduction over Base Model
Diesel-Based Mild Hybrid	Maruti Ciaz VDI SHVS (5-Star)	Maruti Ciaz VDI (5-Star)	7%
Diesel-Based Mild Hybrid	Maruti Ertiga VDI SHVS (5-Star)	Maruti Ertiga VDI (4-Star)	15%
Gasoline-Based Strong Hybrid	Toyota Camry Hybrid (5-Star)	Toyota Camry AT 2.5 L (2-Star)	32%
Battery-Operated Electric	Mahindra E-Verito D2 (5-Star)	Mahindra Verito D2 (4-Star)	68%
Battery-Operated Electric	Mahindra e2o (5-Star)	—	—

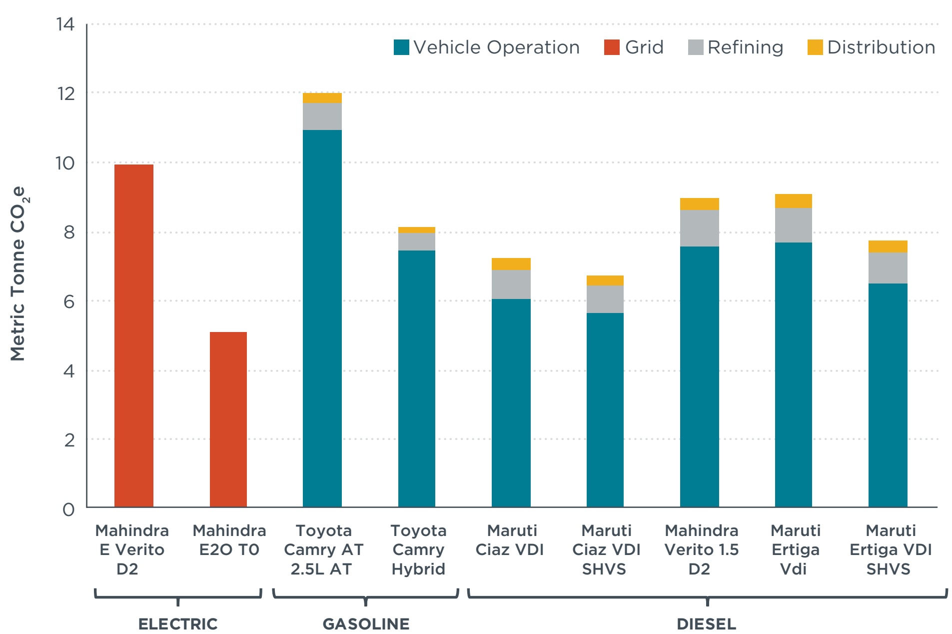

Figure 3. Total Life Cycle Emissions Over 5-year Use Period of Electric and Hybrid Cars and Their Base Models

29 As the Mahindra e2o is not based on a conventional technology base model, the Maruti 800 Alto, the top-selling model from e2o's corresponding market segment (the e2o is classified as a "Mini" according to segment definitions adopted by the Society of Indian Automobile manufacturers) is considered as a reference benchmark for estimating fuel consumption savings.

30 Central Electricity Authority, Ministry of Power, Government of India, "CO2 Baseline Database for the Indian Power Sector," User Guide Version 11 (2016). http://cea.nic.in/reports/others/thermal/tpece/cdm_sco2/user_guide_ver11.pdf

capacity from 36 GW in 2015 to 175 GW by 2022,[31] as per India's Intended Nationally Determined Contribution (INDC) under the United Nations Framework Convention on Climate Change This is expected to result in an abatement of an estimated 326 million tonnes of CO_2e per year. Further, it is reported that the efficiencies of power generation[32] as well as transmission and distribution[33] in India are significantly lower than global averages, and improvement of efficiencies in the power sector have also been recognized as a priority in the INDC[34]. Thus, the life-cycle emissions intensity of electric vehicles in India are poised for substantial reductions in the near term in alignment with India's post 2020 climate action plans. Thus, it is important to build up markets for electric mobility in a parallel timeframe as the renewable energy footprint and energy efficiency of India's power sector undergo transformational improvements.

TWO-WHEELERS

There are 24 two-wheeler models, all battery-operated electric, registered to receive demand incentives under the FAME scheme. Nineteen of the 24 models are low-speed scooters with maximum power output of less than 250 watts and maximum speed of 25 kilometers per hour. All but one of the models are based on conventional lead-acid battery technology, while one low-speed electric model (Hero Optima Dx Li) based on advanced lithium ion battery technology. However, the Hero Optima Dx Li has yet to be launched in the market[35]. Lithium-based batteries have a higher energy density than lead-acid batteries (thus being lighter for a given capacity and increasing efficiency), have a longer life cycle (> 2,000 charges) than lead-acid batteries (300 to 400 charges), and are capable of fast charging (up to 80%

