

Priorities for Transport Decarbonization in India

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based on a decision of the German Bundestag

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

Vehicle fuel efficiency standards

- The first PC FE: 130 gCO₂/km in 2017 and 113 gCO₂/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)

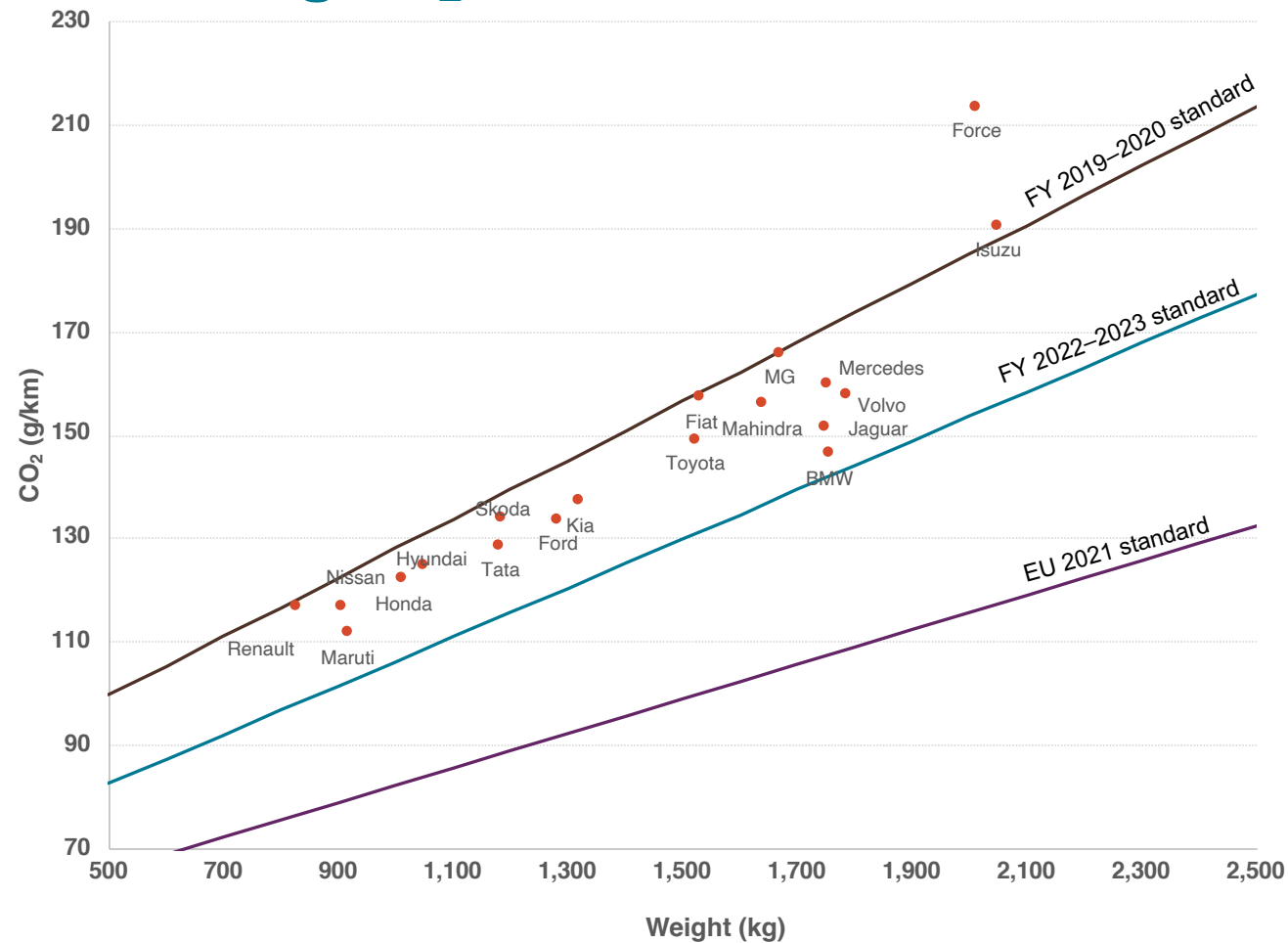
- Lower GST rates for EVs; exemption from compensation cess
- FAME-II fiscal incentive
- Road tax waiver and additional fiscal incentives proposed in several states including attractive electricity tariffs for EV charging stations
- Numerous additional non-fiscal incentives such as permit waivers, green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

Energy diversity

- National Policy on Biofuel, 2018
 - 20% bio-ethanol blending target by 2030 (>6% realized in 2020)
 - 5% bio-diesel blending target by 2030
- PM Ji-Van Yojana for 2G ethanol from March 2019 onwards
- More than 3.3 million CNG vehicles on road as of March 2019

