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Why India's proposed CAFE III and IV norms need to be more stringent

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We analyze India's Bureau of Energy Efficiency (BEE)'s proposed Corporate Average Fuel Efficiency (CAFE) III (2027-2032) and IV (2032-2037) norms[2] and argue why they need to be more stringent.

After reviewing the BEE proposal we make the two main points below.

1) We recommend **one or more of the following** (reasons detailed below)

- ***a.*** *Make the emission norm substantially more stringent than current proposed*
- ***b.*** *Reduce super-credits for EVs from 4 to 3, which is the present value.*
- ***c.*** *Rectify the formula for computation of carbon intensity CI of EV as it is not scientifically sound*

Maintaining all these three as proposed is untenable and in fact weakens the case for OEMs to scale up EVs.

One specific recommendation is the table below. For 2027-2032 we simply recommend tightening the norms but for 2032-37 we recommend both tightening the norm and reducing the super-credit from 4 to 3.

	Emission norm gCO2/km & Super-credit		**Estimated BEV sales required to achieve norms***	
	BEEproposal	**Our recommendation**	**To achieve BEE proposed norms**	**To achieve our recommended norms**
2027-2032	91.7 &4	**68 & 4**	9 %	**23%**
2032-2037	70.0 & 3	**51 & 3**	21%	**50%**

**Calculations in the following pages*

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2 https://beeindia.gov.in/en/om-on-inviting-comments-on-the-proposal-of-future-fuel-efficiency-norms-ie-cafe-iii-cafe-iv-norms

The current formula for computing the carbon intensity (CI) of EVs which is independent of actual grid emission intensity results is scientifically unsound and results in an artificially low CI for EVs. Under a given sales-weighted emission intensity standard this benefits internal combustion engines (ICE) vehicles. When this is coupled with generous super-credits for EVs, it further weakens the norms such that the proposed norms are too weak to accelerate EV adoption beyond what current baseline trends suggest and which are far below levels needed to meet India's own stated energy independence and carbon reduction goals.

2) *EVs have attained cost parity with ICE vehicles in China and the operating cost of EVs in India is 1/3rd to 1/4th that of ICE vehicles. India should strive to achieve upfront cost parity in India within 5 to 10 years, which requires stronger CAFE norms.*

The Govt of India (GoI) and many states already provide generous subsidies in the form of lower GST, FAME incentives, income tax deduction on interest payment on EV loans and various other rebates on registration, road taxes, preferential tariffs for charging etc. Policies such as CAFE therefore can and need to be more stringent in order to push automakers to scale up EV production and achieve cost-parity with ICE vehicles if India is to harness the full potential of economic and environmental potential of EVs.

The rest of the document describes the rationale and calculations supporting the above

1) Explanation of issues created by the approach/formula for computing the carbon intensity (CI) of EVs and the amplification of the problem by the proposed super-credit

The CI of EV is currently computed independent of the emissions intensity of electricity used to charge EVs. This results in CI value for EVs that is substantially lower than what would result if one uses the grid average emissions intensity.

The CI of EV is calculated using the formula below which is found in ARAI documents CO2 (gCO2/km) = (Fuel consumption (FC) in kWh/100 km) x 0.1028 x 23.7135 (Reference)[3]

This is more intuitively rewritten as below

CI of EV in gCO2/km = FC (kWh/km) x 0.1028 (Litre/kWh) x 2371.35 (gCO2/Litre)
Where, 2371.25 is the CO2 intensity of petrol

Since the EV's use no liquid fuel, the value of 0.1028 Litre per km is key here. This appears to have been derived based on the following two facts:

1) 1 kWh = 3.6 Mega joules (MJ)
2) 1 litre of petrol = 35 MJ

Therefore, 1kWh of electricity ≡ 0.1028 Litre (= 3.6/35)

Please note therefore that there is **no reference to the grid emission intensity anywhere in the BEE formula**. See appendix for further discussion.