Table 7. Electric Two-Wheelers on the Indian Market

Vehicle	Maximum Speed (kmph)	Curb Weight (kg)	Price (INR Thousand)	Gasoline Equivalent Fuel Consumption (l/100 km)	Life-Cycle CO_2e Emissions (tonnes/ 5 years)
Ajanta J-500 Plus	25	Not Available	35.00	0.32	1.90
Ampere V48	25	85	37.27	Not Available	No data
Ampere V60	25	100	47.92	Not Available	No data
Avon Escoot 207	24	Not Available	33.50	Not Available	No data
Avon E Mate	24	Not Available	45.00	Not Available	No data
Breeze Lite	25	Not Available	Not Available	Not Available	No data
Yo Electron ER	25	84	30.00	0.23	1.36
Yo Explor	25	86	34.76	0.27	1.58
Yo Spark	45	114	47.13	0.45	2.66
Yo Exl ER	55	138	51.81	0.70	4.11
Hero Maxi	25	75	35.49	0.18	1.08
Hero Zion	25	Not Available	Not Available	Not Available	No data
Hero Optima Plus	25	82	40.19	0.18	1.08
Hero E-Sprint	45	106	47.69	Not Available	No data
Hero Photon	45	111	48.49	Not Available	No data
Hero Cruz	25	75	42.89	0.18	1.08
Hero Wave	25	Not Available	Not Available	Not Available	No data
Hero Wave DX Extra Mile	25	Not Available	48.19	0.19	1.14
Hero Optima DX	25	Not Available	Not Available	Not Available	No data
Hero NYX	25	Not Available	39.19	0.18	1.08
Lohia OMA Star	25	89	35.50	0.32	1.90
Lohia OMA Star DX	25	Not Available	41.5	0.24	1.42
Lohia Genius	25	89	32.5	0.28	1.63

*All listed models are based on conventional lead-acid batteries.

31 Print Release on India's Nationally Determined Contribution, Press Information Bureau, Government of India (October 2, 2015). http://pib.nic.in/newsite/PrintRelease.aspx?relid=128403

32 Center for Science and Environment, "India's first-ever environmental rating of coal-based power plants finds the sector's performance to be way below global benchmarks," CSE Webnet, February 2015, http://cseindia.org/content/india%E2%80%99s-first-ever-environmental-rating-coal-based-power-plants-finds-sector%E2%80%99s-performance

33 United States Energy Information Administration, "India aims to reduce high electricity transmission and distribution system losses," *Today in Energy,* October 22 2015, http://www.eia.gov/todayinenergy/detail.php?id=23452

34 Print Release on India's Nationally Determined Contribution, Press Information Bureau, Government of India (October 2, 2015). http://pib.nic.in/newsite/PrintRelease.aspx?relid=128403

35 "Optima DX Li," Hero Electric, accessed July 6, 2016, http://heroelectric.in/optima-dx-li-ion/

charge in 30 minutes) compared with lead-acid batteries (7-8 hours for a full charge). Further, lead-acid batteries are also associated with higher environmental risks on account of potential lead leakage that may occur in the recycling and disposal process. However, lithium-based batteries have a higher upfront purchase cost than lead-acid batteries. For example, it is reported that the Hero Optima Dx Li is likely to be priced upward of INR 60,000 (~ USD 900) in Delhi[36], while the average cost of lead-acid-based low-speed scooters in Delhi is about INR 30,000 (USD 450).

A summary of the available specifications and fuel consumption data of the registered models available on the market is presented in Table 7.

The above models are part of an all-electric two-wheeler series from the manufacturers, and do not have corresponding non-electric base models. In this case, the top-selling two-wheeler scooter in the Indian market, the Honda Activa 3G, is considered as a reference benchmark. As electrical energy consumption values were not available for all the registered two-wheelers under the FAME scheme, it was not possible to compute the gasoline equivalent fuel consumption values for all of the models. However, the FAME scheme caps the maximum energy consumption from low- and high-speed electric two-wheelers at 5 kWh/100 km and 8 kWh/100 km, respectively, as eligibility criteria to receive demand incentives under the scheme. These energy consumption limits are used as a perspective for comparison against the non-electric reference benchmark. A summary of the maximum fuel consumption for electric two-wheelers under the FAME scheme compared with the Honda Activa 3G is presented in Table 8.

Table 8. Fuel Consumption Limits for Two-Wheelers Under FAME Scheme Compared with Non-Electric Benchmark

	Maximum Speed (kmph)	Maximum Power Output (W)	Gasoline Equivalent Fuel Consumption (l/100 km)	Life-Cycle CO_2e Emissions (tons/5 years)
Low-Speed Electric Scooters	25	250	< 0.51	< 3.04
High-Speed Electric Scooters	45 - 55	1,500 – 1,800	< 0.82	< 4.86
Honda Activa 3G	82	5,966	1.5	2.33

Electric scooter manufacturers in India do not disclose energy consumption data. It is reported in the literature[37] that the average energy consumption of electric scooters in India is about 3.3 kWh/100 km, or 0.34 gasoline equivalent l/100 km.

It is interesting to note the differences between electric scooters on the Indian market and electric scooters in China, which is the global leader in electric two-wheeler manufacturing and use[38]. While lead-acid batteries are still the most prevalent battery type in both markets, Chinese regulations promote low-weight, low-power, low-speed design, with a view toward passenger safety and reduced environmental impacts. As summarized in Table 9, the Indian models are more comparable in design to compete with the performance of bulkier gasoline-powered conventional scooters prevalent in the market. The widespread penetration of electric two-wheelers in China is attributed majorly to government restrictions on gasoline-powered scooters in certain cities as well as access to a well-developed bicycling infrastructure that provides safe driving lanes[39].

