Fuel efficiency Standards: Next Steps for India

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CSE Roundtable on India's Fuel Economy Benchmarks

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Two-Wheeler Fuel Efficiency

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Recent ICCT papers analyze pathways for **reducing two-wheeler CO_2 emissions** in India

- Fuel consumption reduction technologies for the two-wheeler fleet in India (*https://theicct.org/publications/2w-fuel-reduction-india-mar2021*)
- Fuel consumption standards for the new two-wheeler fleet in India (*https://theicct.org/publications/fuel-consumption-2w-india-aug2021*)
- Market analysis of new two-wheeler fleet for FY 2020-21 (*Forthcoming*)
- Estimating electric two-wheeler costs in India to 2030 and beyond (*https://theicct.org/publications/E2W-cost-2030-India-jul2021*)

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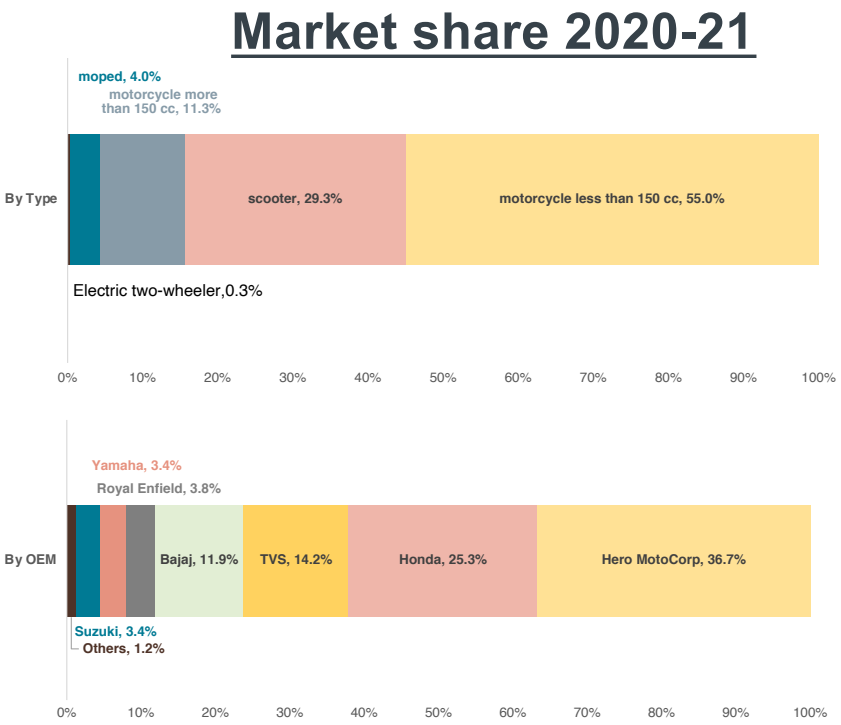
For all these analyses, the market share of **motorcycles** is 70% and **scooters** is 30% based on vehicle sales trend



- The adoption of **Fuel injection technology** is a significant step in the technology level, post BS VI

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BS VI two-wheeler fleet-engines are 100% equipped with Fuel Injection, **Transmission** of all scooters are CVT, 40% motorcycles use 4-speed manual transmission

Category	Motorcycle less than 150 cc	Motorcycle more than 150 cc	Scooter
Engine	Fuel injection(FI), capacitor charge ignition Compression ratio 9.9:1	Fuel injection(FI), single spark electronic ignition Compression ratio 8.5:1	Fuel injection(FI), spark injection Compression ratio 10:1
Transmission	4-speed manual	5-speed manual	Continuously variable transmission (CVT)

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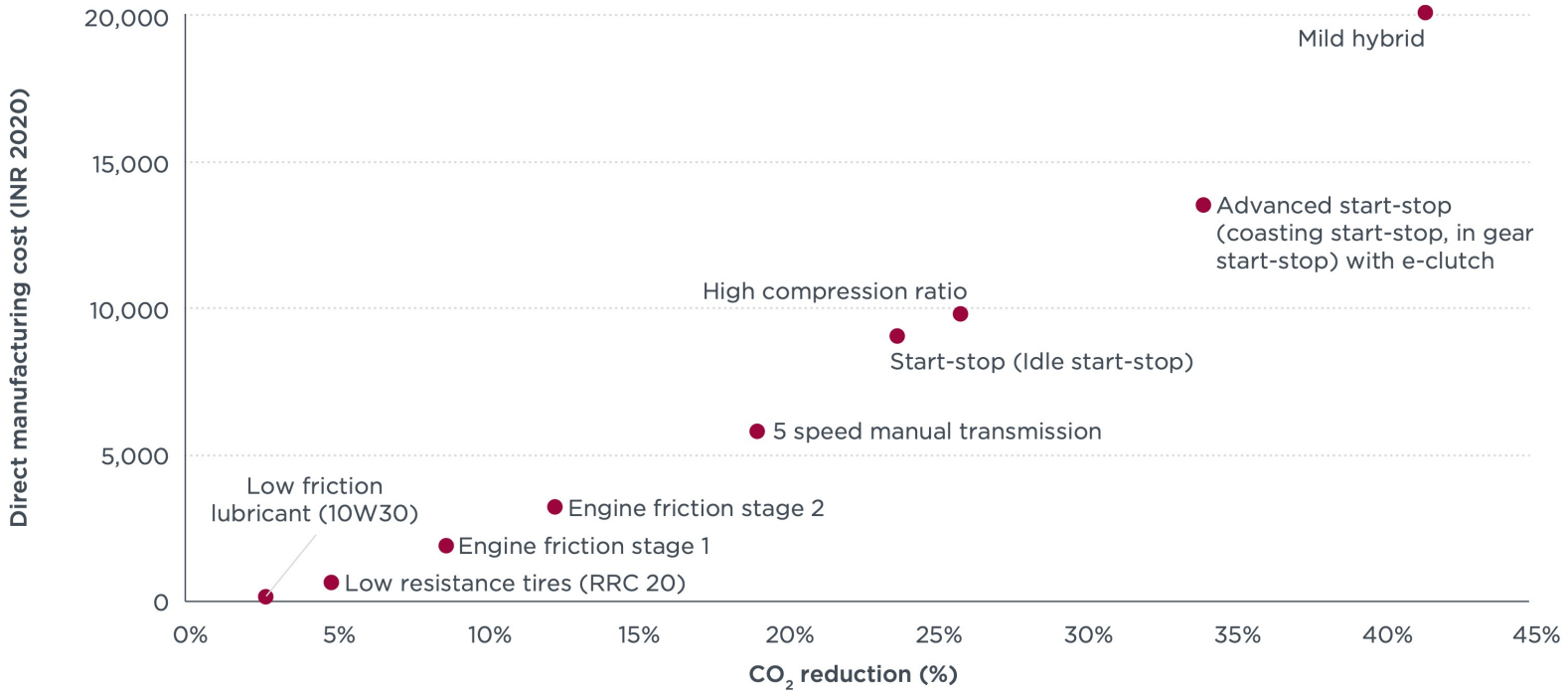
Many technology options to reduce fuel consumption of 2W

Type of technology	Specific technology	Applicability in small motorcycle	Applicability in large motorcycle	Applicability in scooter
Engine technology	Engine friction reduction	✓	✓	✓
	Lubricating oil additives	✓	✓	✓
	Cam phasing		✓	
Transmission technology	5-speed manual transmission	✓		
	6-speed manual transmission		✓	
	Dual-clutch transmission		✓	
	Improved CVT			✓
	Electronic clutch	✓		
	AMT	✓		✓
Vehicle technology	Start-stop	✓	✓	✓
	Low-rolling-resistance tires	✓	✓	✓
	Low-drag brake calipers	✓	✓	✓
	Mild hybridization	✓	✓	✓
	Electrification	✓	✓	✓
Advanced engine technology	High compression ratio	✓	✓	✓
	Variable valve lift		✓	
	Atkinson cycle		✓	
	Gasoline direct injection		✓	
	Exhaust gas recirculation		✓	

Individual technologies arranged in the order of cost-to-benefit ratio. Upto **42% CO_2 reduction*** can be achieved in motorcycle less than 150 cc