Assuming a fuel economy of 8 km per kWh for the average EV, the formula suggests CI of EV using BEE = 1/8 (kWh/km) x 0.1028 (Litre/kWh) x 2371.35 (gCO2/Litre) = 30.47 gCO2/km

Now if we computed the CI based on an average Indian grid emission intensity of 650 gCO2/kWh (based on https://carbontracker.in/)
CI of EV using Grid CI = 1/8 (kWh/km) * 650 gCO2/kWh
= 81.25 gCO2/km

[3] Amendment No. 8 to AIS 137 (Part 3) (07/2023) Chapter 19: Administrative and Technical Procedure for Measurement and Monitoring [Average] Fuel Consumption in l/100 km of M1 vehicles with GVW not exceeding 3500 kg, See Page 253/296

The implication of using the BEE formula is that the CI of EV ~40% lower than it actually is today on average. **Such an artificially low CI means that a given CAFE standard can be met with fewer EVs than would be required under a higher CI for EV. This naturally helps ICE vehicles.**

Additionally there are super-credits, which allow each EV to be counted as though they are multiple EVs. When coupled with the artificially low CI, even fewer EVs are required to meet a given standard.

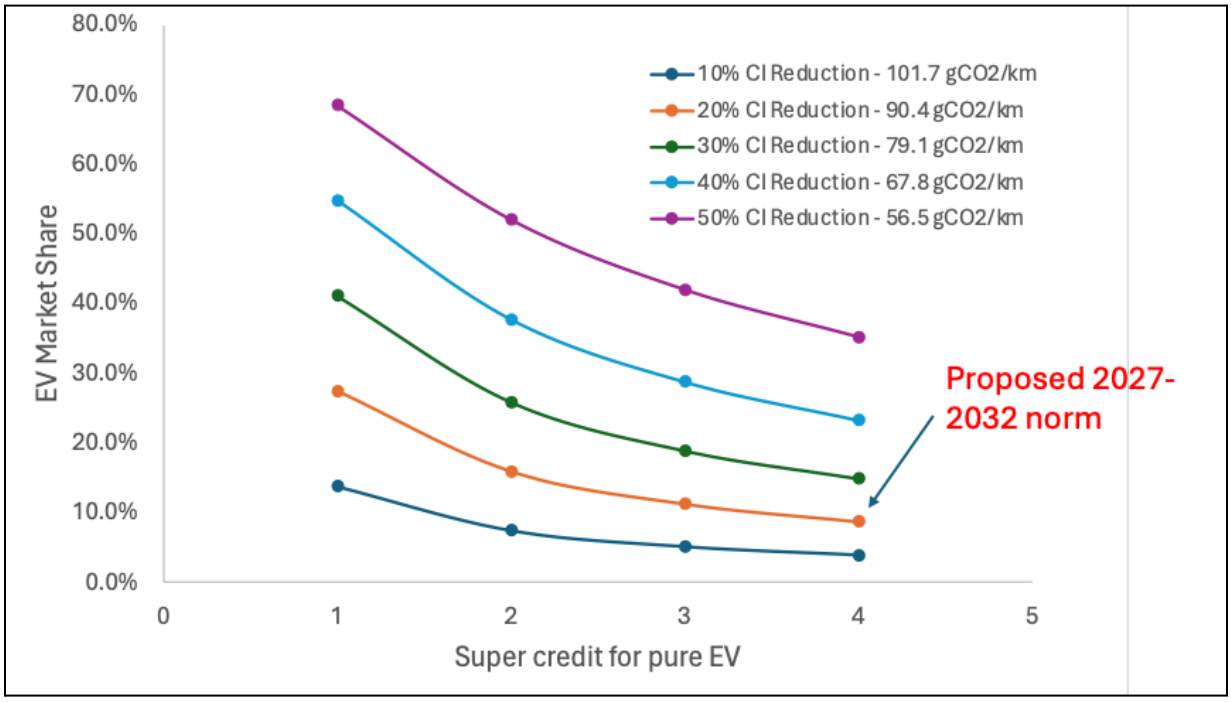
The example below illustrates the combined effect of low CI for EV and super-credits. Let us assume the norm is set to reduce CI by **20%** from the 2023 norm of 113 to 90.4 gCO2/km. For reference, the proposed norm for 2027 to 2032 is 91.7 gCO2/km which comes pretty close to 20%. The market share of EVs required under different super credits and for the two different CI of EVs (BEE formula and Grid CI) is as follows. Detailed calculation in Appendix.