Table 9. Comparison of Electric Scooter Design in India and China

Parameter	India	China
Weight	>85 kg	< 60 kg
Speed	25 kmph to 55 kmph	< 40 kmph
Power	250 W to 1,500 W	< 500 W
Battery Type	Lead Acid	Lead Acid
Annual Sales	~ 17,000 units (2015-16)	~ 35 million units (2012)

36 Ajinkya Paralinkar, "Pricing of Hero Optima DX in Various States," *DriveSpark,* July 9, 2016, http://www.drivespark.com/two-wheelers/2016/hero-optima-dx-lithium-ion-e-bike-price-015672.html

37 Saxena et al. "Electrical consumption of two-, three- and four-wheel light-duty electric vehicles in India," Applied Energy, 2014, 115: 582-590 doi:10.1016/j.apenergy.2013.10.043

38 International Energy Agency, "Global EV Outlook," Publications (2016). https://www.iea.org/publications/freepublications/publication/Global_EV_Outlook_2016.pdf

39 The Asian Development Bank, "Electric Two-Wheelers in India and Vietnam, Market Analysis and Environmental Impacts," (2009). https://www.adb.org/sites/default/files/publication/27519/electric-bikes-ind-vie.pdf

Incentive Analysis

To understand the relative contribution of FAME in bringing down the costs of hybrid and electric technologies in the Indian market, it is important to also consider other incentive mechanisms that significantly impact cost of ownership at a consumer level.

CENTRAL EXCISE DUTY

Central Excise Duty in India is an indirect tax levied on all goods manufactured in India. The duty is paid by manufacturers, who pass that cost on to consumers. As outlined in Table 10, hybrid and electric vehicles are subjected to reduced central excise duty rates compared with the tariffs for conventional technologies.

CENTRAL INFRASTRUCTURE CESS

An infrastructure cess was put in place for passenger vehicles in India in 2016, as an additional excise duty to be paid by manufacturers. As outlined in Table 11, hybrid and electric vehicles are exempt from this cess. It is expected that manufacturers of non-exempt vehicles will pass on the incidence of this tax to consumers.

Table 10. Central Excise Duty Tariffs on Motor Vehicles

Vehicle Category	Central Excise Duty
Length < 4m, gasoline/LPG/CNG, and engine capacity < 1200 cc	12.5%
Length < 4m, diesel, and engine capacity < 1500 cc	12.5%
Length < 4m, gasoline/LPG/CNG, and engine capacity > 1200 cc but < 1500 cc	24%
Length > 4m and engine capacity < 1500cc	24%
Length > 4m and engine capacity > 1500cc	27%
Length > 4m, engine capacity > 1500cc, and ground clearance >170mm (SUVs and MUVs)	30%
Buses	12.5%
Trucks	12.5%
Three wheelers	12.5%
Two wheelers	12.5%
Hybrid cars	12.5%
Electric Cars, Buses, Two Wheelers, Three Wheelers	6%

Table 11. Central Infrastructure Cess on Motor Vehicles

Vehicle Category	Infrastructure Cess
Ambulances	0%
Taxis	0%
Battery electric vehicles	0%
Hybrid motor vehicles	0%
Three-wheeled vehicles	0%
Cars for physically handicapped persons	0%
Hydrogen vehicles based on fuel cell technology	0%
Petrol, LPG, CNG vehicles, length < 4000 mm, engine capacity < 1200 cc	1%
Diesel vehicles, length < 4000 mm, engine capacity < 1500 cc	2.5%
All categories other than above	4%

STATE VALUE ADDED TAX (VAT)

VAT is a type of a state sales tax that is collected by sellers from buyers at every point of value-addition in the manufacturing and distribution supply chain, and ultimately borne by the end consumer. The tariff for VAT differs across states. As outlined in Table 12, many states in India have now declared a reduced VAT rate for electric vehicles, while the NCT of Delhi extends its reduced VAT tariffs to both electric and hybrid vehicles.

Table 12. VAT Rates for Electric Vehicles in India

State	VAT on Electric Vehicles	VAT on Conventional Vehicles
Delhi[40]	5.0%	12.5%
Haryana[41]	5.0%	12.5%
Chandigarh[42]	0.0%	12.5%
Punjab[43]	14.3%	14.3%
Rajasthan[44]	0.0%	14.5%
Uttrakhand[45]	0.0%	12.5%
Uttar Pradesh[46]	12.5%	12.5%
Bihar[47, 48]	15%	15%
Jharkhand[49]	12.5%	12.5%
Odisha[50]	5.0%	12.5%
West Bengal[51]	5.0%	14.5%
Gujarat[52]	5.0%	12.5%
Maharashtra[53]	5.5%	12.5%
Goa[54]	12.5%	12.5%
Madhya Pradesh[55]	5.0%	12.5%
Chhattisgarh[56]	0.0%	14%
Tamil Nadu[57]	5.0%	14.5%
Kerala[58]	5.0%	14.5%
Karnataka[59]	5.5%	14%
Andhra Pradesh[60]	5.0%	14.5%

40 "Budget 2016-17," Government of NCT of Delhi, accessed September 16, http://delhi.gov.in/wps/wcm/connect/DoIT_Planning/planning/budget+of+delhi/budget+2016-17

41 "VAT Schedules," Excise and Taxation Department, Government of Haryana, accessed September 16, 2016, https://haryanatax.gov.in/HEX/appmanager/HexPortal/HaryanaExcise?_nfpb=true&_pageLabel=HaryanaExcise_portal_book_11#wlp_HaryanaExcise_portal_book_11

42 "VAT Schedules," Excise and Taxation Department, Chandigarh Administration, accessed September 16, 2016, http://etdut.gov.in/ExciseOnline/download.html

43 "Punjab VAT Schedules," Excise and Taxation Department, Government of Punjab, accessed September 16, 2016, https://www.pextax.com/PEXWAR/appmanager/pexportal/PunjabExcise?_nfpb=true&_pageLabel=PunjabExcise_portal_page_100#wlp_PunjabExcise_portal_page_100

44 "VAT Schedules," Commercial Taxes Department, Government of Rajasthan, accessed September 16, 2016, http://rajtax.gov.in/vatweb/download/Help/VAT.pdf