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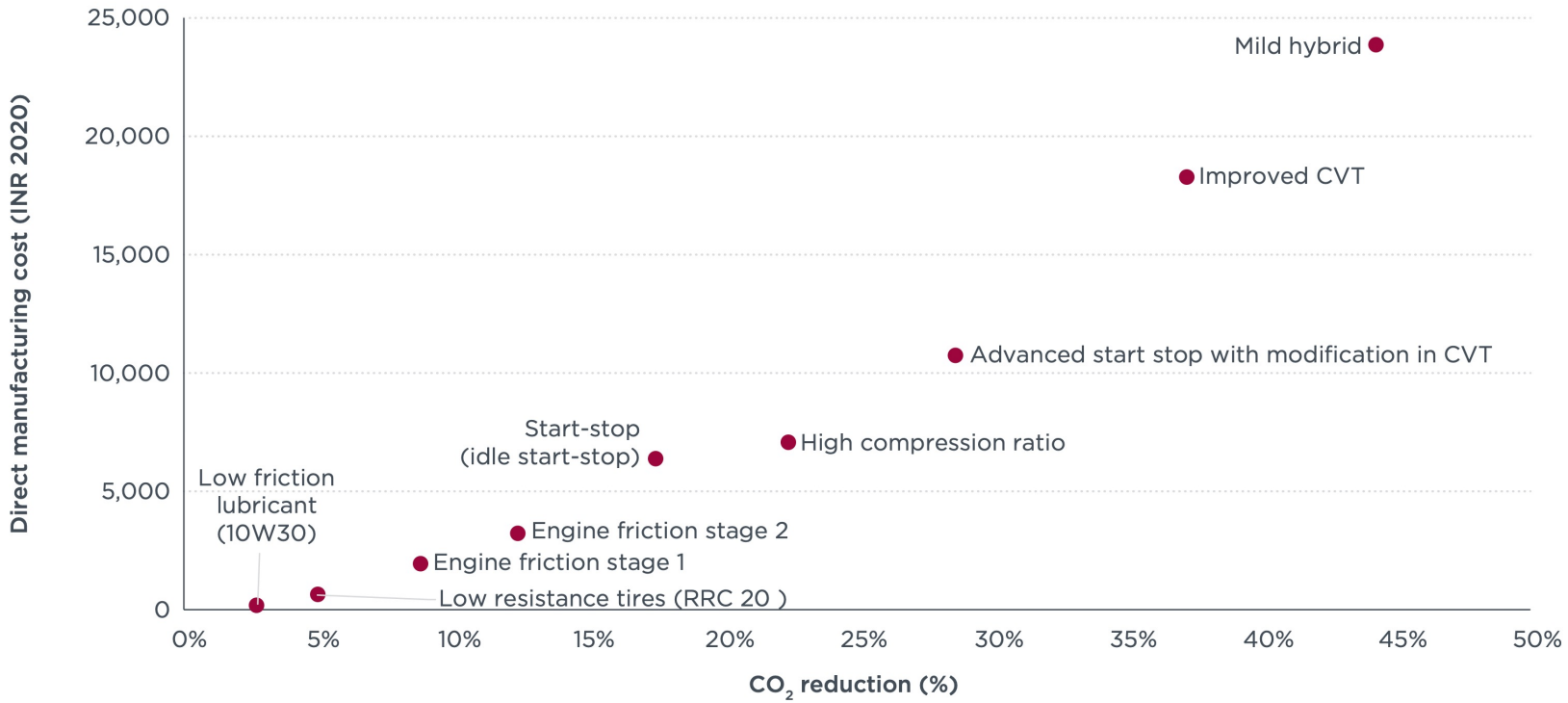
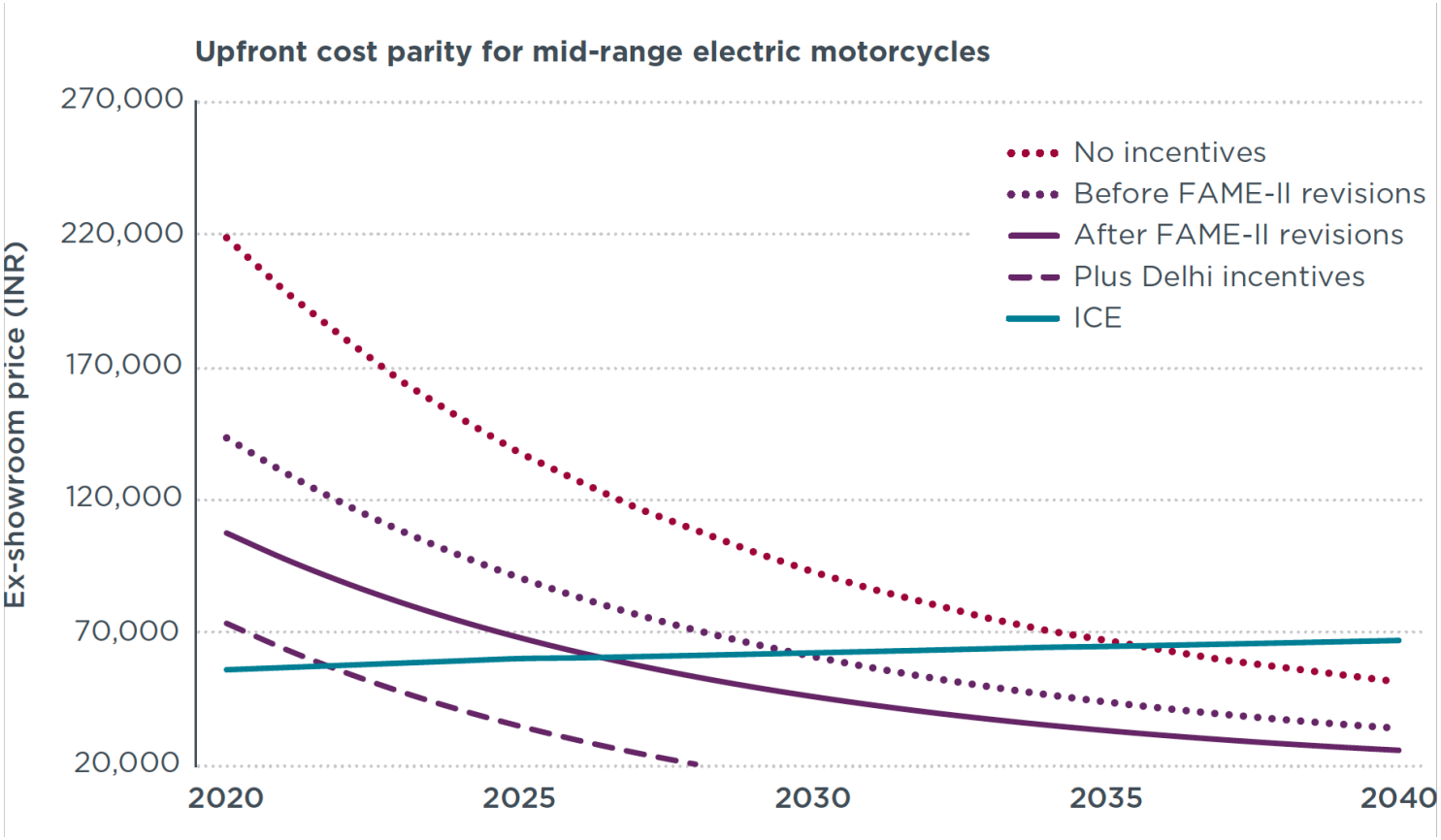
** over and above the benefit from Fuel injection*

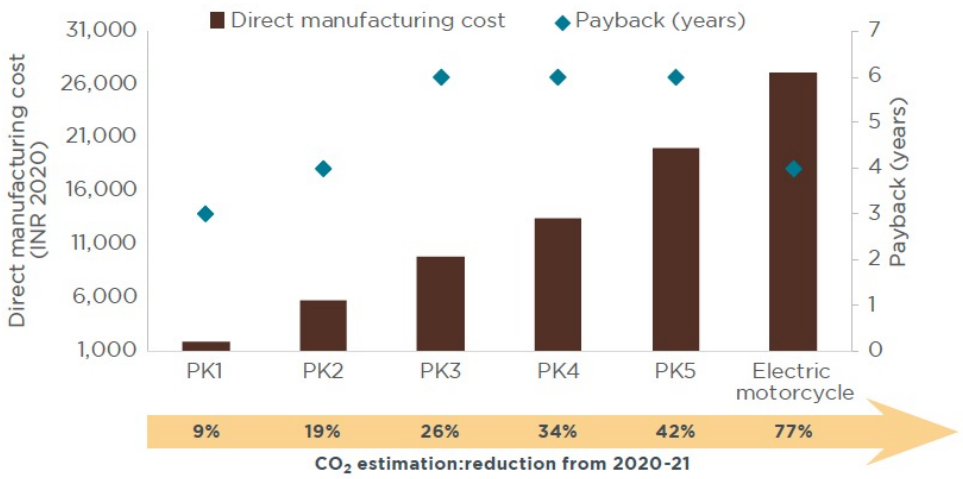
~44% CO_2 reduction in scooter emissions possible for a cost of less than INR 24,000

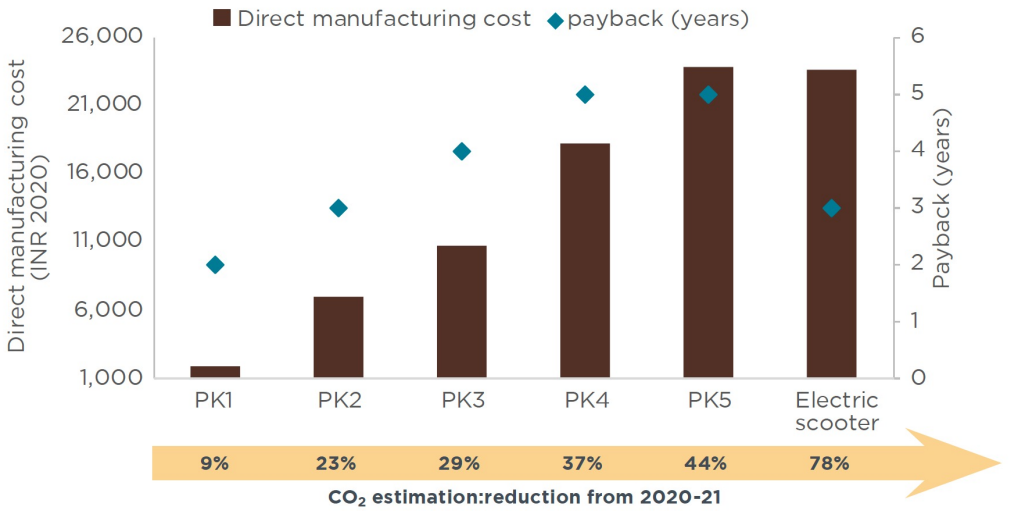


Upfront cost parity of E2W is near with FAME+state incentives



Payback period for E2W is shorter than the most expensive ICE technology





** Individual technologies were combined to form packages PK1,PK2,PK3,PK4 and PK5. Battery electric technology is considered as a technology package*