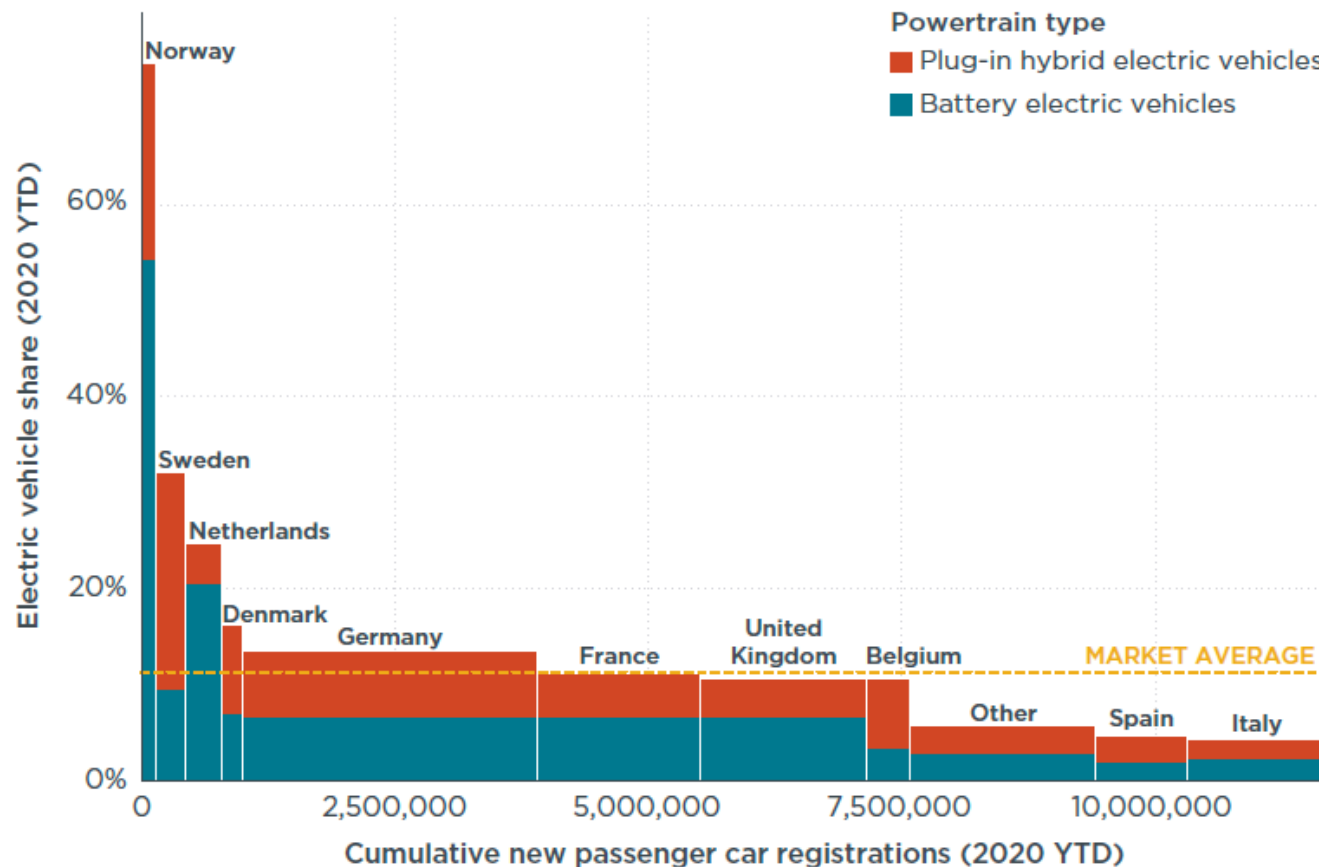
Vehicle Fuel Efficiency Standards

Passenger vehicle CO₂ emissions down from 141gCO₂/km in 2009 to 122gCO₂/km in 2019

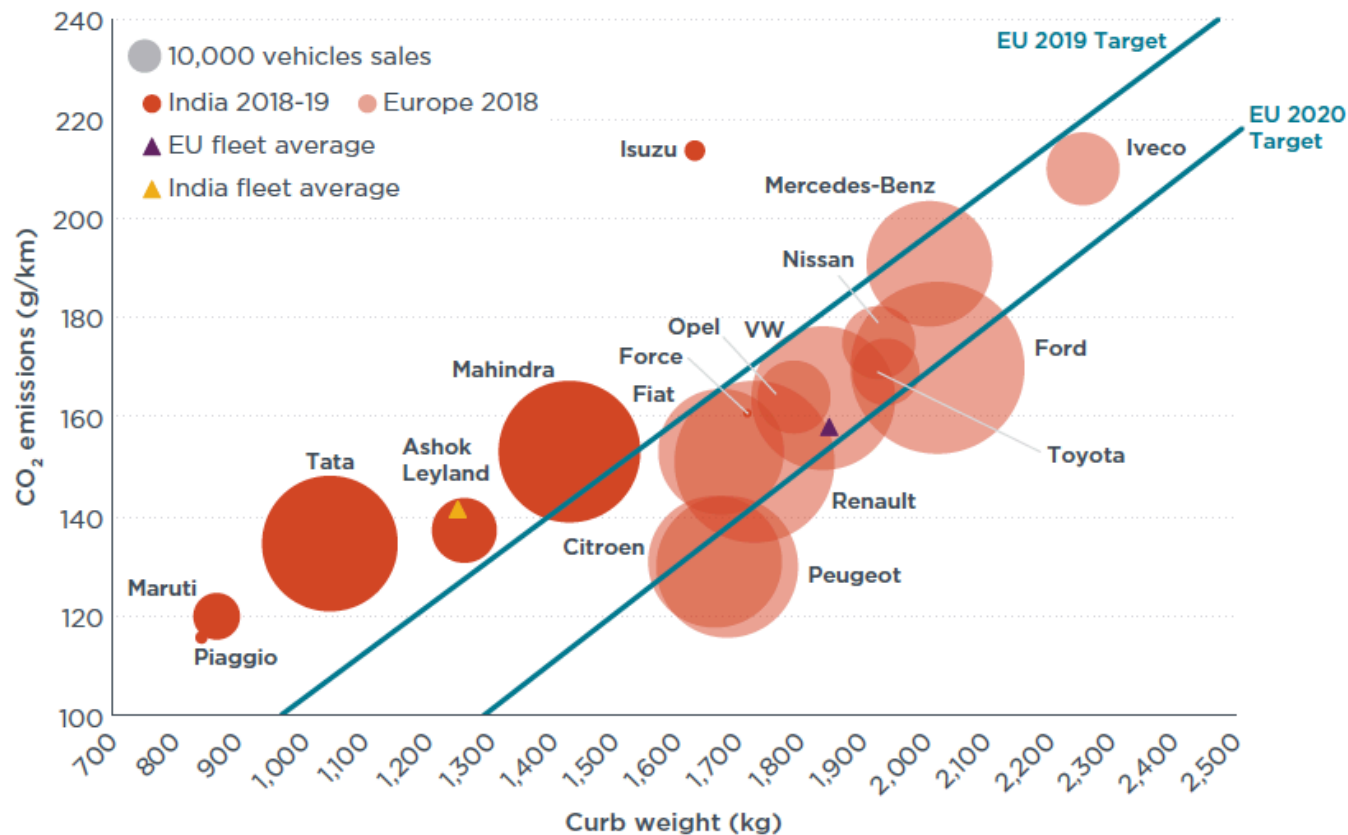


➤ <https://theicct.org/publications/fuel-consumption-pv-india-052020>

EV Share of new car registration in EU increased to 11% in 2020 from 3% in 2019



Indian LCVs smaller, lighter, but not much more fuel efficient than EU counterparts