45 "Tax Rates," Commercial Tax Department, Government of Uttarakhand, accessed September 16, 2016, http://comtax.uk.gov.in/pages/show/1674-tax-rates

46 "VAT Schedule," Uttar Pradesh Commercial Taxes Department, http://comtax.up.nic.in/Vat_Act/UPVAT%20SCHEDULE%20Updated%20upto%20dt%2012-03-2015.pdf

47 Press Trust of India, "Bihar Legislative Council passes VAT Amendment Bill 2016," *India Today,* August 4, 2016, http://indiatoday.intoday.in/story/bihar-legislative-council-passes-vat-amendment-bill-2016/1/731685.html

48 "VAT Schedule," Commercial Taxes Department, Government of Bihar, accessed September 16, 2016, https://www.biharcommercialtax.gov.in/bweb/topmenu/topmenuMain.jsp?viewPageNo=33

49 "VAT Schedule," Commercial Taxes Department, Government of Jharkhand, accessed September 16, 2016, http://www.jharkhandcomtax.gov.in/documents/10231/23891/SCHEDULE+%E2%80%93+II+PART-D/01c7dedd-31f0-4ef8-956b-b820fefb8e9b?version=1.1

50 "VAT Schedules," Commercial Tax Organization, Govern

50 "VAT Schedules," Commercial Tax Organization, Government of Odisha, accessed September 16, 2016, https://odishatax.gov.in/

51 "Schedules under the West Bengal Value Added Tax Act," West Bengal Commercial Tax Department, accessed September 16, 2016, http://www.wbcomtax.nic.in/Act_Rule_Schedule_Form/VAT_Schedules_20160113.pdf

52 "VAT Schedule," Gujarat Commercial Tax Department, accessed September 16, 2016, https://commercialtax.gujarat.gov.in/vatwebsite/schedules/schedulesMain.jsp?viewPageNo=1

53 "VAT Schedule," Department of Sales Tax, Government of Maharashtra, accessed September 16, 2016, http://mahavat.gov.in/Mahavat/MyFold/KNOWLEDGE%20CENTER/RATE%20SCHEDULE/KNOW_RATESCHEDULE/S%20C%20H%20E%20D%20U%20L%20E.pdf

54 "Tax Rate Schedules," Department of Commercial Taxes, Government of Goa, accessed September 19, 2016, http://goacomtax.gov.in/salestax_article_disp.php?cid=35

55 "VAT Schedule," Department of Commercial Tax, Government of Madhya Pradesh, accessed September 19, 2016, https://mptax.mp.gov.in/mpvatweb/requestRedirect.do?dispatch=displayVATScheduleDetails

56 "VAT Rate," Commercial Tax Department, Government of Chattisgarh, accessed September 19, 2016, http://comtax.cg.nic.in/pages/tax_rates.htm

57 "VAT Schedules," Commercial Taxes Department, Government of Tamil Nadu, accessed September 19, 2016, http://www.tnvat.gov.in/English/VAT%20SCHEDULE_201516.pdf

58 "Tax Rate," Commercial Taxes Department, Government of Kerala, accessed September 19, 2016, http://keralataxes.gov.in/taxrate.aspx

59 "Tax Rates," Commercial Taxes Department, Government of Karnataka, accessed September 19, 2016, http://ctax.kar.nic.in/tax_rates/kvat/VAT_RATE%20OF%20TAX.pdf

60 "Tax Rates," Commercial Taxes Department, Government of Andhra Pradesh, accessed September 19, 2016, https://www.apct.gov.in/apportal/index.aspx

ADDITIONAL STATE SUBSIDIES

The Government of NCT of Delhi created an "Air Ambience Fund" in 2008, which is funded by a cess collected on the sale of diesel fuel. The cess continues to be in effect and part of the proceeds are being utilized to provide cash subsidies to consumers on purchasing battery electric vehicles two-, three-, and four-wheeled vehicles. The Delhi Pollution Control Committee (DPCC) manages the fund. Unlike the demand incentive subsidy under the FAME scheme (available as a direct discount on the retail price from the dealer), the DPCC subsidy is deposited into the bank account of the consumer subsequent to an application made to the DPCC demonstrating proof of purchase. Based on feedback from the market, the subsidy is available to the consumer three to four months after vehicle purchase. A summary of the available subsidies by the DPCC is presented in Table 13.

Table 13. Subsidy for Battery Electric Vehicles from the Delhi Pollution Control Committee

Type of Vehicle	Vehicle Base Price	Subsidy Amount
Four-Wheeled	< INR 5 lakhs (< USD 7,500)	INR 30,000 (USD 450)
Four-Wheeled	> INR 5 lakhs (> USD 7,500)	INR 150,000 (USD 2,250)
Two-Wheeled	< INR 20,000 (> USD 300)	INR 1,000 (USD 15)
Two-Wheeled	> INR 20,000 < INR 25,000 (> USD 300 < INR 375)	INR 2,000 (USD 30)
Two-Wheeled	> INR 25,000 (> USD 375)	INR 5,500 (USD 82.5)
Three-Wheeled (E-Rickshaw)	—	INR 15,000 (USD 225)

While some portions of the Air Ambience Fund have been used toward other environmental projects such as development of hazardous waste treatment and disposal facilities in the early years of its inception, it is reported that the majority of the fund utilizations to date have gone toward subsidizing battery electric vehicles. However, as per the disbursement accounts released by the Government of NCT of Delhi[61], utilization rates for such subsidies have been low, at an average of 20% of total collections, indicating low demand and supply for battery electric vehicles. Further, while fund collections increased at an average year-on-year rate of about 37% as of 2013-14, collections increased by 120% in 2014-15 alone compared with cumulative collections in 2013-14. This indicates an increase in diesel consumption corresponding with the fall in crude oil prices starting in 2014-15. A summary of the cumulative collections and utilizations made under the Air Ambience Fund is presented in Table 14.

