

# Getting to India's Electric Vehicle Targets Cost-effectively

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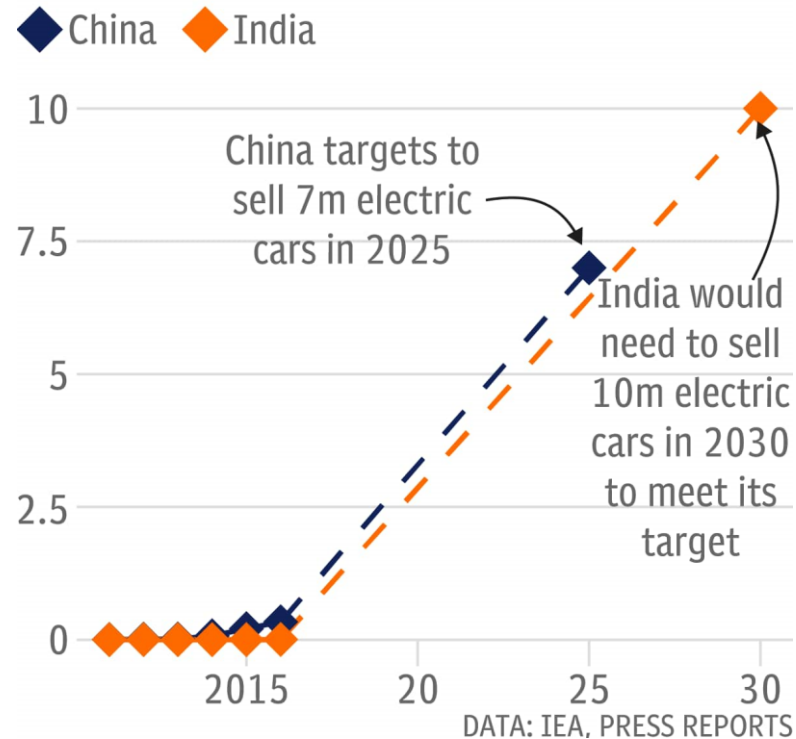
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# India has ambitious plans for EVs

## China and India's ambitious electric vehicle targets

*Number of electric car sales (millions)*



# Background

- India has ambitious climate targets for 2030
  - 40% of electricity generation capacity by RE
  - 30% of vehicle fleet by EVs
- There are many barriers to EV adoption
  - **Higher CAPEX**, despite lower OPEX: Battery costs coming down
  - Less attractive models: Changing now, e.g., due to Tesla
  - Range anxiety: Improving over time & models
  - Unknown technology, esp. batteries
- We focus on the first barrier, i.e., higher CAPEX
  - We examine total cost of ownership

# This study

- India has announced FAME policies to subsidize EVs
  - Multiple vehicles are covered
    - Covered: 2W, 3W, 4W-cars, 4W-buses
    - Not covered: 4W-taxis, 4W-trucks
  - Upfront (CAPEX) subsidies are provided
    - FAME-I (2015): INR 7,980 million
    - FAME-II (2019): INR 100,000 million
- We ask two questions
  - Which vehicle segments should be subsidized, if at all?
  - Which policy – CAPEX, OPEX, FINEX – should be used to subsidize?

# FAME is quite detailed

**Table 1: Two Wheeler (Category L1, L2 & ≤ 250 W)**

SEGMENT	INCENTIVE (Rs)	
	Level 1	Level 2
<b>Scooter</b>		
Mild HEV (Conventional Battery)	1800/-	2200/-
Mild HEV (Advance Battery)	3600/-	4300/-
Plug-in HEV (Advance Battery)	13000/-	15600/-
BEV (Conventional Battery)*	7500/-	9400/-
BEV (Advance Battery)*	17000/-	22000/-
<b>Motor Cycle</b>	<b>Level 1</b>	<b>Level 2</b>
Mild HEV (Conventional Battery)	3500/-	4200/-
Mild HEV (Advance Battery)	5200/-	6200/-
Plug-in HEV (Advance Battery)	15000/-	18000/-
BEV (Conventional Battery)*	9600/-	12000/-
BEV (Advance Battery)*	23000/-	29000/-
<i>Note: In case of BEV 2W, 'Level 1' incentive is applicable for 2 Wheeler with 'max power not exceeding 250 Watts' and 'Level 2' incentive is applicable for others BEV 2W.</i>		