~35% CO₂ reduction for an ICE motorcycle possible with a five-year payback; ~77% CO₂ reduction possible for an E2W with a 3.5-year payback

Package	Technologies	CO ₂ emissions reduction (%)	Cumulative cost (2020 INR)
	Baseline (4-speed MT, air-cooled, EFI, BS VI)	0%	0
Tech PK1	Low-friction lubricant, low-rolling-resistance tires, low-drag brakes, engine friction stage 1	9%	1,907
Tech PK2	Low-friction lubricant, low-rolling-resistance tires, low-drag brakes, engine friction stage 1, engine friction stage 2, 5-speed MT	19%	5,782
Tech PK3	Low-friction lubricant, low-rolling-resistance tires, low-drag brakes, engine friction stage 1, engine friction stage 2, 5-speed MT, start-stop (idle), high compression ratio	26%	9,806
Tech PK4	Low-friction lubricant, low-rolling-resistance tires, low-drag brakes, engine friction stage 1, engine friction stage 2, 5-speed MT, start-stop (idle), high compression ratio, advanced start-stop (coasting/in-gear) with e-clutch	34%	13,514
Tech PK5	Low-friction lubricant, low-rolling-resistance tires, low-drag brakes, engine friction stage 1, engine friction stage 2, 5-speed MT, start-stop (idle), high compression ratio, advanced start-stop (coasting/in-gear), mild hybrid	42%	20,063
Tech PK6	Electric motorcycle	77%	27,148

30% E2W penetration by 2025 possible with stringent fuel efficiency standards: 25gCO₂/km

Table 16. Compliance cost in 2025 for fleet average 25.3 gCO₂/km for two-wheeler fleet achieved by ICE technology exhaustion.

Vehicle type	Segment share (%)	ICE share of segment (%)	ICE gCO ₂ /km	EV share of segment (%)	EV gCO ₂ /km	ICE share of market (%)	EV share of market (%)	Compliance cost (INR 2020)
Small motorcycle	60%	100%	21.0	0%	8.2	60%	—	18,589
Scooter	30%	100%	26.0	0%	9.8	30%	—	22,069
Large motorcycle	10%	100%	49.0	0%	—	10%	—	6,346
Fleet average	100%	100%	25.3	0%	—	100%	—	18,409

Table 17. Compliance cost in 2025 for fleet average 25.3 gCO₂/km for two-wheeler fleet achieved by cost beneficial E2W penetration.

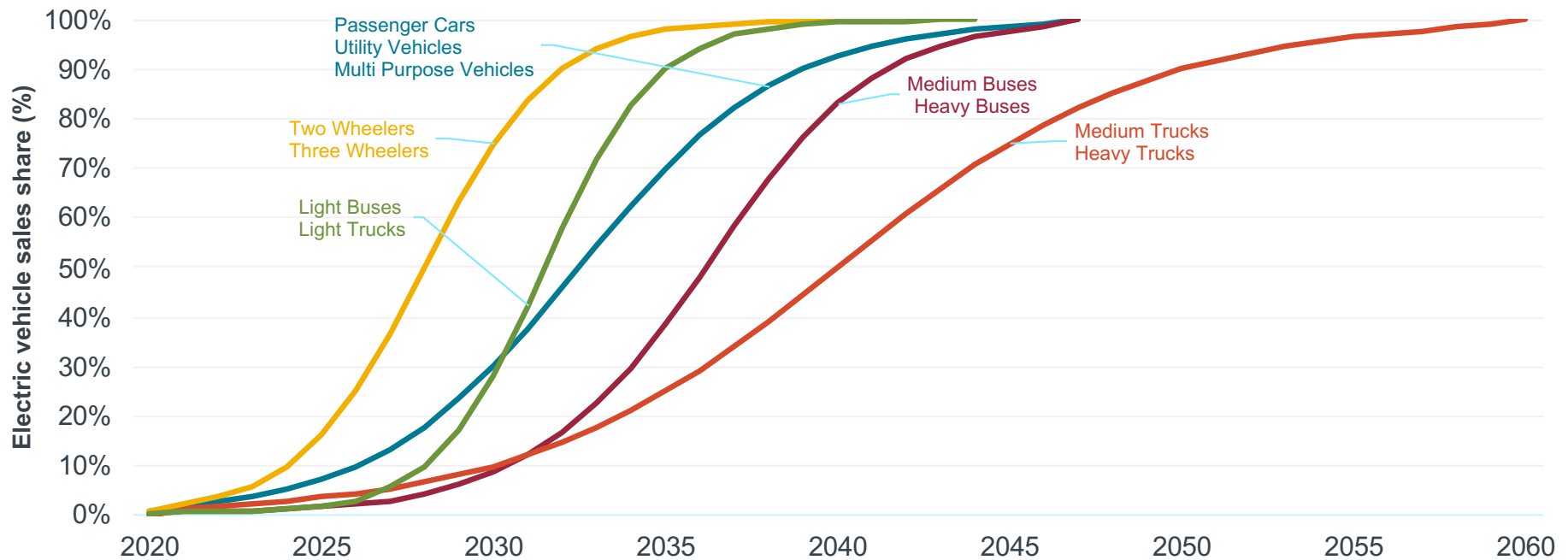
Vehicle type	Segment share (%)	ICE share of segment (%)	ICE gCO ₂ /km	EV share of segment (%)	EV gCO ₂ /km	ICE share of market (%)	EV share of market (%)	Compliance cost (INR 2020)
Small motorcycle	60%	68%	21.0	32%	8.2	41%	19%	10,308
Scooter	30%	58%	26.0	42%	9.8	17%	13%	8,271
Large motorcycle	10%	100%	49.0	0%	—	10%	—	6,346
Fleet average	100%	68%	25.3	32%	—	100%		9,300