Table 14. Collections and Utilization of Air Ambience Fund for Incentivizing Electric Vehicles[62]

Year (Up to)	Cumulative Fund Collections Million INR (Million USD)	Cumulative Utilization toward Battery Electric Vehicle Subsidy Million INR (Million USD)	% Utilization on Cumulative Basis
FY 2008-09	383.2 (5.75)	—	—
FY 2009-10	688.8 (10.33)	41.2 (0.62)	5.98%
FY 2010-11	893.5 (13.40)	181.2 (2.72)	20.28%
FY 2011-12	1160.4 (17.41)	307.0 (4.61)	26.46%
FY 2012-13	1442.0 (21.63)	395.8 (5.94)	27.45%
FY 2013-14	1754.5(26.32)	428.6 (6.43)	24.43%
FY 2014-15	3856.5 (57.85)	495.7 (7.44)	12.86%

As can be seen from the above table, fund collections are high and utilizations are low. There is significant opportunity for the Government of NCT of Delhi to further increase the subsidy allocation toward battery electric vehicles on the market, including the possibility of allocating funds for creation of charging infrastructure across the NCT.

TCO – PASSENGER CARS

The total cost of ownership is estimated for one representative passenger car technology that received a subsidy under the FAME scheme, both with and without applicable central- and state-level incentives described earlier. The TCO is then compared with its base non-hybrid or non-electric model.

Technology	Example Considered	Base Model
Mild Hybrid	Maruti Ciaz SHVS VDI	Maruti Ciaz VDI
Strong Hybrid	Toyota Camry Hybrid	Toyota Camry 2.5L AT
Battery-Operated Electric	Mahindra E-Verito D2	Mahindra Verito D2

The TCO is computed considering vehicle ownership in the NCT of Delhi over a five-year period with the following costs accounted for:

61 Government of NCT of Delhi, "Economic Survey of Delhi for FY 2014-15," (2015), http://delhi.gov.in/wps/wcm/connect/DoIT_Planning/planning/economic+survey+of+dehli/economic+survey+of+delhi+2014+-+2015

62 Government of NCT of Delhi, "Economic Survey of Delhi for FY 2014-15," (2015), http://delhi.gov.in/wps/wcm/connect/DoIT_Planning/planning/economic+survey+of+dehli/economic+survey+of+delhi+2014+-+2015

- Purchase costs[63]
- Fuel costs
- Insurance costs
- Maintenance costs
- Depreciation

The following figures depict the TCO comparisons for examples from each technology segment to their base models: mild hybrid (Figure 5, Figure 6); strong hybrid (Figure 7, Figure 8); and battery electric vehicles (Figure 9, Figure 10).

Mild Hybrids

The Maruti Ciaz SHVS was used for the TCO mild hybrid diesel sedan analysis, which found:

- The TCO for the mild hybrid is approximately 5% lower than its base model with incentives, and 14% higher without any incentives.
- The most significant incentive contributions are reductions in central excise duty and VAT tariffs in the NCT of Delhi for mild hybrids compared with conventional technologies.
- The demand incentive subsidy available from FAME made up just 7% of the total incentives available.
- Maruti has discontinued the base models altogether upon launch of the mild hybrid models and all diesel versions of the Ciaz are now available only in the SHVS variant.

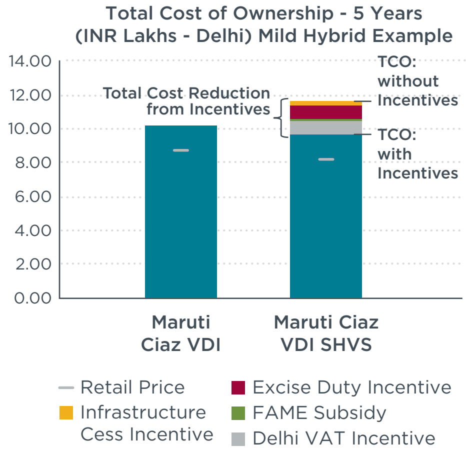

Figure 5. Total Cost of Ownership With and Without Incentives – Mild Hybrid Compared with Base Model

* One INR Lakh = USD 1,500; Retail price is inclusive of all subsidies.

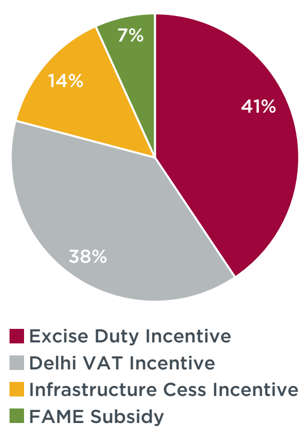

Figure 6. Relative Contribution of Total Incentives – Mild Hybrid Example

Strong Hybrids

The Toyota Camry Hybrid was used for the strong hybrid gasoline sedan TCO analysis, which found:

- The TCO for the strong hybrid is approximately 1% lower than its base model with incentives, and 23% higher without any incentives.
- The most significant incentive contributions come from the reductions in central excise duty and VAT tariffs in the NCT of Delhi for strong hybrids compared with conventional technologies.
- The demand incentive subsidy available from FAME makes up just 8% of the total incentives available.
- With tax incentives in place, the strong hybrid is cost-competitive with its base model. This is reflected in recent sales: In FY 2015-16, sales for the Toyota Camry Hybrid were more than seven times higher than its base model, albeit both at a very low level[64].