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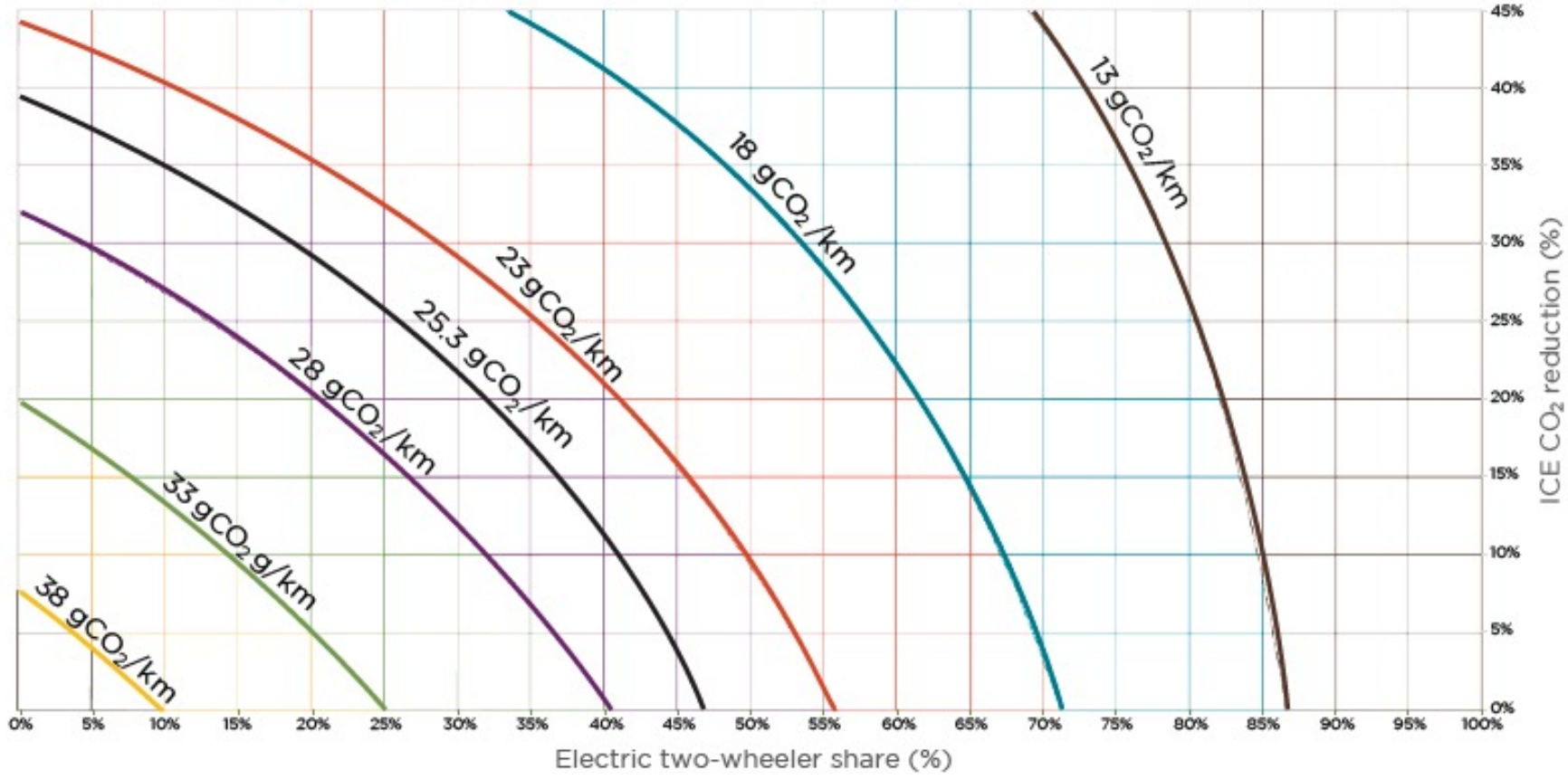
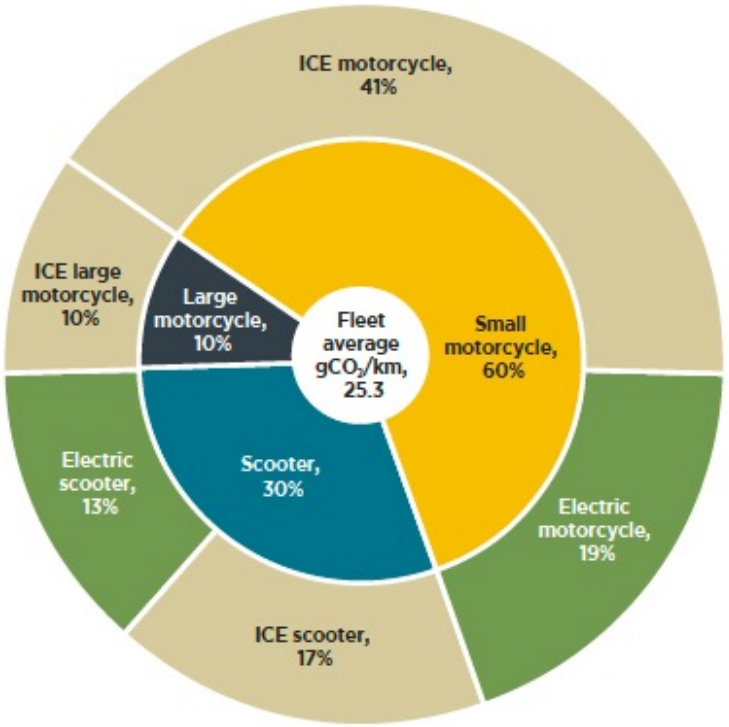
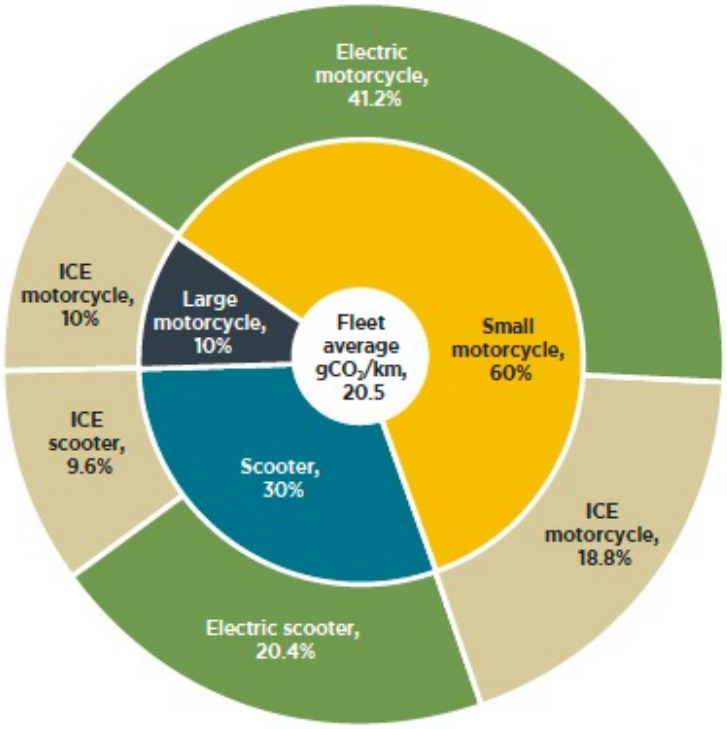
Manufacturers likely to choose a combination of ICE improvements and electrification to meet CO2 standards



Based on the market share, the **possible target for the fleet** is 25.3 gCO_2/km for 2025 and 20.5 gCO_2/km for 2030

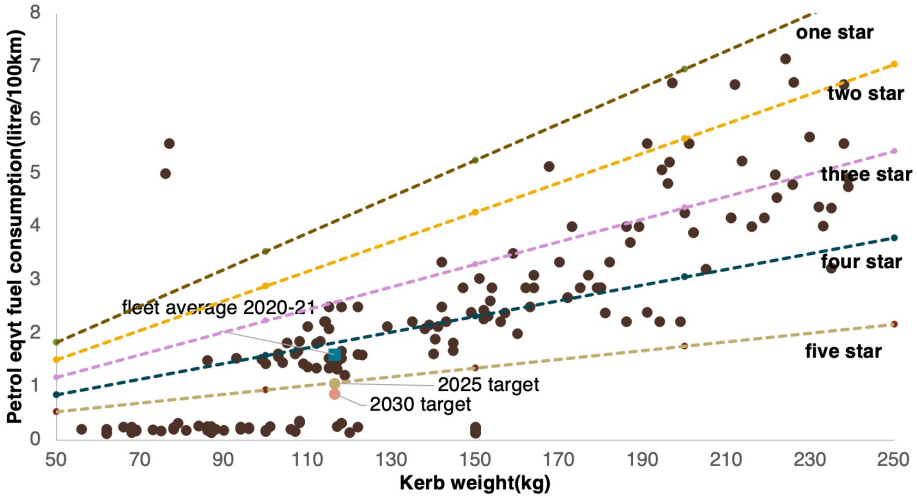


32%(13%+19%) of electric two-wheeler in the fleet achieved through the fleet average **target of 25.3 gCO_2/km in 2025**

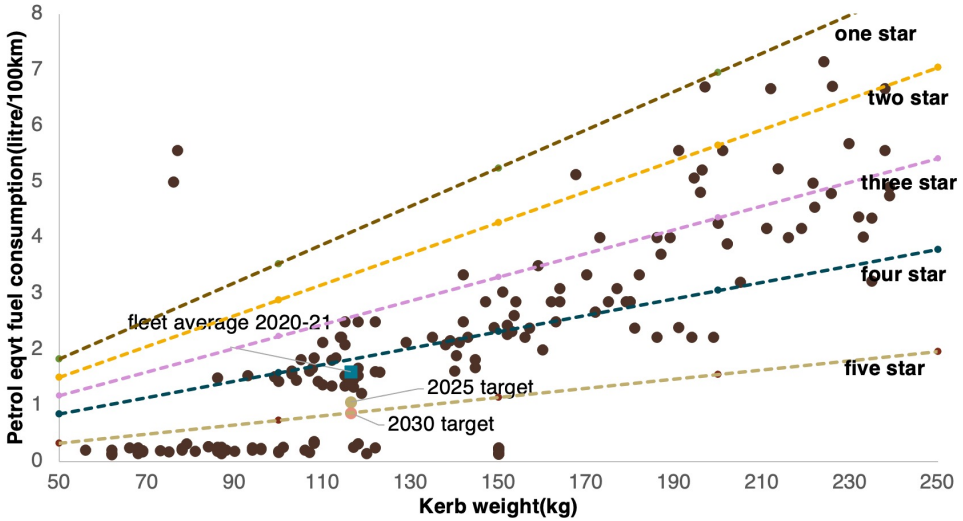


61%(41.2%+20.4%) of electric two-wheeler in the fleet achieved through the fleet average **target of 20.5 gCO_2/km in 2030**

Fuel efficiency labelling could be designed based on the CO_2 target for 2025 and 2030



Star rating	2 star	3 star	4 star	5 star
Sales weighted market share for labelling design based on 5-star given to **2025 target**	0.4 %	12.4%	86.9%	0.3%



Star rating	2 star	3 star	4 star	5 star
Sales weighted market share for labelling design based on 5-star given to **2030 target**	0.5 %	35.3%	63.9%	0.3%

Full electrification of new 2W should be the aspiration for 2035

- Post BSVI fuel injection technology allows two wheelers to incorporate many cost-effective ICE technologies.
- ICE technologies are cost effective as compared with EV till 23% of CO_2 reduction.
- New 2W average CO_2 target of 25 gCO_2/km for 2025 will ensure ~30% EV share, whereas a 20 gCO_2/km for 2030 will enable ~60% EV share.