# Methods and data

- Financial – cash flow based – analysis
  - Many useful metrics exist: CAPEX, Payback, IRR
  - Need to compare based on lifetime costs
- We use NPV and TCO
  - TCO is used to compare equivalent EV and ICEV: Private perspective
  - NPV is used to calculate the cost of subsidy: Public perspective

Vehicle type	Driven per day (Km)	Duration (years)	ICEV CAPEX (INR) [Vehicle]	EV CAPEX (INR) [Vehicle]
2W-personal	18	10	60,000 [Activa]	58,990 [Hero Nyx 5]
2W-freight	100	10	60,000 [Activa]	58,990 [Hero Nyx 5]
3W	120	10	187,000 [Generic CNG Auto]	214,000 [M&M Yari]
4W-taxi	225	10	772,000 [Generic Car]	1,317,000 [M&M Verito]
4W-car (personal)	60	10	772,000 [Generic Car]	1,317,000 [M&M Verito]
4W-bus-intracity (9M)	200	20	4,500,000 [Generic Bus]	5,685,000 [Generic]
4W-bus-intercity (9M)	500	20	6,000,000 [Generic Bus]	8,580,000 [Generic]
4W-truck	500	20	2,500,000 [Benz 25T]	11,325,000 [Benz EV 25T]

# Results (1): TCO parity

Vehicle type	TCO-ICE (INR/km)	TCO-EV (INR/km)	TCO-EV/ TCO-ICE (%)	Need subsidy?
2W-personal	5.06	3.49	69%	No
2W-freight	2.08	1.04	50%	No
3W	4.05	3.28	81%	No
4W-taxi	9.12	8.59	94%	No
4W-car	<b>18.05</b>	<b>23.17</b>	<b>138%</b>	<b>Yes</b>
4W-bus-intracity (9M)	54.91	46.11	84%	No
4W-bus-intercity (9M)	43.57	34.68	80%	No
4W-truck	<b>30.45</b>	<b>46.72</b>	<b>153%</b>	<b>Yes</b>

# Results (2): Subsidies

Vehicle type	CAPEX-subsidy (INR) [% of CAPEX]	OPEX-subsidy (INR) [% of CAPEX]	FINEX-subsidy (INR) [% of CAPEX]
4W-car	589,025 [36%]	699,513 [+43%]	724,927 [+44%]
4W-truck	16,158,245 [34%]	21,239,069 [+44%]	NA

As a % of CAPEX

Vehicle type	CAPEX-subsidy (INR)	OPEX-subsidy (INR) [% increase]	FINEX-subsidy (INR) [% increase]
4W-car	589,025	699,513 [+19%]	724,927 [+23%]
4W-truck	16,158,245	21,239,069 [+31%]	NA

As a % of CAPEX subsidy



# Discussion: Is FAME doing the right thing?

- Which vehicles need subsidy?
  - Many EVs – **2Ws, 3Ws, 4W-taxis, 4W-buses** don't need subsidies at all
    - The CAPEX differences are not much to begin with OR
    - The OPEX differences are significant due to high miles driven
  - Some EVs – 4W-cars, **4W-trucks** need subsidies
    - The CAPEX differences are significant AND
    - The OPEX differences are not able to compensate, despite high miles driven
- Which subsidy is most cost-effective?
  - **CAPEX-subsidy** is the most cost-effective
  - **FINEX-subsidy** is the last cost-effective