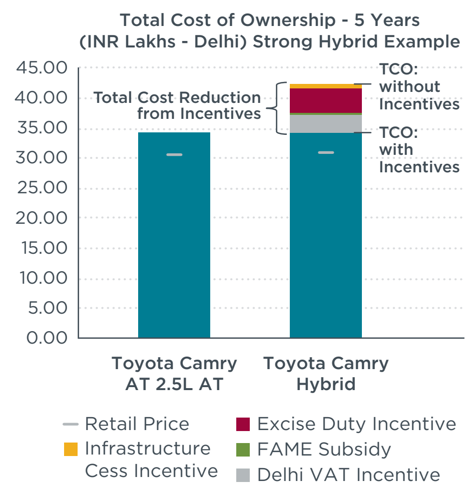

Figure 7. Total Cost of Ownership with and without Incentives – Strong Hybrid Example

* One INR Lakh = USD 1,500; Retail price is inclusive of all subsidies.

63 As per standard market practice, it is assumed that 85% of the retail price of the vehicle is financed through a five-year loan at an annual interest rate of 10.5%.

64 Sales data obtained for FY 2015-16 from Segment Y Automotive Intelligence Pvt. Ltd.

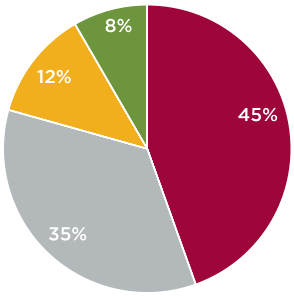

Figure 8. Relative Contribution of Total Incentives – Strong Hybrid Example

Battery-Operated Electric

The recently launched battery-operated electric sedan, the Mahindra E-Verito, was used for the TCO analysis, which found:

- The TCO for the battery-operated electric is approximately 1% higher than its base model with incentives (including the additional subsidy from DPCC), and 51% higher without any incentives.
- Unlike hybrid cars where the subsidy from FAME was a relatively small percentage of the total available incentives, all incentives contribute significantly. The subsidy from FAME in this case makes up 26% of the total incentive amount.
- In addition to the incentive mechanisms for hybrid cars, the additional subsidy for battery-operated electric cars in the NCT of Delhi from DPCC plays an important role in bringing the costs to a range more comparable with the base model. In the absence of this subsidy, the TCO is 9% higher than the base model.
- The total sales for battery-operated electric cars in India in FY 2015-16 was very small, with less than 1,000 units sold[65].

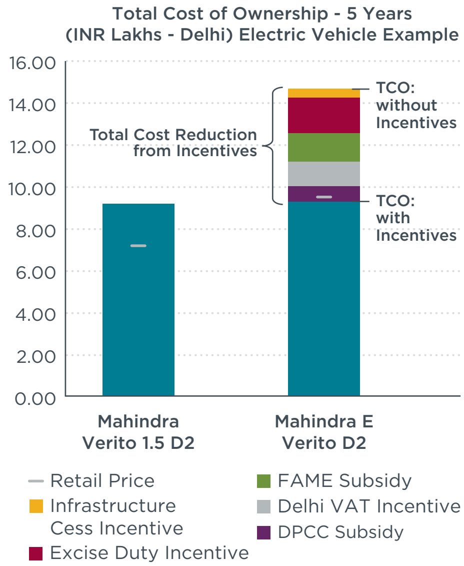

Figure 9. TCO With and Without Incentives – Battery-Operated Electric Compared with Base Model

* One INR Lakh = USD 1,500; Retail price is inclusive of all subsidies except DPCC subsidy, which is claimed as a rebate from the government post-purchase.

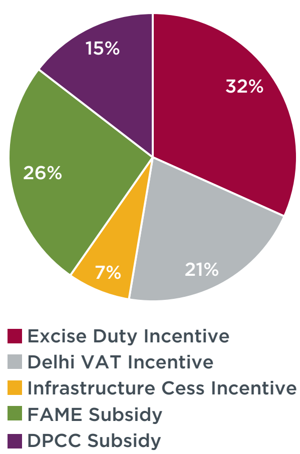

Figure 10. Relative Contribution of Incentives – Battery-Operated Electric Example

65 Sales data obtained for FY 2015-16 from Segment Y Automotive Intelligence Pvt. Ltd. Mahindra e-Verito was launched in the middle of FY2015-16.

TCO – TWO-WHEELERS

The TCO is estimated for one example each of high-speed and low-speed battery-operated electric two-wheeler types that received a subsidy under the FAME scheme, both with and without applicable central- and state-level incentives described earlier. Because all the electric two-wheelers on the market currently are part of a completely electric lineup of models from their respective manufacturers, there is no base model in this case for comparison. In lieu, the TCO is compared to the top-selling conventional scooter on the Indian market, the Honda Activa 3G.

The TCO is computed considering vehicle ownership in the NCT of Delhi over a five-year period with the following costs accounted for:

- Purchase costs[66]
- Fuel costs
- Insurance costs
- Maintenance costs
- Depreciation

The following figures depict the TCO comparisons for examples from each technology segment to the Honda Activa 3G: low-speed electric scooters (Figure 11, Figure 12) and high-speed electric scooters (Figure 13, Figure 14).