Light-Duty Vehicle Fuel Efficiency

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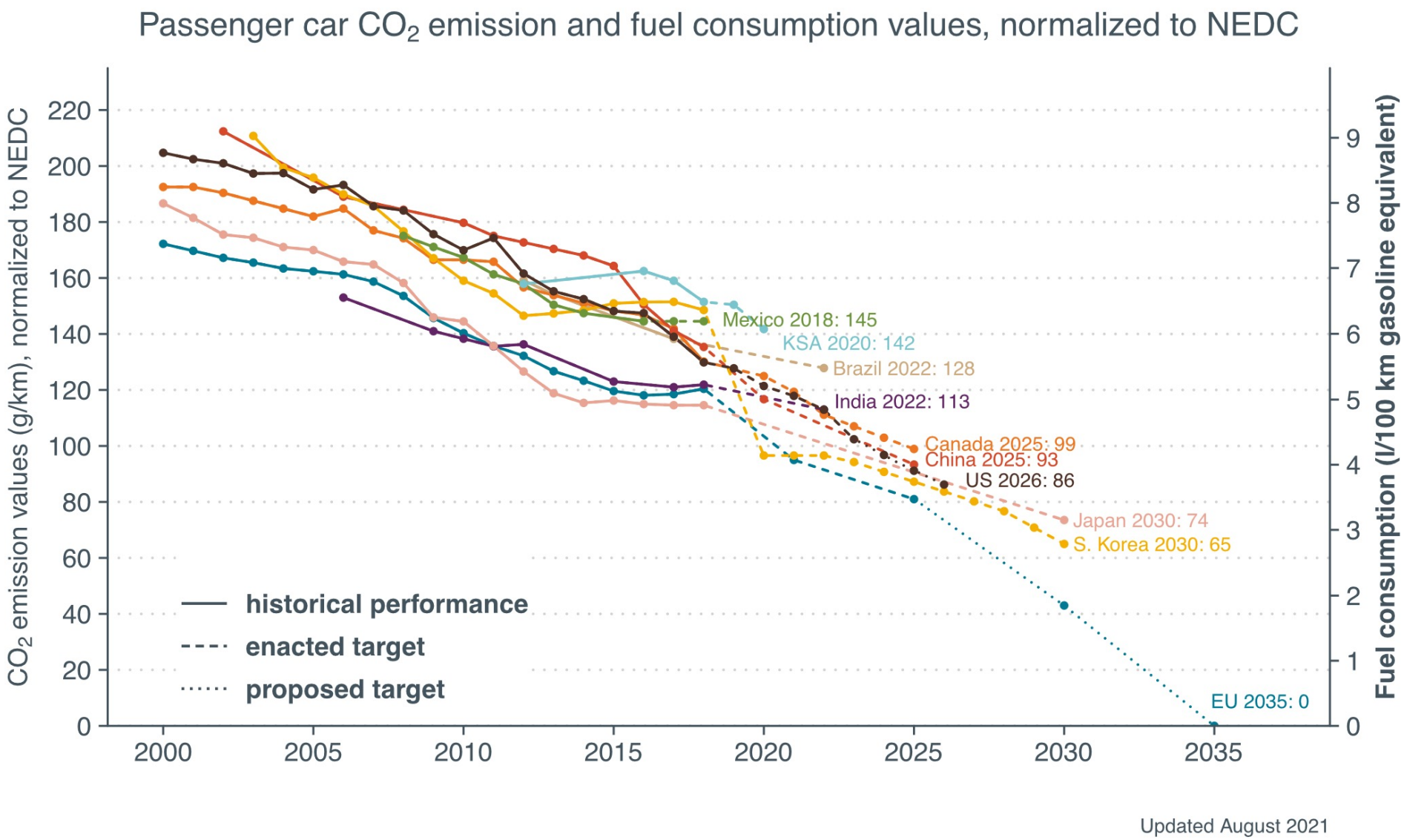
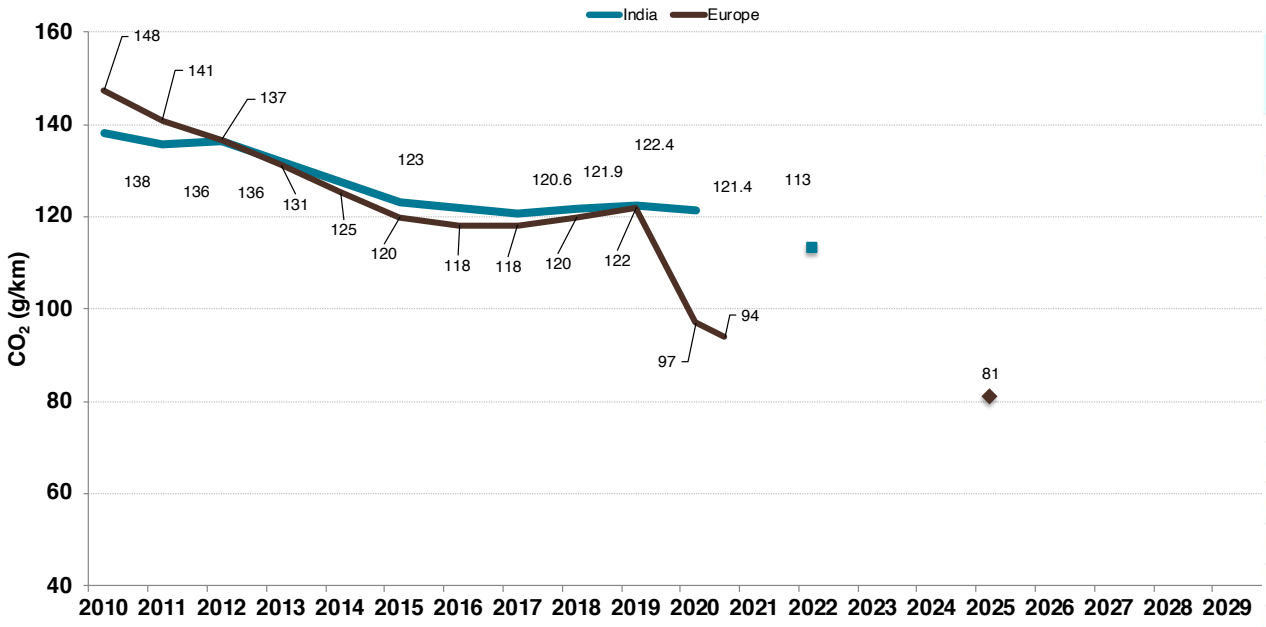

Passenger car CO_2 emission and fuel consumption values, normalized to NEDC
CO_2 emission values (g/km), normalized to NEDC
Fuel consumption (l/100 km gasoline equivalent)
0
20
40
60
80
100
120
140
160
180
200
220
0
1
2
3
4
5
6
7
8
9
2000
2005
2010
2015
2020
2025
2030
2035
historical performance
enacted target
proposed target
Mexico 2018: 145
KSA 2020: 142
Brazil 2022: 128
India 2022: 113
Canada 2025: 99
China 2025: 93
US 2026: 86
Japan 2030: 74
S. Korea 2030: 65
EU 2035: 0
Updated August 2021

European Union (EU)					India				
Year	Curb weight (kg)	CO_2 (g/km)	Hybrid (%)	PHEV+BEV (%)	Year	Curb weight (kg)	CO_2 (g/km)	Hybrid (%)	PHEV+BEV (%)
2017	1395	118	2.7	1.4	2017-18	1064	120.6	0.00	0.01
2018	1397	120	3.7	2	2018-19	1078	121.9	0.01	0.06
2019	1415	122	5.4	3	2019-20	1068	122.4	0.03	0.10
2020	NA	107	12.4	10.6	2020-21	1081	121.4	0.13	0.2

https://theicct.org/publications/fuel-consumption-pv-india-apr2021



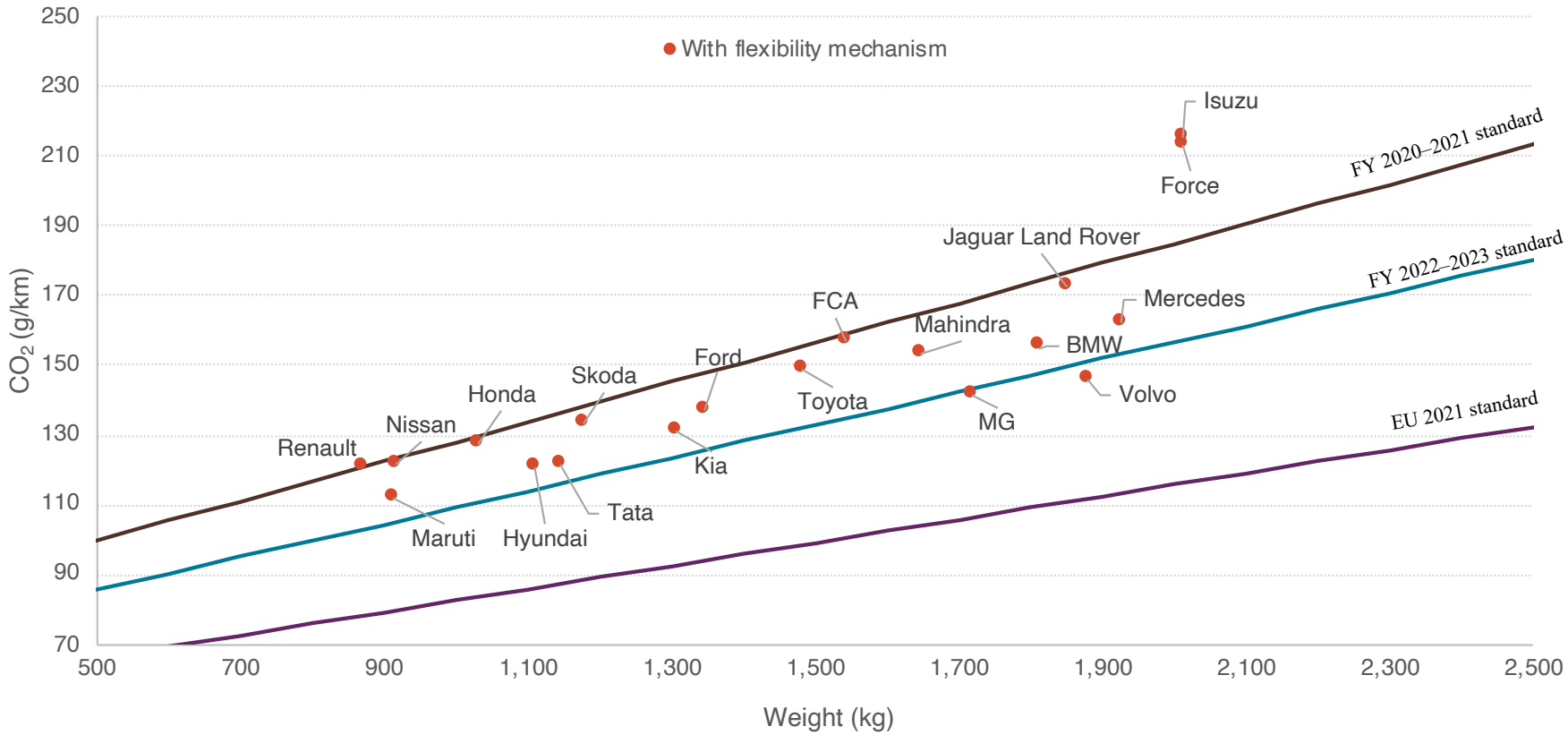
https://theicct.org/blog/staff/atmanirbhar-bharat-targets-may2021

Table 2. Share of plug-in hybrid and battery electric passenger cars, by manufacturer.