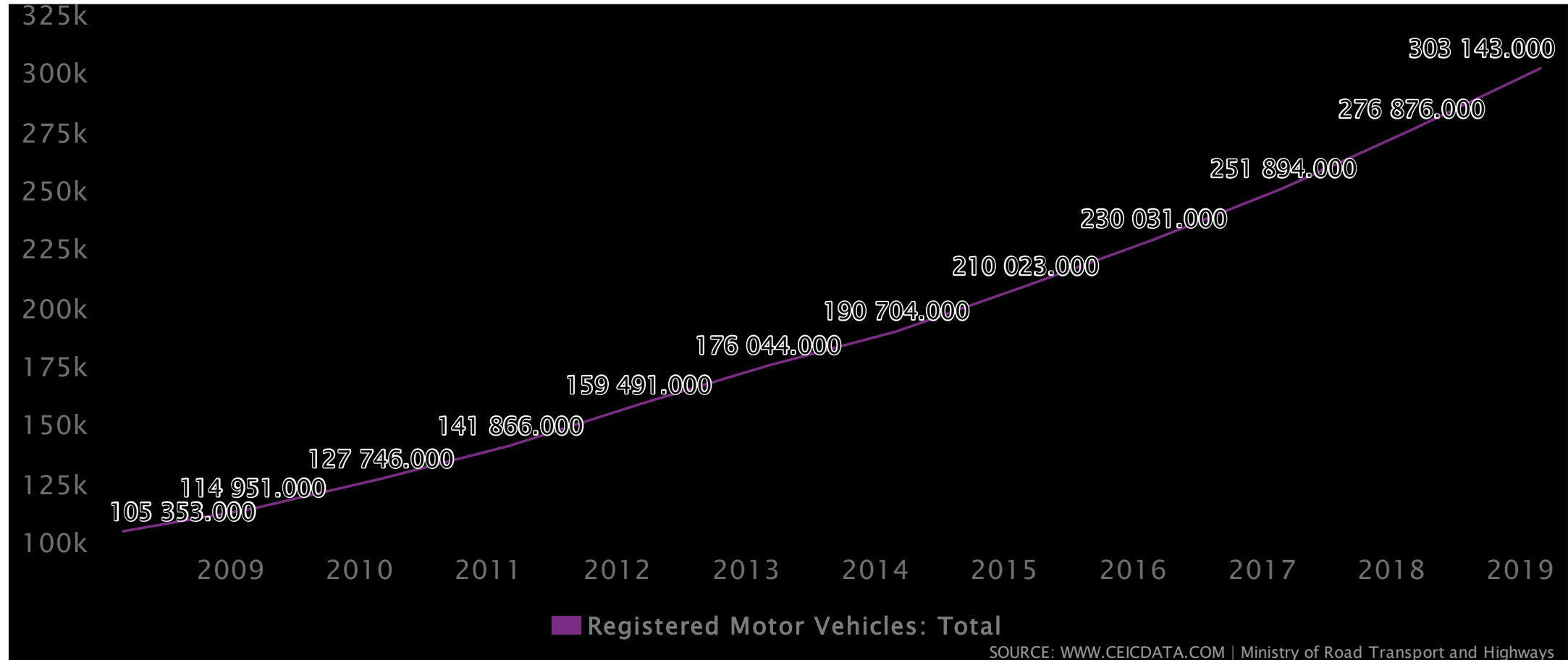
# Discussion: How to address higher CAPEX?

- Lower NPV/TCO: How to make it appealing to the buyer?
  - Higher CAPEX means higher upfront payment (if buying) or higher recurring payment (if borrowing or leasing): Buyer cares
  - Much lower OPEX: Buyer does not seem to care as much and, therefore, ends up discounting heavily
- Solution: Annualize payments
  - Option 1: Combine CAPEX and OPEX and annualize discounted sum into equal payments – like an annuity
  - Option 2: Separate battery payments from EV payments and combine battery payments with fuel payments
- Harder to do than it sounds: Who would provide the annuity?
  - Option 1: How to address fuel price volatility?
  - Option 2: Can we create good financial models for battery leasing?



# Questions?




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# Number of vehicles in India



# EV sales in India



Segment Of Electric Vehicle	FY 2018-19	FY 2017-18
Two Wheelers 	1,26,000	54,800
Three Wheelers 	6,30,000	5,20,000
Four Wheelers 	3,600	1,200
<b>Total</b>	<b>7,59,600</b>	<b>5,76,000</b>