LOW-SPEED ELECTRIC SCOOTERS

Based on the TCO analysis for the low-speed electric scooter, the YO Explor, compared with the gasoline-fueled Honda Activa 3G:

- It may be inappropriate to compare the low-speed electric

66 Conventional scooters: As per standard market practice, it is assumed that 85% of the retail price of the conventional scooter is financed through a 3-year loan at an annual interest rate of 10.5%. Electric scooters: Finance for electric scooters is not very widely available from banks, hence, purchase cost is considered as an up-front payment.

scooters to conventional scooters due to differences in output characteristics and user base. For the comparison made here, the TCO for the low-speed electric scooter is approximately 44% lower than the conventional model with the considered incentives (including the additional subsidy from DPCC), and 28% lower without any incentives.

- The subsidy from FAME and DPCC in this case are the most significant contributors in reducing costs of this technology, making up 39% and 28% of the total incentive amount, respectively.

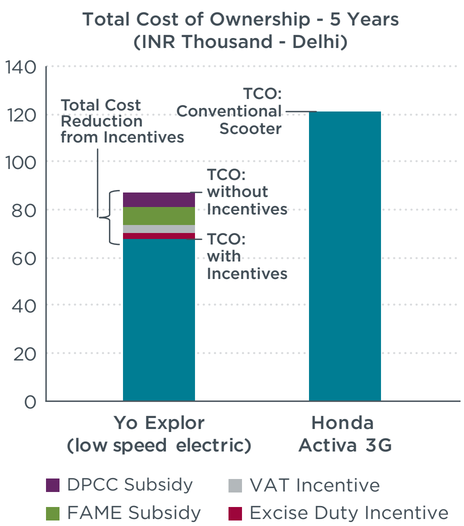

Figure 11. Total Cost of Ownership of Low-Speed Electric Scooters Compared with Conventional Scooters

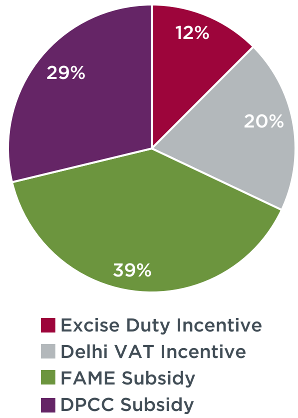

Figure 12. Relative Contribution of Incentives – Low-Speed Electric Scooter Example

HIGH-SPEED ELECTRIC SCOOTERS

While the maximum speed range of the high-speed electric scooters on the market is still approximately 30% lower than that of conventional scooters, they are a more comparable segment to conventional scooters in their applications. Based on the TCO analysis for the high-speed electric scooter, the YO Spark, compared with the gasoline-fueled Honda Activa 3G:

- The TCO for the high-speed electric scooter is approximately 7% higher than the conventional model with the considered incentives (including the additional subsidy from DPCC), and 26% higher without any incentives.
- The subsidy from FAME and DPCC in this case are the most significant contributors in reducing costs of this technology, making up 41% and 24% of the total incentive amount, respectively.

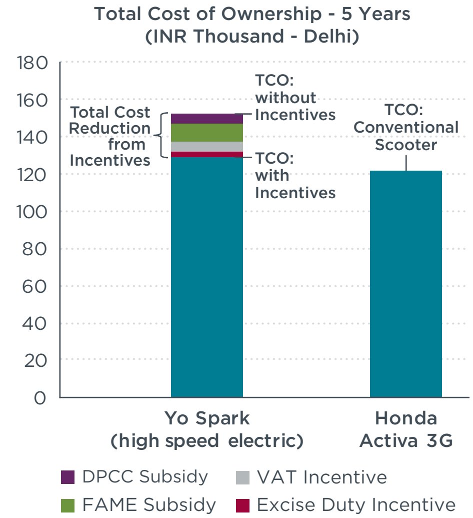

Figure 13. Total Cost of Ownership of High-Speed Electric Scooters Compared with Conventional Scooters

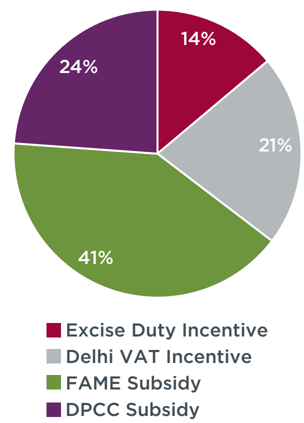

Figure 14. Relative Contribution of Incentives – High-Speed Electric Scooters

Summary of Observations

PASSENGER CARS

- Current models available are limited and include mild hybrid, strong hybrid, and battery-operated electric technologies. The majority of sales in FY 2015-16 were mild hybrids (95%). All mild hybrid models on the market are based on lead-acid batteries, and penetration of advanced battery technologies is low.

- In terms of utilization of FAME subsidy funds, mild and strong hybrid cars together constitute approximately 68% of the total demand incentives utilized in FY 2015-16, with mild hybrids taking up the majority share (59%).
- For both mild and strong hybrid cars, the relative incentive contribution from the FAME scheme is small (~7% and ~8%, respectively) when compared with other central and state tax incentives. Further, central and state tax incentives alone seem to be sufficient in keeping the TCO of these technologies competitive with their base models.
- For battery-operated electric cars, the relative incentive contribution from the FAME scheme becomes significant (~26%) in comparison with other central and state tax incentives. With all the incentives in effect, including the additional cash subsidy available from the Government of the NCT of Delhi, the TCO for the electric car example is comparable with its base model.
- The state-level incentives available from the Government of NCT for both hybrid cars (reduced VAT) and battery-operated electric cars (reduced VAT + subsidy) play an important role in reducing costs of these technologies. In states that do not have such incentives in place, the TCO for all technology types becomes significantly higher compared with base models.