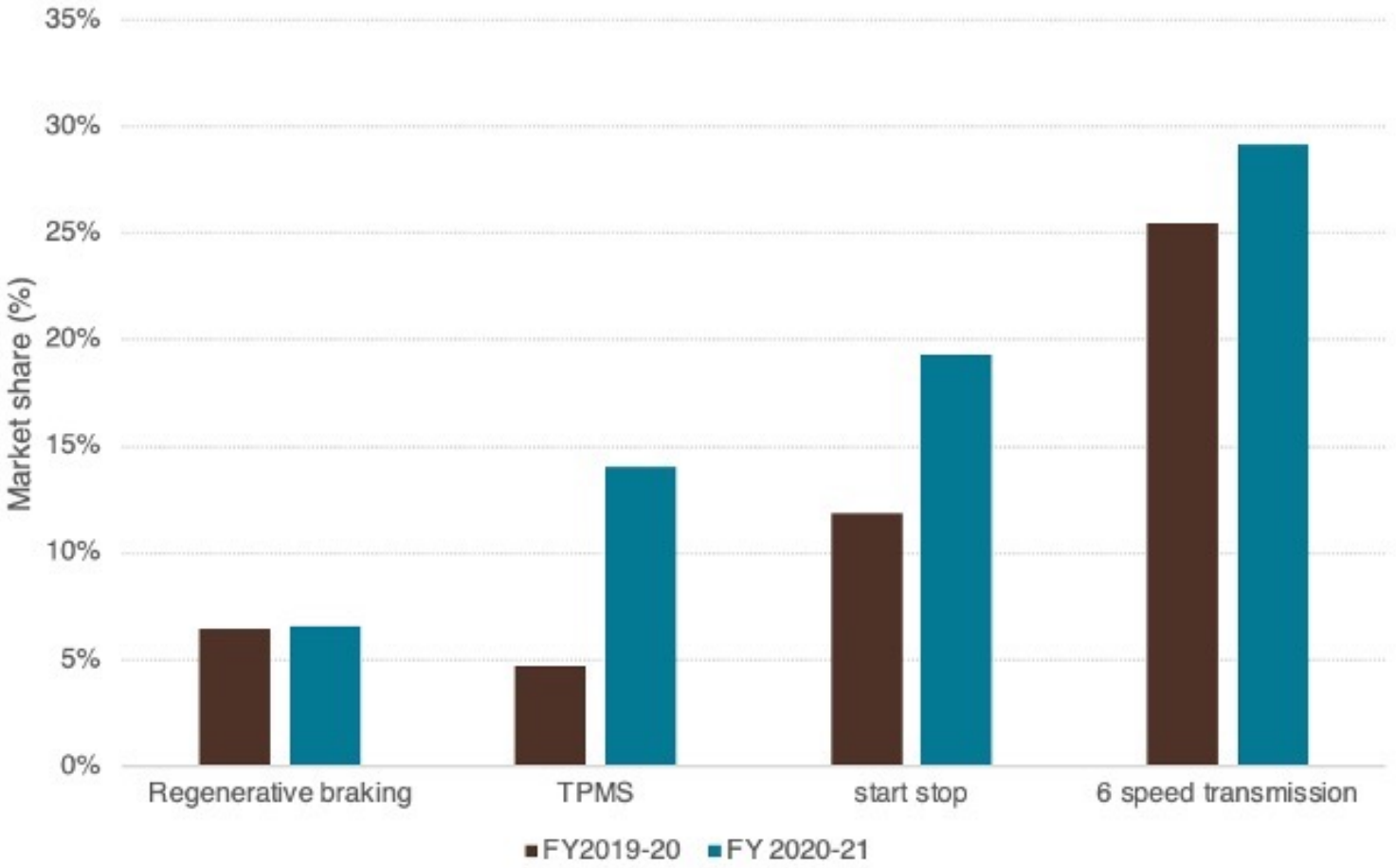
Share of plug-in hybrid and battery electric cars	Jun 2021		YTD 2021		2020	
	BEV	PHEV	BEV	PHEV	BEV	PHEV
Tesla-Honda	84%	0%	74%	0%	60%	0%
Daimler	12%	17%	10%	22%	6%	16%
Hyundai	11%	8%	11%	4%	14%	1%
Renault-Mitsubishi	10%	4%	8%	4%	8%	3%
VW Group	10%	10%	8%	8%	7%	5%
AVERAGE	10%	9%	7%	9%	6%	5%
Kia	9%	11%	9%	12%	9%	9%
BMW	8%	17%	6%	18%	5%	13%
Ford-Volvo	8%	23%	4%	19%	2%	13%
PSA-Opel	7%	5%	6%	5%	4%	3%
FCA	6%	6%	5%	4%	1%	1%
Toyota-Mazda	1%	3%	1%	3%	1%	1%
Other	1%	5%	2%	5%	2%	3%

https://theicct.org/publications/market-monitor-eu-jul2021

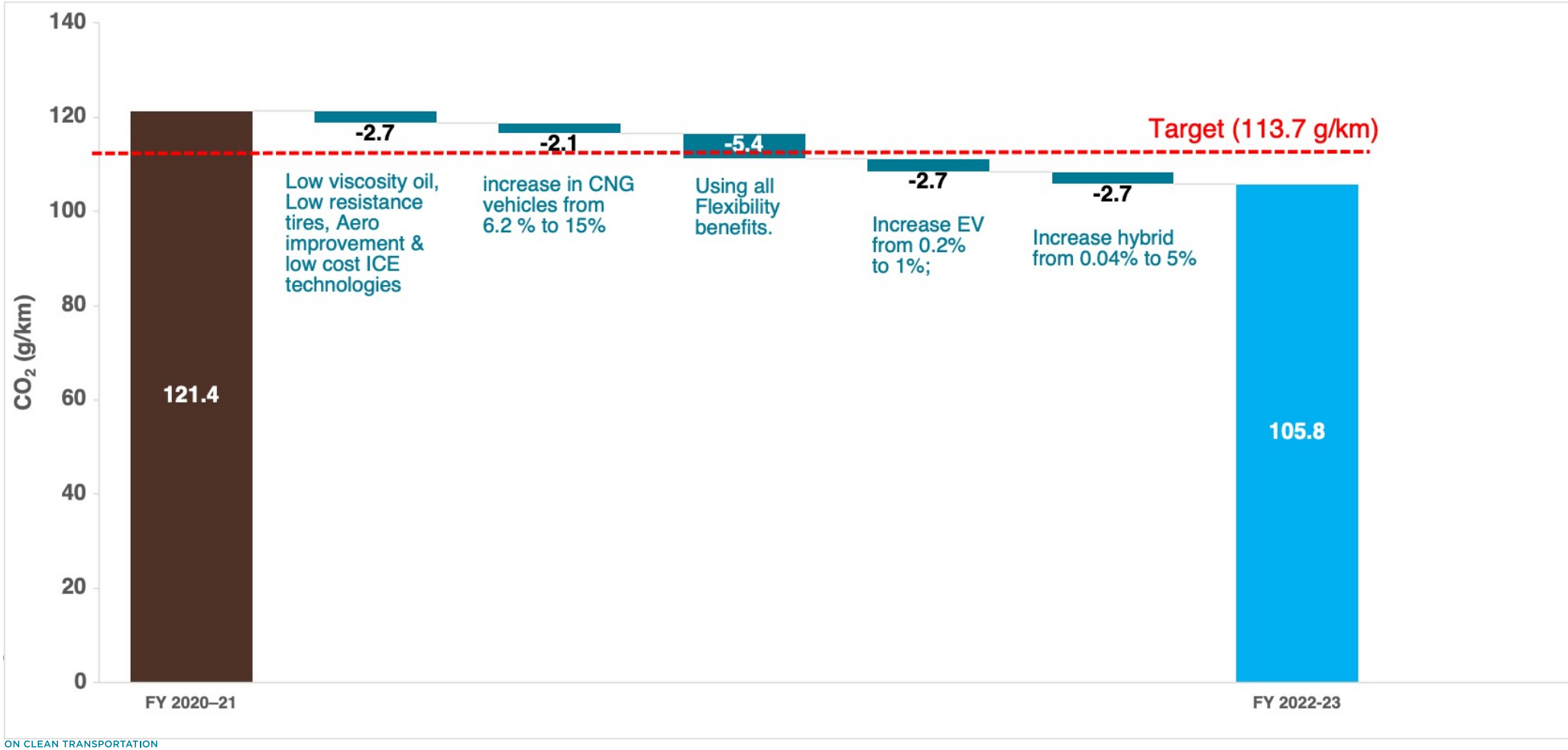
FY 2022-23 standards already met by some companies thanks to EV sales



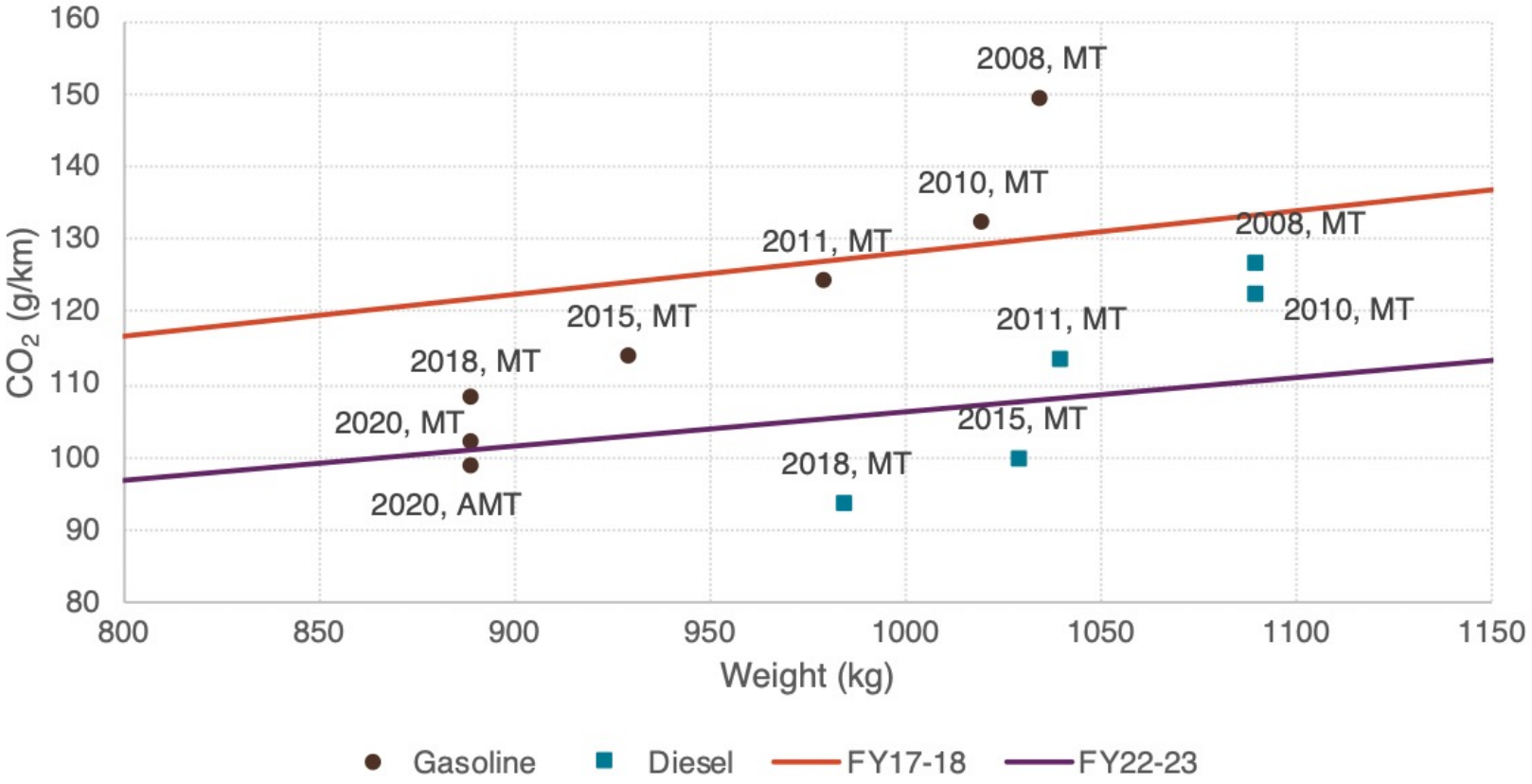
Comparison of flexibility mechanisms for FY 2019-20 and FY 2020-21