Zero Emission Vehicle Standards

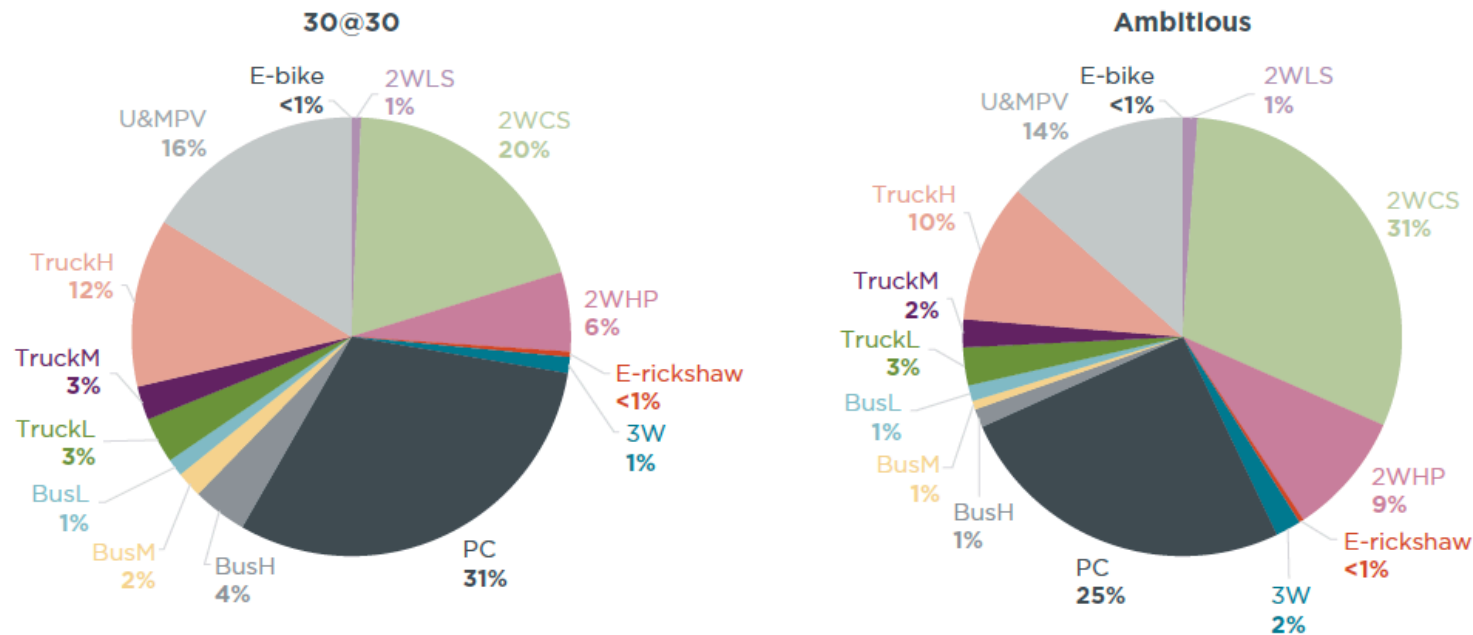
Passenger vehicle zero emission vehicle targets growing rapidly

Government	Target year	Target
China	2023 2035	~7-8% New Energy Vehicles (NEVs) 50% Hybrids + 50% NEVs
California (+ Sec. 177 states)	2025 2035	~10% 100% PHEV+BEV+FCEV only
British Columbia	2040	100% PHEV+BEV+FCEV only
United Kingdom	2030 2035	HEV+PHEV+BEV+FCEV only PHEV+BEV+FCEV only
Japan	2035	50% Hybrids + 50% (PHEV+BEV+FCEV)
European Union (EU)	2025 2030	~15% ~30%
South Korea	2025 2030	~10% ~33%

Goal is to fully electrify new vehicle sales in India by mid-century. Chart shows current optimistic, but plausible trajectory.