Table 1: Market share of EV required to achieve given reduction in CI of average new vehicle

Desired CI reduction	20%	
Implied Emission norm	**90.4 gCO2/km**	(90% of 113gCO2/km
EV Super credit	BEE CI for EV (30.47 gCO2/km)	Grid CI for EV (81.25 gCO2/km)
4	8.6%	38.2%
3	11.2%	45.2%
2	15.9%	55.3%
1	27.4%	71.2%

In other words, under the proposed BEE formula for CI and super credit of 4, a 20% reduction in average CI can be achieved with just 8.6% share of EVs in new sales by 2032. For comparison China achieved EV sales of 10%, 20%, and 40% by 2020, 2021, and 2024 respectively. In contrast, using the actual grid CI of EVs and no super-credits, a 71.2% market share of EV is needed to achieve 20% reduction in average CI.

Figure: Share of EVs in sales required to meet different CI reduction targets under different super-credits using current formula for CI of EV instead of grid-based CI



We therefore recommend on or more of the below

1) Make the emission norm much more stringent than what is proposed
2) Reduce super-credits
3) Rectify the formula for CI of EV

One specific recommendation is the table below. For 2027-2032 we simply recommend tightening the norms but for 2032-37 we recommend both tightening the norm and reducing the super-credit from 4 to 3.

	Emission norm gCO2/km & Super-credit		**Estimated BEV sales required to achieve norms***	
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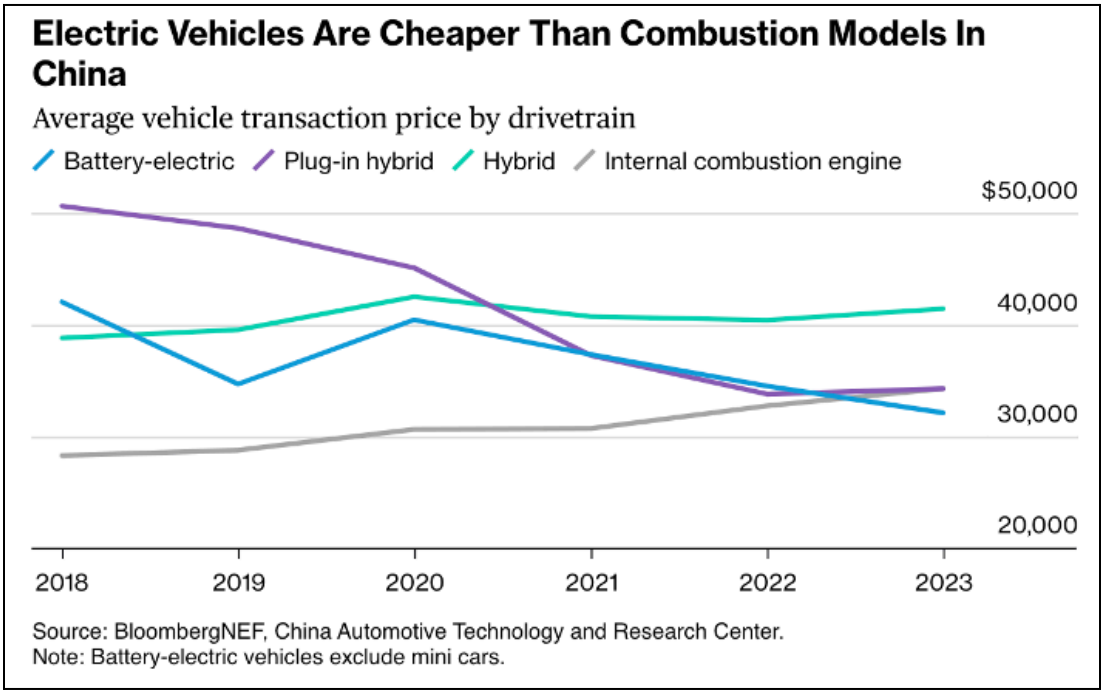
**Calculations in the following pages*