Multiple technology pathways to exceed FY 2022-23 standards

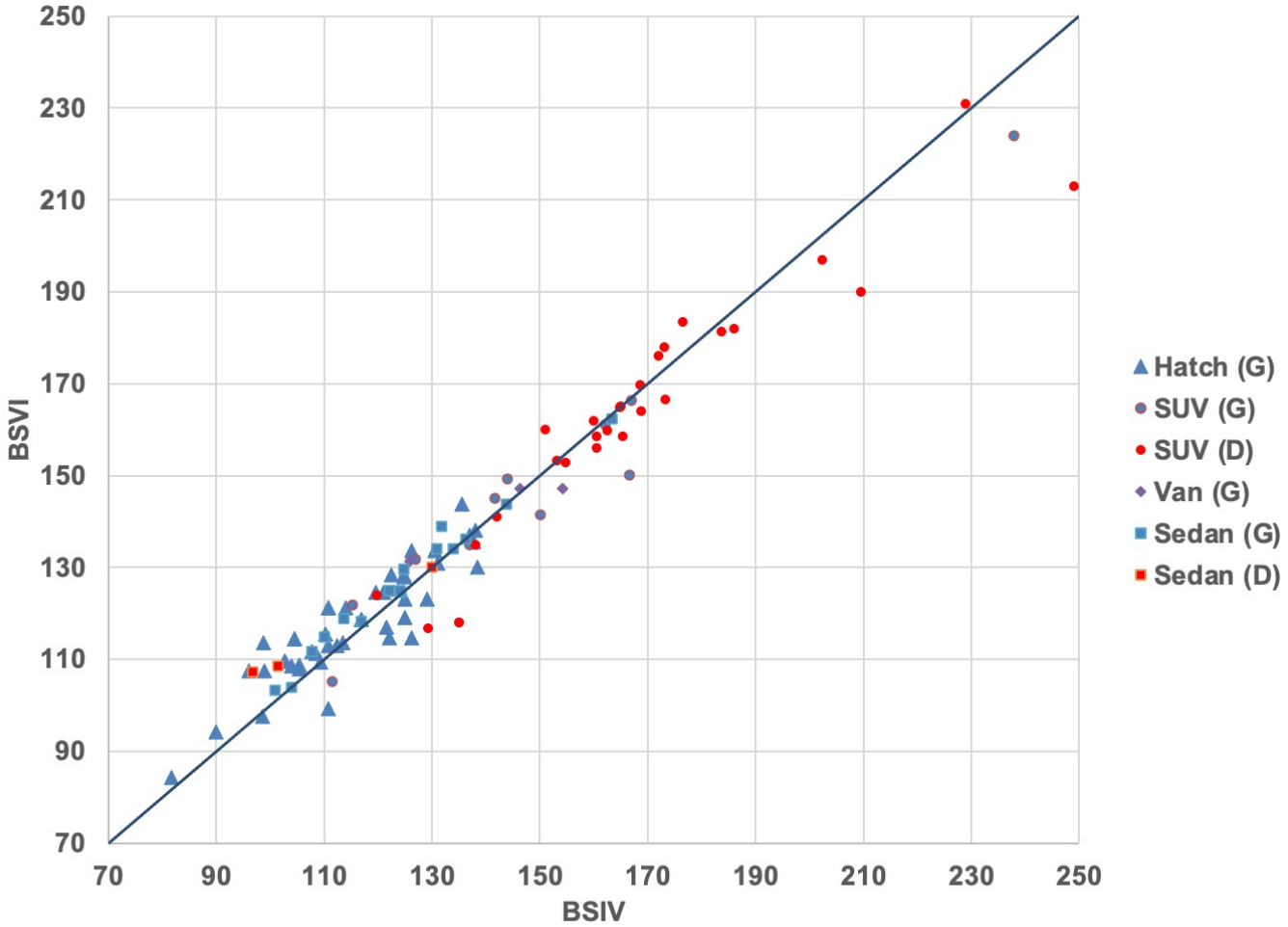


Market leading cars like Maruti Dzire already show better fuel efficiency than required by FY22-23 standards using off the shelf ICE technologies



- Every manufacturer's "Dzire" for meeting PV fuel consumption standards in India: https://theicct.org/blog/staff/dzire-pv-fuel-consumption-standards-india-nov2020

BS VI versus BS IV CO_2 emissions (g/km)



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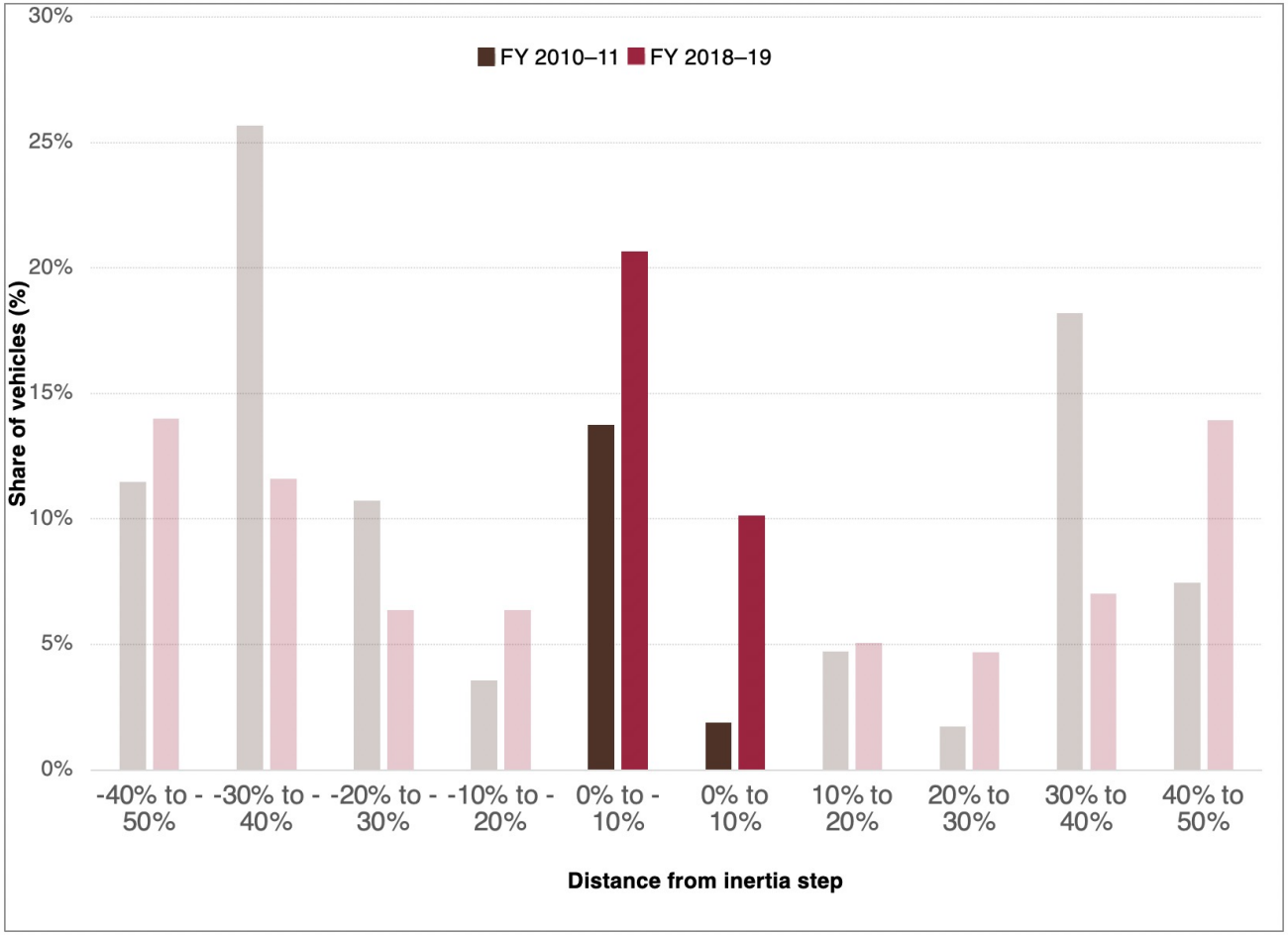
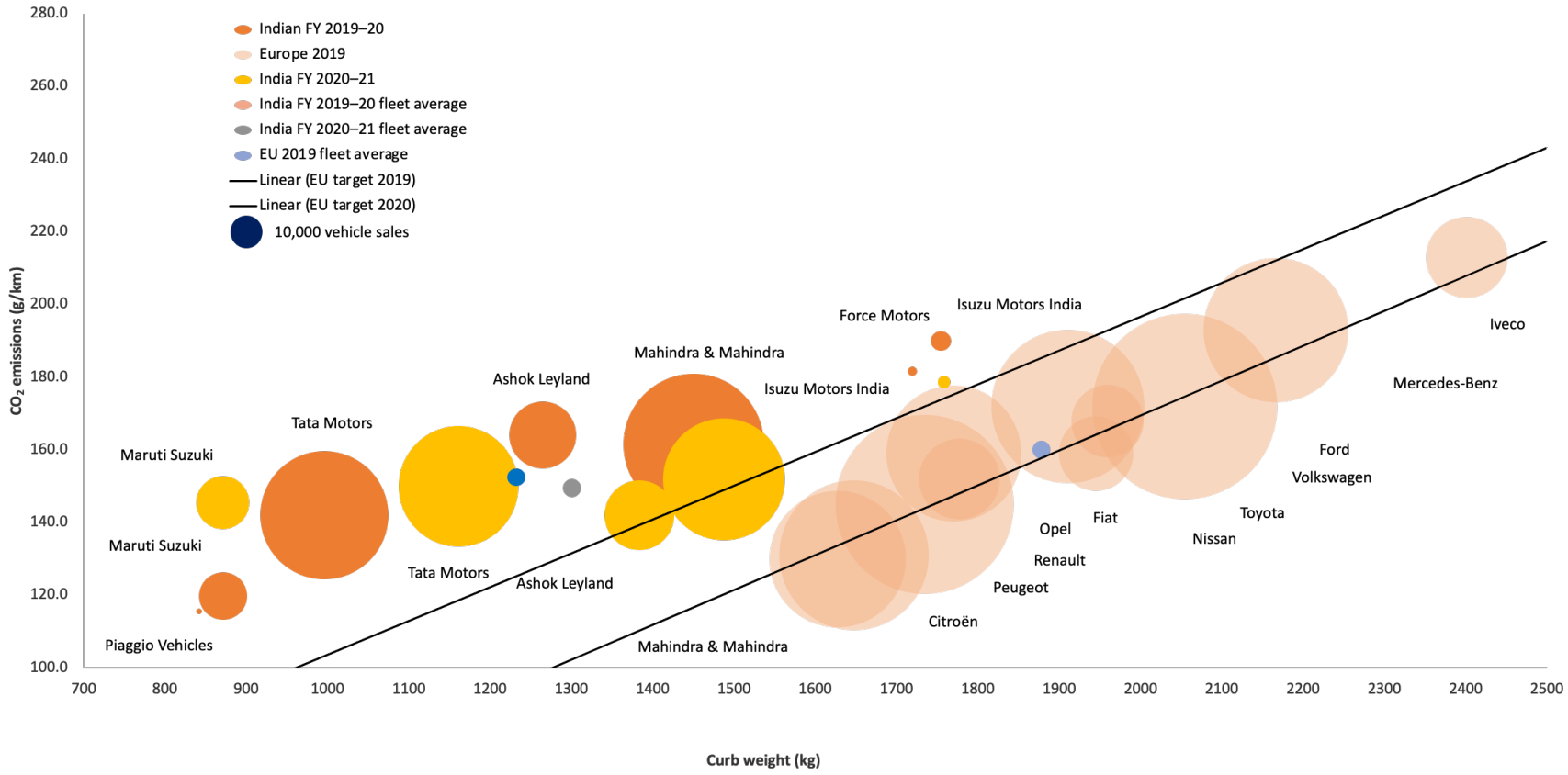
Adoption of WLTP will prevent gaming of inertia weight class and close other loopholes