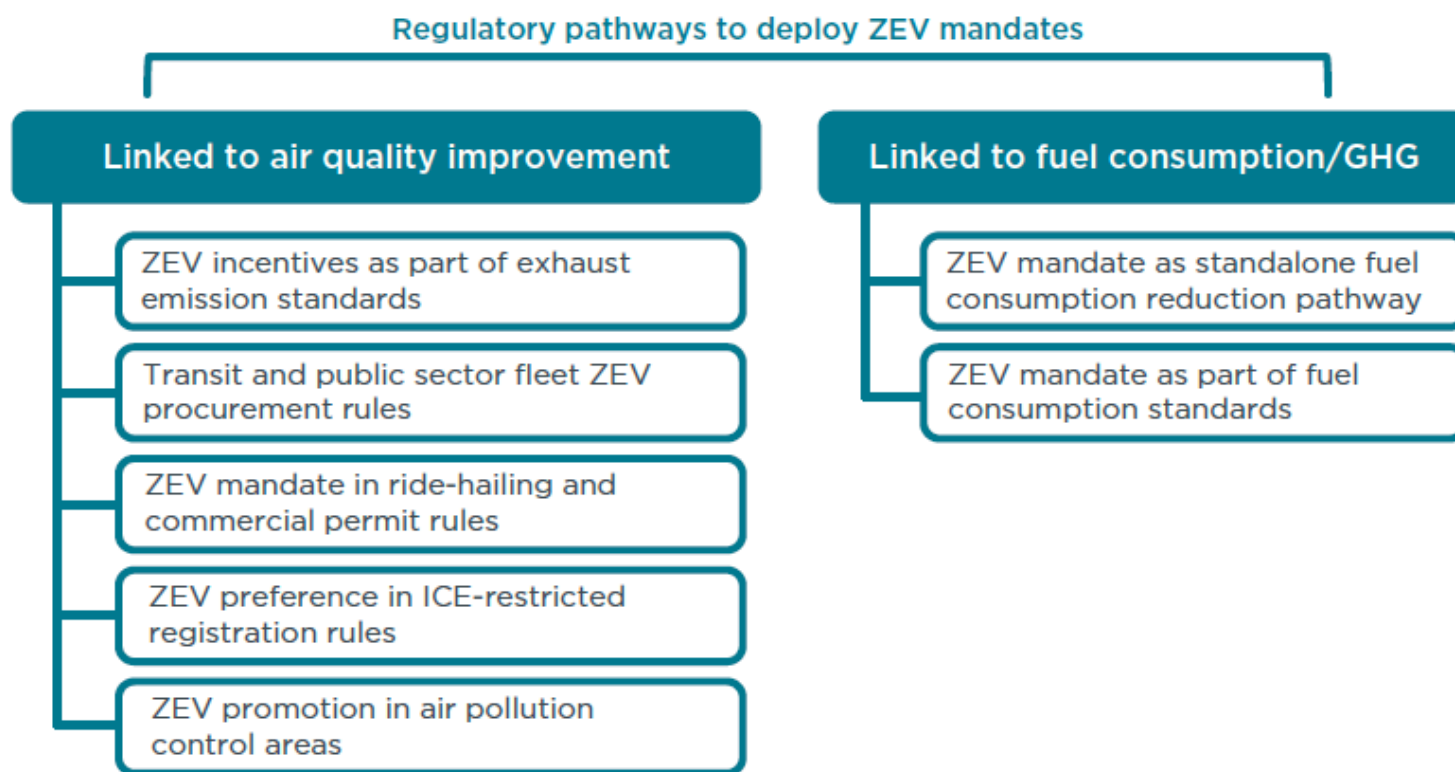


250Gwh annual battery production capacity required by 2030 to meet battery demand in 30@30 scenario



Contribution of different EV categories to cumulative battery capacity requirement by 2035

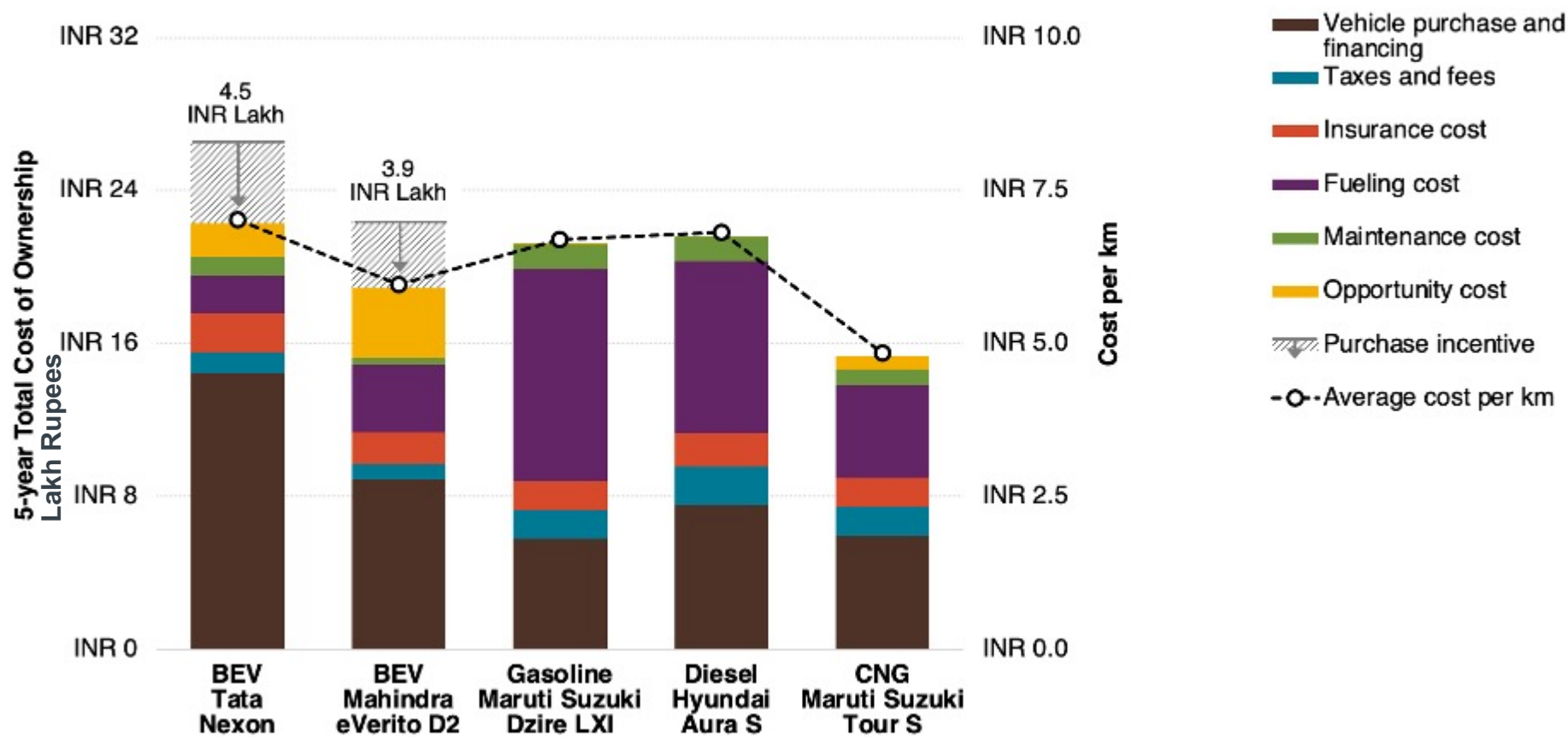
Continued investment in charging infrastructure, & fiscal/non-fiscal incentives for EVs need to be accompanied by mandates