TWO-WHEELERS

- Current models available include a range of low-speed (maximum speed 25 kmph) and high-speed (maximum speed 45 kmph to 55 kmph) battery-operated electric scooters.
- Unlike passenger cars, the subsidy from FAME constitutes the major incentive component (~40%) for eligible two-wheelers compared with other central and state incentives.
- It may not be appropriate to compare the low-speed scooters to conventional gasoline scooters as they form a very niche market segment. With all incentives in place and considering battery life of one year, the TCO for the high-speed electric scooters is approximately 7% higher than top-selling conventional gasoline scooters. If battery replacement is required more frequently, the TCO increases substantially.
- For both the low-speed and high-speed scooters, the key reason for high TCO is battery replacement cost. All but one of the 24 models currently eligible under FAME are based on conventional lead-acid batteries. Based on feedback from the market, battery replacement is required annually or even twice a year depending on usage. The average cost of batteries is INR 10,000 (USD 150) and INR 21,000 (USD 315) for the low-speed and high-speed scooters respectively.
- Two-wheelers constituted approximately 19% of the outflow from FAME in FY 2015-16.

Policy Implications

CENTRAL TAX INCENTIVES

- The prevailing central excise duty tariffs treat hybrid and electric technologies preferentially compared with conventional technologies. The cost reduction due to the reduced tariffs is significant and plays a key role in keeping costs of such technologies comparable with conventional models. It is important that the existing relative advantage available to hybrid and electric technologies be maintained going forward in other fiscal year budgets, particularly considering that the Indian Indirect Tax Code is expected to undergo complete restructuring with the introduction of a uniform Goods and Services Tax (GST)[67,68].

STATE LEVEL INCENTIVES

- The NCT of Delhi has a preferential VAT rate for both electric and hybrid vehicles. The benefit is significant and plays a key role in bringing down costs, along with tax incentives available from the Central Government. While many states have preferential VAT rates for electric vehicles, not many states extend such a benefit to hybrid vehicles. Punjab, Uttar Pradesh, Bihar, Jharkhand, and Goa do not have VAT incentives in place even for electric vehicles. Such states need to consider introduction of preferential taxes or exemptions altogether for electric and hybrid vehicles in order to increase penetration of these technologies. Further, with the likely introduction of a uniform GST rate that subsumes all central and state taxes going forward, it is important that the relative advantage available to hybrid and electric technologies due to state-level incentives be maintained.

67 http://www.autocarindia.com/auto-news/impact-of-gst-on-auto-industry-402707.aspx

68 http://www.financialexpress.com/auto/car-news/how-gst-will-affect-your-next-car-purchase-maybe-you-shouldnt-buy-one/338906/

- For battery electric vehicles, even the combined benefits from the current central and state tax incentives along with the subsidy from the FAME scheme are insufficient to bring costs down to a range comparable with conventional base models. In the NCT of Delhi, this gap is bridged by funds collected through a diesel-linked cess and offered as a subsidy to consumers. The subsidy amount is substantial and comparable to the allocation from the FAME scheme. However, although this cess has been in place since 2008, utilization levels have been low compared with total collections. Thus, there is significant scope for the NCT of Delhi to further increase allocations by way of an increased subsidy amount and creation of charging infrastructure. This type of state measure will go a long way in further incentivizing electric mobility and cost-competitiveness of electric vehicles.
- The National Capital Region (NCR) of India is the largest urban agglomeration in India and consists of the NCT of Delhi as well as urban areas from neighboring states of Uttar Pradesh, Haryana, and Rajasthan. As seen in the TCO analysis, state-level tax incentives play a major role in positively impacting cost-competitiveness of both hybrid and electric vehicles. Currently, the NCT of Delhi has a preferential VAT rate for electric and hybrid vehicles, while Haryana has a preferential VAT rate for electric vehicles only. Rajasthan completely exempts electric vehicles from VAT, while Uttar Pradesh has no VAT incentives in place. Thus, Uttar Pradesh in particular should consider implementing a preferential VAT rate for both electric and hybrid vehicles, while Rajasthan and Haryana should consider extending VAT benefits to hybrid vehicles as well. Further, Uttar Pradesh, Harayana, and Rajasthan can consider implementing cash subsidy schemes for electric vehicles similar to the diesel-cess-linked scheme offered by the NCT of Delhi. Further, while the NCT of Delhi, Rajasthan, and Uttar Pradesh exempt electric vehicles from state road tax, Haryana levies a road tax of 6%[69]. Thus, Haryana should also consider a similar road tax exemption for electric vehicles.

FAME SCHEME

- While the majority of the existing utilization from the FAME scheme has gone to mild hybrid passenger cars, the relative contribution from the scheme is currently playing a small role in keeping hybrid technologies cost-competitive with base models. Thus, there is potential to realign allocations to focus more on electric technologies compared with hybrid, particularly for passenger cars, including increased emphasis on supporting aspects such as creation of public and privately owned charging infrastructure.
- Further, it is important to understand that, from a consumer perspective, there is a difference between owning electric (and plug-in hybrid) and hybrid technologies. While hybrid ownership is similar in experience to owning a conventional internal combustion-engine-based technology, electric technologies call for a significant shift in driving habits. For example, consumers will have to schedule travel routes and distances based on vehicle range and availability of charging points. Thus, expecting a shift to electric technologies from consumers will likely require substantially greater investments in charging infrastructure, including subsidies for home-based and workplace charging stations.

69 "Duty and Tax Structure," Society of Manufacturers of Electric Vehicles, accessed November 16, 2016, http://www.smev.in/industry-info/duty-and-tax-structure/