- Inertia of outdated regulation: https://theicct.org/blog/staff/inertia-class-india-jan2021

Indian LCVs smaller, lighter, but not much more fuel efficient than EU counterparts – Need to adopt fuel efficiency standards for LCVs in India!



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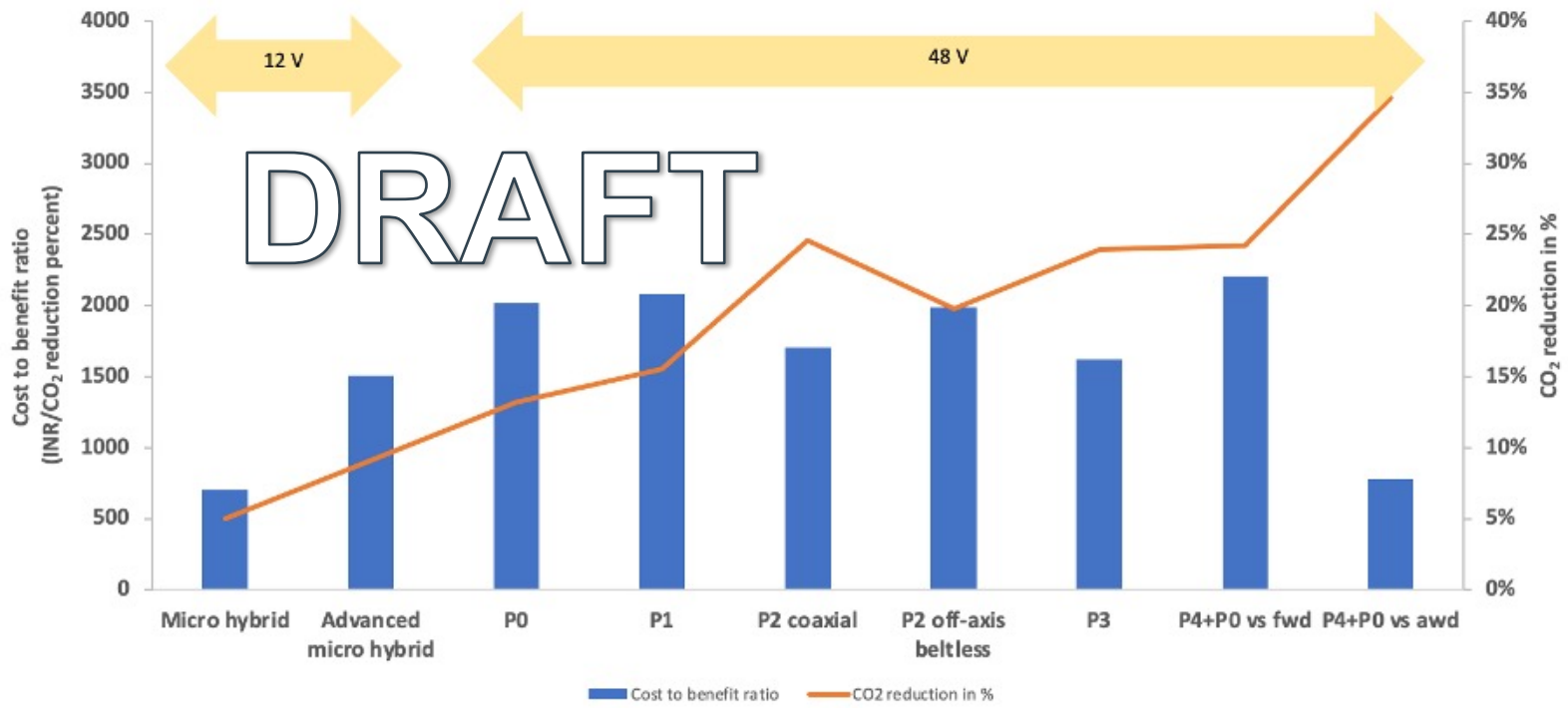
➢ https://theicct.org/publications/fuel-consumption-lcv-india-jan2021

Hybrid benefits of ~20-25% achievable at INR ~1600/ percent CO_2 reduction in 2025 versus conventional vehicles without stop/start



Potential pathway for light-duty fuel efficiency standards in India

- Switch to WLTP testing from April 2023 after implementation of FY 2022-23 fuel efficiency norms
- FY 2023-24 onwards compliance with standards should be set in WLTP terms (113gCO_2/km as measured on WLTP)
- Follow EU pathway for standards implementation with 4-year lag

Standards in gCO_2/km as measured on WLTP	FY 2023-24	FY 2027-28	FY 2031-32	FY 2035-36	FY 2039-40
Passenger Cars (M1)	113	95	75	45	~0 (?)
Light-commercial vehicles (N1)	147	125	100	70	~0 (?)

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The International Council on Clean Transportation (ICCT)

The mission of ICCT is to dramatically improve the environmental performance and efficiency of cars, trucks, buses and transportation systems in order to protect and improve public health, the environment, and quality of life.

- Non-profit research organization
- Air Pollution and Climate Impacts
- Focus on regulatory policies and fiscal incentives
- Activity across modes including aviation and marine
- Global outreach, with special focus on largest markets
- Offices in Washington D.C., San Francisco, Berlin, Beijing

India has been making slow but measurable progress on reducing transportation emissions

Vehicle fuel efficiency standards

- The first PC FE: 130 gCO_2/km in 2017 and 113 gCO_2/km in 2022
- The first HDV(>= 12 tons) FE rule adopted in August 2017
- The first HDV(< 12 tons) FE rule adopted in July 2019

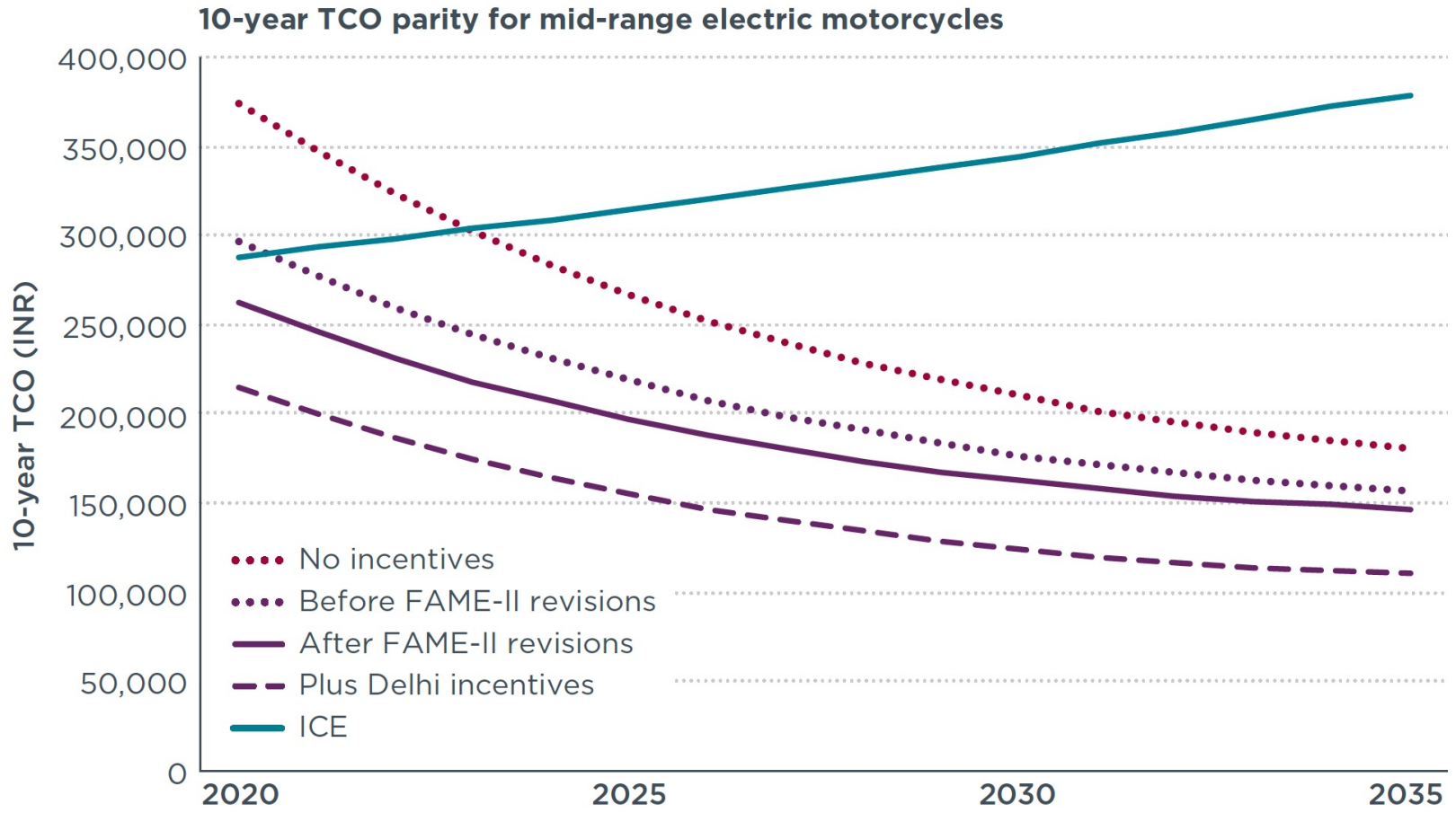
Zero-emission vehicles (ZEVs)