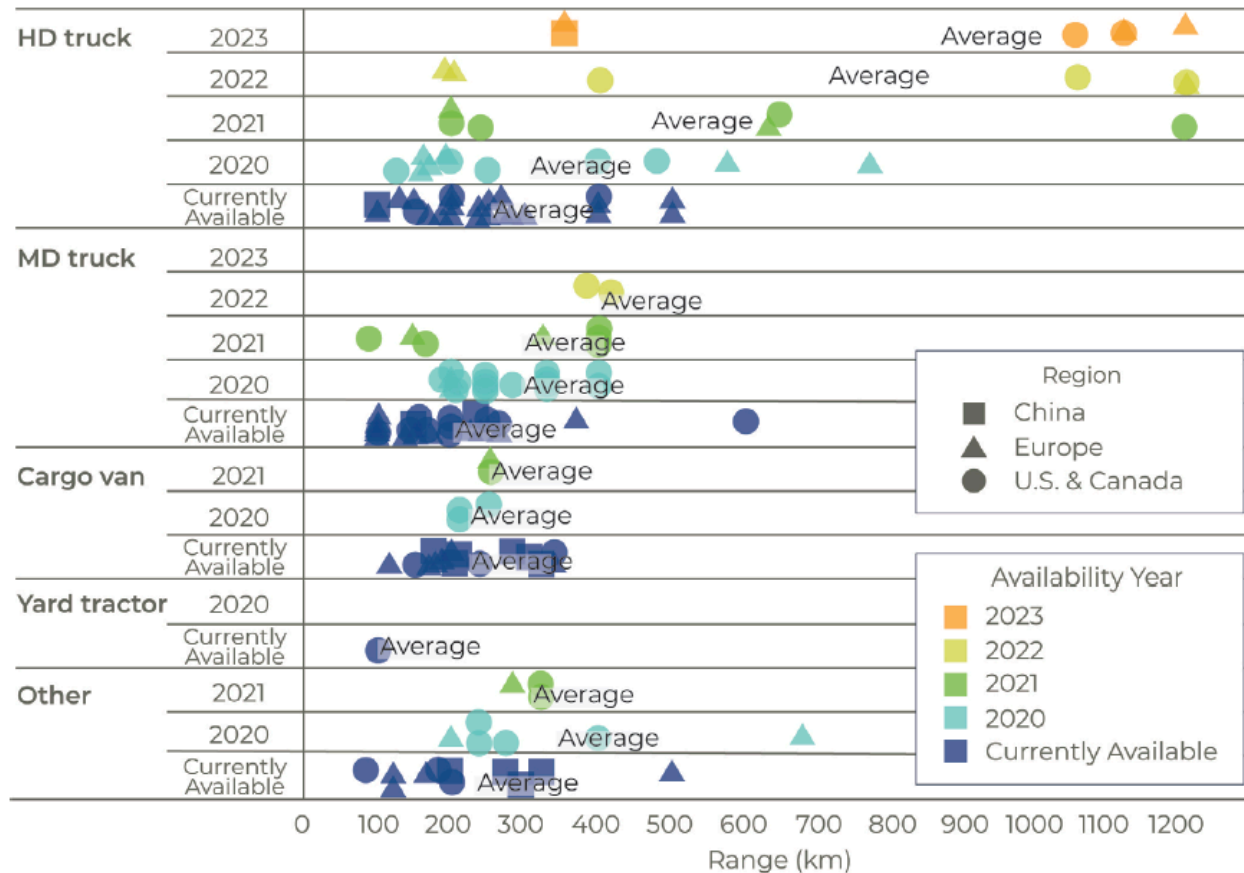
➤ Regulatory pathways for zero-emission vehicle mandates:
<https://theicct.org/publications/regulatory-pathways-zev-mandates-201907>

Delhi City (NCT of Delhi)