2) EVs have attained cost parity with internal combustion engine (ICE) vehicles in China and the operating cost of EVs in India is 1/3rd to 1/4th that of ICE vehicles.



Source: Bloomberg News 9-July-2024[4] Link

Although EVs are costlier upfront in India, economies of scale can help drive down costs and policy has a role to play in ensuring EVs are produced at a scale that will help approach upfront cost parity. In fact, given the operating cost benefits (see below), EVs are economical on a levelized cost per kilometer basis cycle basis even when costlier upfront. The Govt of India (GoI) and many states already provide generous subsidies in the form of lower GST, FAME incentives, income tax deduction on interest payment on EV loans and various other rebates such as road taxes and preferential tariffs for charging etc. Since further increasing subsidies is not warranted, policies such as CAFE are therefore can be more stringent in order to push automakers to scale up EV production and achieve cost-parity with ICE vehicles so that the nation can harness the full economic and environmental potential of EVs.

4 https://www.bloomberg.com/news/newsletters/2024-07-09/china-s-batteries-are-now-cheap-enough-to-power-huge-shifts

Retail price of petrol = Rs. 100
Average fuel economy of petrol = 20 km per litre
Cost per km for petrol car = 100/20 = Rs 5 per km

Retail electricity price = Rs 10 per kWh
Average Fuel economy of EV = 8 km per kWh
Cost per km of EV = 10/8 = 1.25 per km

EV operating cost is 1/4th that of petrol

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Appendix

1) Calculation for CI achieved for a given market share of EV under different super-credits and CI of EV

CI of ICE = 113 gCO2/km, which is the norm for 2023
CI of EV based on BEE formula = 30.5 gCO2/km

CI using BEE formula + super credit of **4** = (113*0.9+30.5*0.1*4)/(0.9+0.1*4) = 87.6 gCO2/km
CI using BEE formula + **No super credit** = (113*0.9+30.5*0.1)/(0.9+0.1) = 104.8 gCO2/km
CI using **Grid CI** + No super credit = (113*0.9+81.25*0.1*3)/(0.9+0.1*3) = 109.83 gCO2/km

Table 1: Carbon Intensity in gCO2/km achieved for a given market using BEE formula for CI for EV and using average Grid CI for EV for under super-credits

EV Market share	10%	
Super credit	BEE CI	Grid CI
4	87.61	103.23
3	92.37	105.06
2	97.99	107.23
1	104.75	109.83

2) Calculation for CI achieved for a given market share of EV under different super-credits and CI of EV

Also please note the capacity to do useful work with 3.6 MJ of electrical energy is different from 3.6 MJ of heat energy with the former being a higher quality of energy. This can be seen from the following
Let us assume an EV can go 8 km per kWh and petrol car goes 16 km per Litre

This means 1 kWh ≡ 0.5 Litre

In other words, 1kWh does the work of 0.5 litre of gasoline but according to the BEE formula it only does the work of 0.1 litre of gasoline, which is inaccurate and biased against EVs. This means there is no adjustment for the superior quality of electricity and it makes EVs less efficient that they actually are.

The California Low Carbon Fuel Standard, one of the pioneering policies for transforming the transportation fuel sector, uses an energy equivalence ratio that reflects the superior energy quality of electrical energy for vehicle propulsion.