- Lower GST rates for EVs; exemption from compensation cess
- FAME-II fiscal incentive
- Road tax waiver and additional fiscal incentives proposed in several states including attractive electricity tariffs for EV charging stations
- Numerous additional non-fiscal incentives such as permit waivers, green license plates

Energy diversity

- National Policy on Biofuel, 2018
  - 20% bio-ethanol blending target by ~~2030~~ 2025 (>6% realized in 2020)
  - 5% bio-diesel blending target by 2030
- PM Ji-Van Yojana for 2G ethanol from March 2019 onwards
- More than 4 million CNG vehicles on road as of March 2021

Total cost parity of E2W is already here with FAME + state incentives



Well-to-wheel **GHG emissions** are 34% - 50% lower for battery electric 2W

Type	ICE small motorcycle (97.2 cc)	Electric motorcycle (3.5 kWh)	Electric motorcycle (2.7 kWh)	ICE scooter (109.5 cc)	Electric scooter (2.9 kWh)
Well-to-tank g $CO_{2\,eq.}$/km	11.0	28.7	21.7	12.8	31.7
Tank-to-wheel g CO_2 eq./km	38.3	0.0	0.0	43.4	0.0
Vehicle production g CO_2 eq./km	4.9	5.0	3.9	4.7	4.2
Battery production g CO_2 eq./km	0.0	2.0	1.6	0.0	1.7
Total g CO_2 eq./km	54.2	35.7	27.1	60.9	37.5
Life-cycle GHG savings compared to ICE	—	34.1%	50.0%	—	38.4%

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- https://theicct.org/publications/fuel-consumption-2w-india-aug2021

Life-cycle GHG emissions analysis shows the advantage of EV pathway

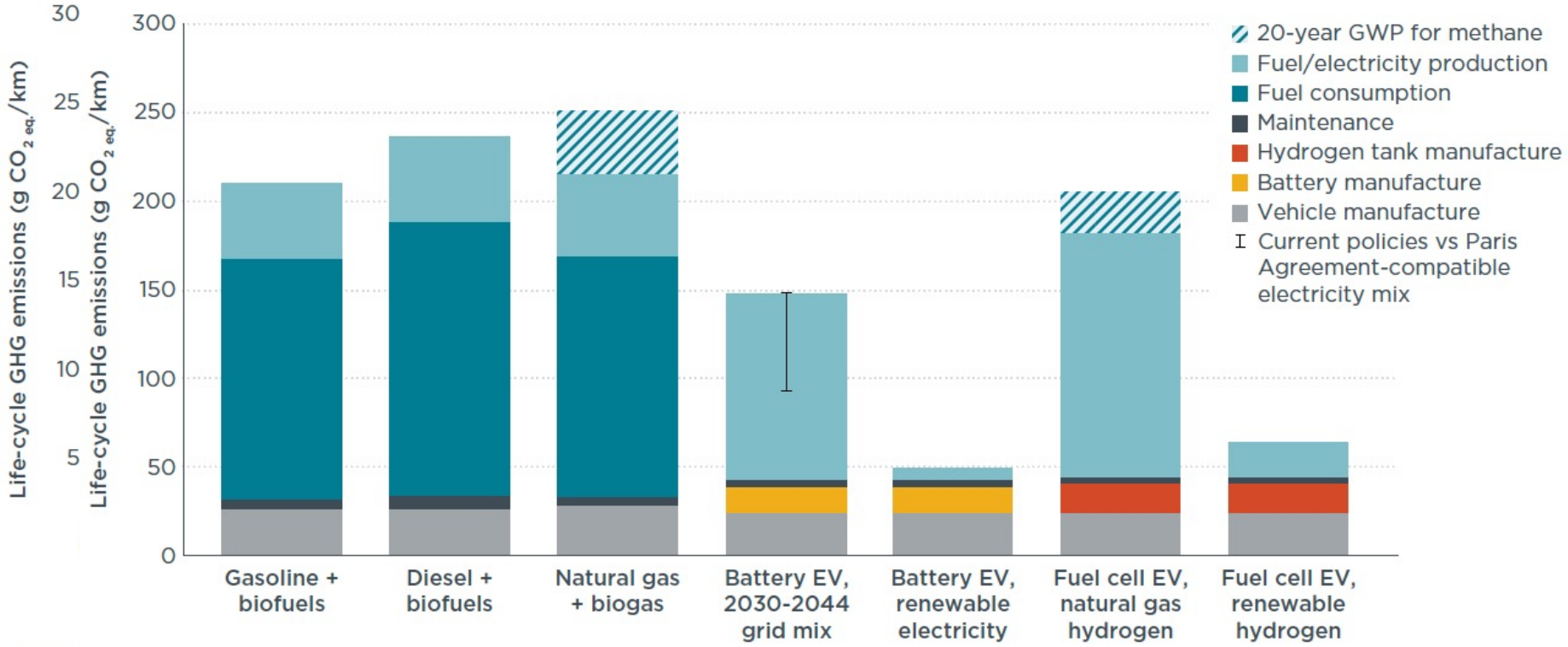
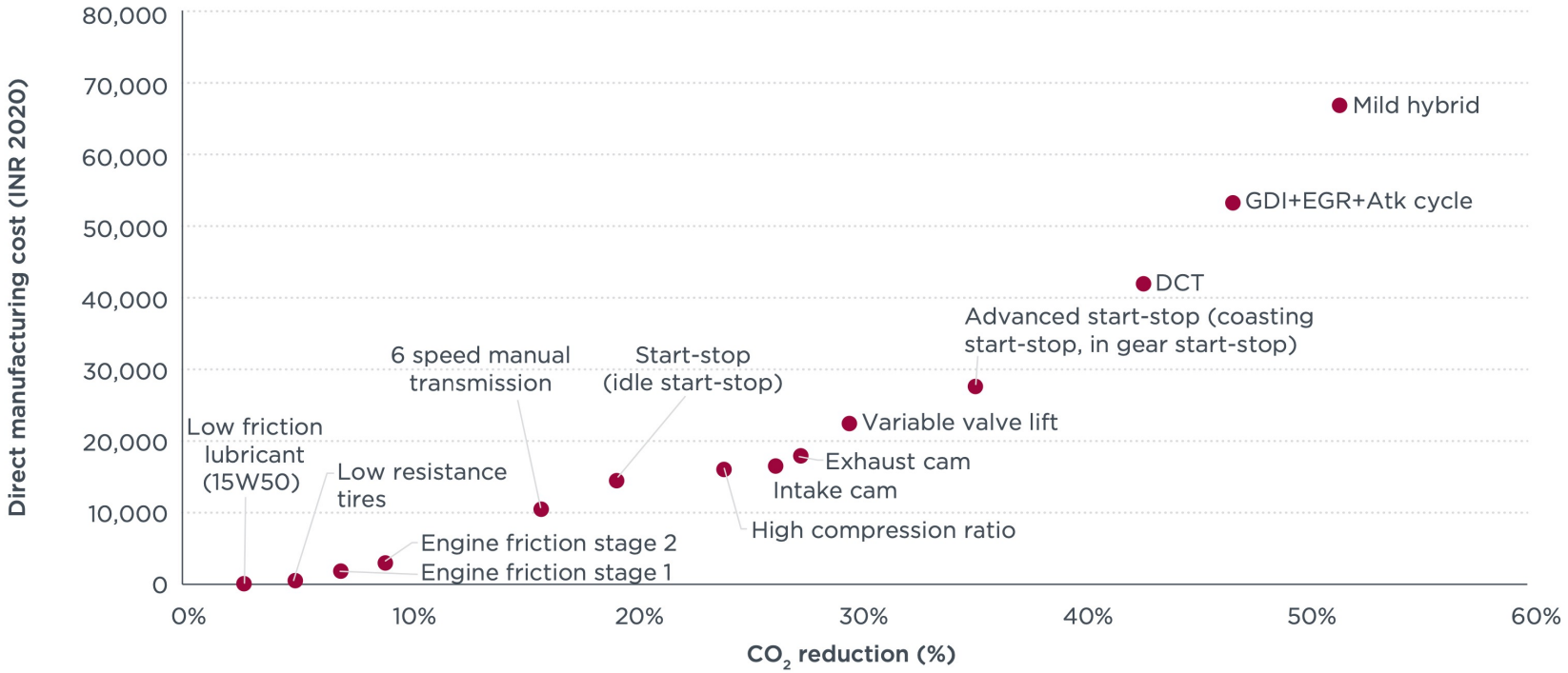


Figure 6.5. Life-cycle GHG emissions of sedan segment gasoline, diesel, and CNG ICEVs, BEVs, and FCEVs projected to be registered in India in 2030.

2021 sedan in India

2030 sedan in India

Doubling the fuel economy of large motorcycles possible at a cost of less than INR 67,000



Technology cost curve shows till what level of CO_2 reduction benefit can be cost-effectively availed. There are two ways of plotting technology cost curves