Total cost of ownership (TCO) for vehicles in ride-hailing operation in 2020

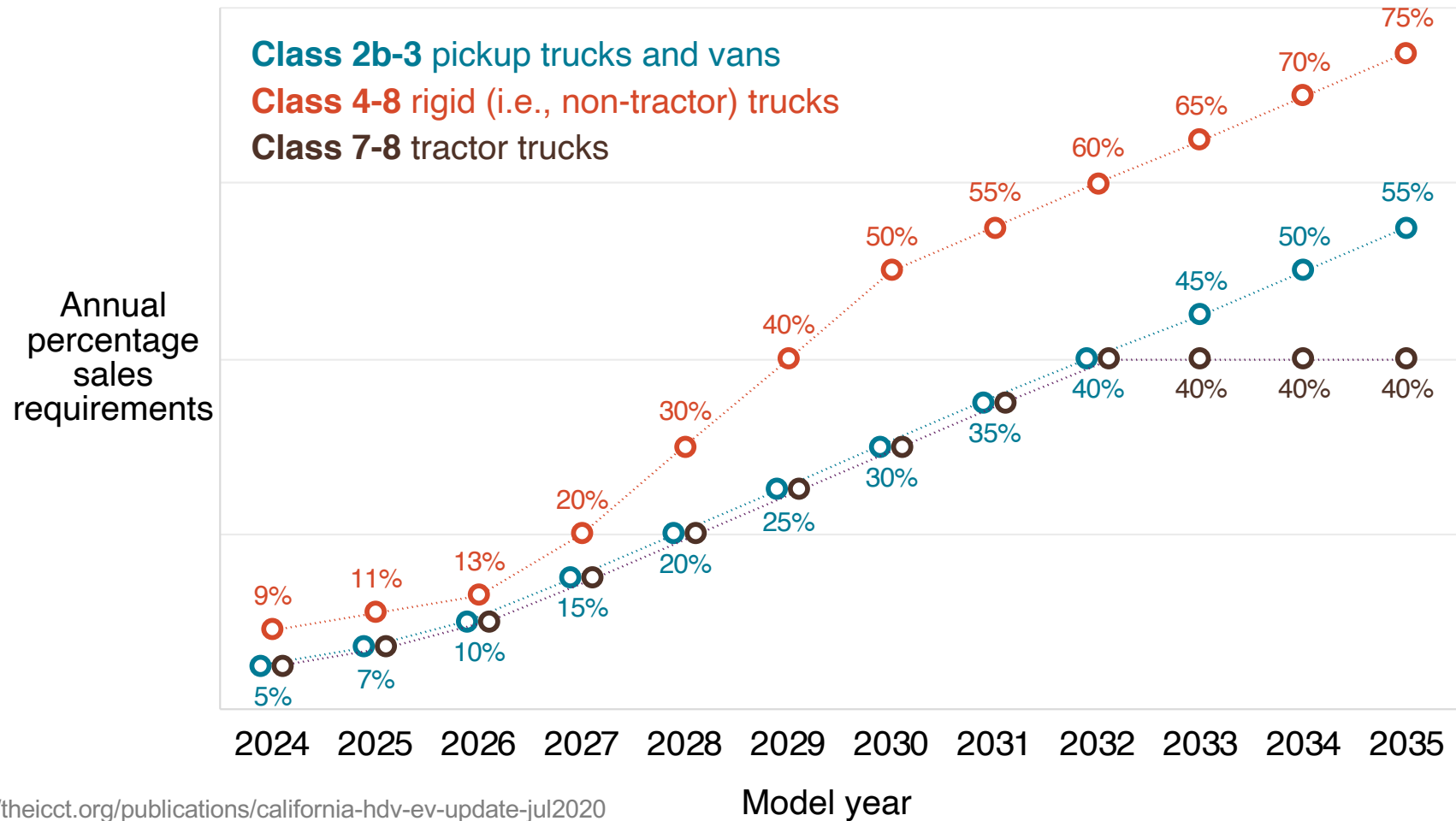


Zero-emission trucks (ZET) are becoming available for sale in US, EU and China



➤ <http://www.zevalliance.org/zero-emission-freight-2020/>

California Advanced Clean Truck (ACT) rule is paving the way for Zero Emission Trucks (ZETs)



Second Generation (2G) Ethanol

Financial Support to Scale Up Cellulosic Ethanol

Pradhan Mantri Ji-Van yojana in 2019

- Bridge the ethanol supply gap
- Accelerate production of cellulosic ethanol
- Provide Viability Gap Funding (VGF) for 12 commercial projects and 10 demonstration projects
 - Rs 19.7 billion in total
 - Funding cap per project
 - Rs 1.5 billion for commercial projects
 - Rs 0.15 billion for demonstration projects
 - Two implementation phases
 - Phase I: 2018-19 to 2022-23
 - Phase II: 2020-21 to 2023-24

Levelized Production Cost

– With and Without VGF Funding

- Current highest fixed ethanol price in India is 59.48 Rs/liter (0.8 USD/liter)
- VGF funding shall be chosen as the minimum of:
 1. 20% of project cost
 2. Rs 50 million for every million liter ethanol production
 3. **Rs 1.5 billion (applied to each case)**

Rs per Liter (USD per Liter)		36.5M capacity	70M capacity	Range from other studies
No funding	Rice straw	114.8 (1.55)	98.2 (1.33)	40 – 157 (0.5 – 2.1) (India's fixed ethanol price as 59.48 Rs/liter or 0.8 USD/liter)
	Wheat straw	115.3 (1.56)	98.7 (1.33)	
	Sugarcane bagasse	114.2 (1.54)	97.6 (1.32)	
With VGF funding	Rice straw	98.9 (1.34)	89.9 (1.21)	
	Wheat straw	99.4 (1.34)	90.4 (1.22)	
	Sugarcane bagasse	98.3 (1.33)	89.2 (1.21)	

Conclusions on VGF under PM JI-VAN Yojana



Current policy support, including the VGF funding, is insufficient to scale up 2G ethanol industry

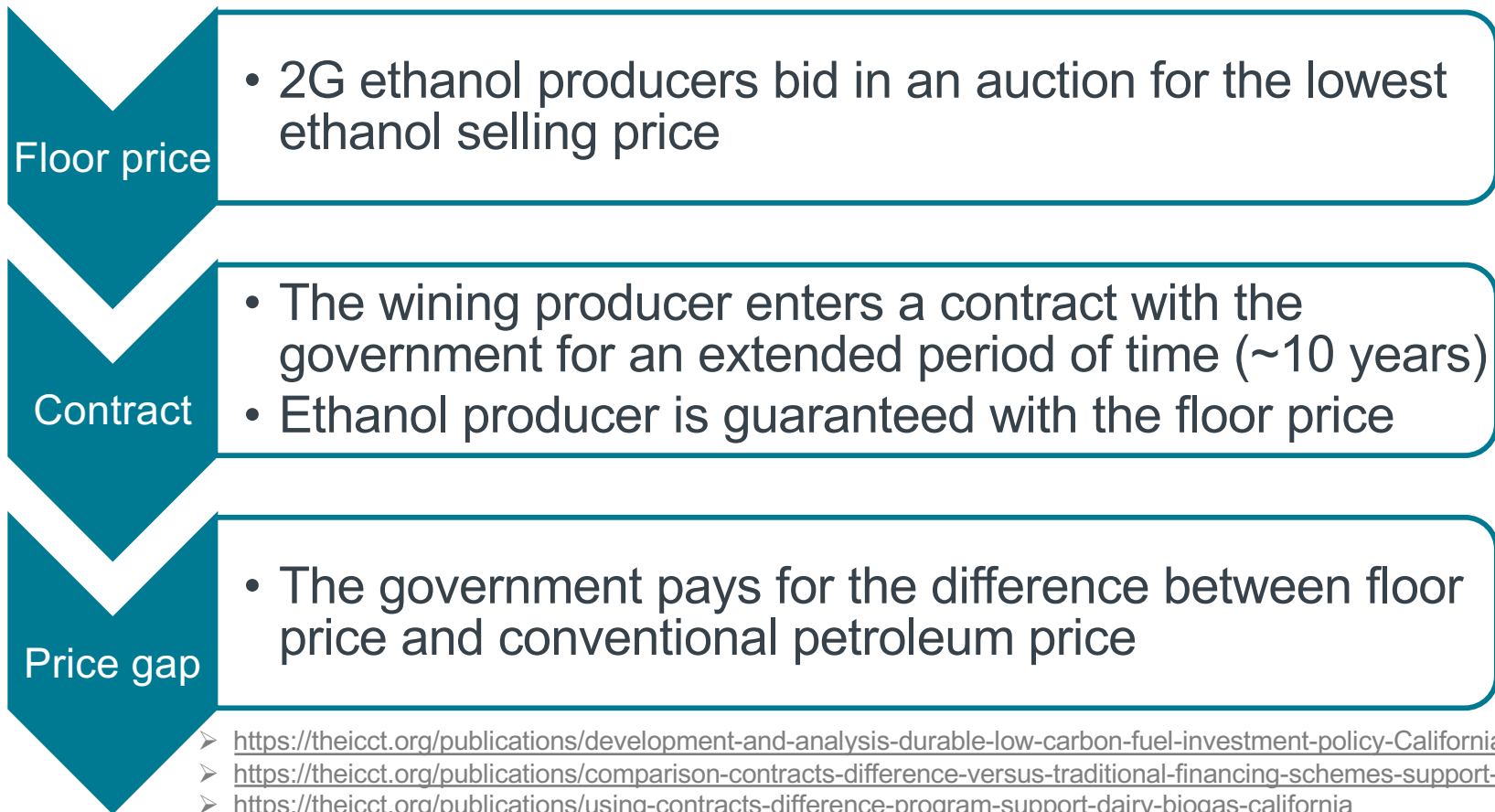


Production cost (at 18% return) is higher than the highest fixed ethanol price currently in place



Current fixed ethanol price (= Rs 59.48 per liter) only gives less than 6% return with VGF or less than 4% return without VGF

New Policy Design – Contracts for Difference (CfD)



Benefits of the CfD Mechanism

For 2G ethanol industry

- Provide policy and financial certainties to ethanol producers
- Reduce the investment risks and attract private investment

For government

- Guaranteed amount of ethanol supply
- Avoid overspending in financial incentive – vary according to the petroleum price

ICCT India Initiative: <http://www.theicct.org/india>

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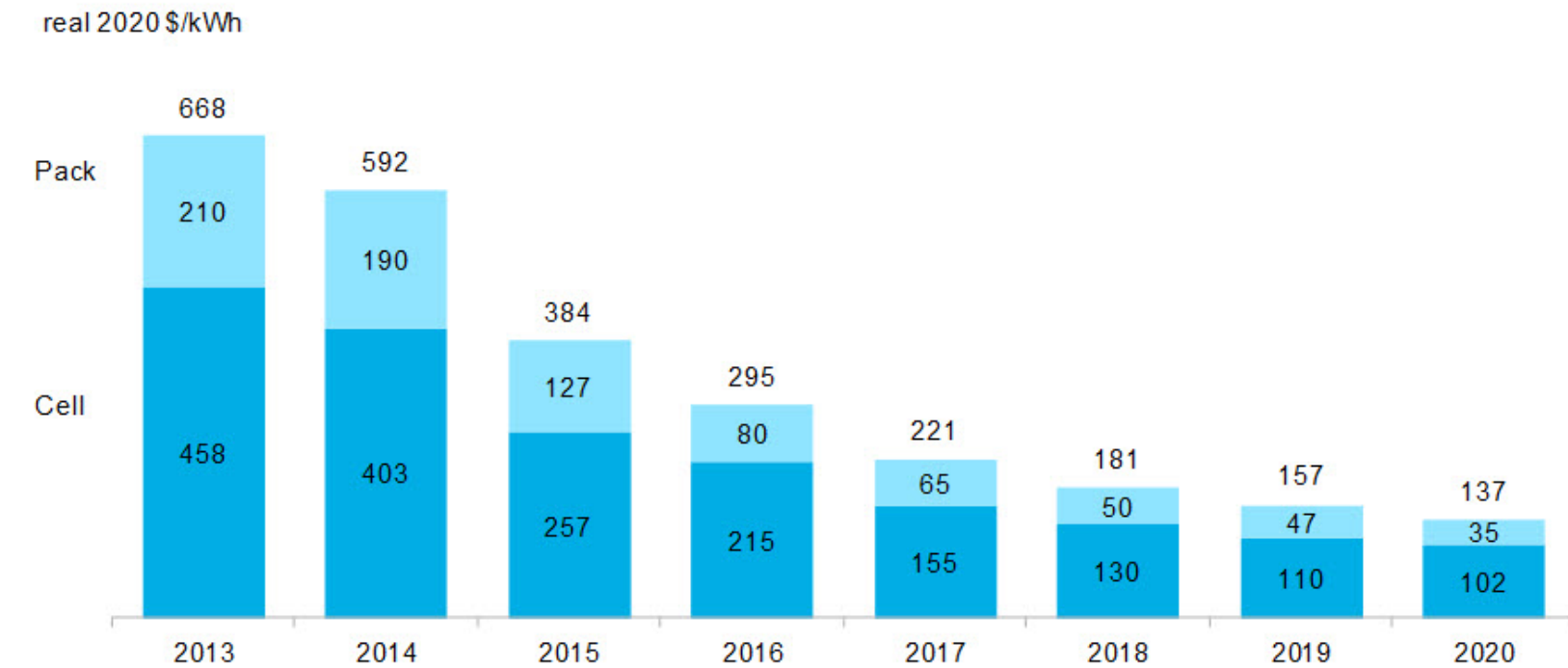
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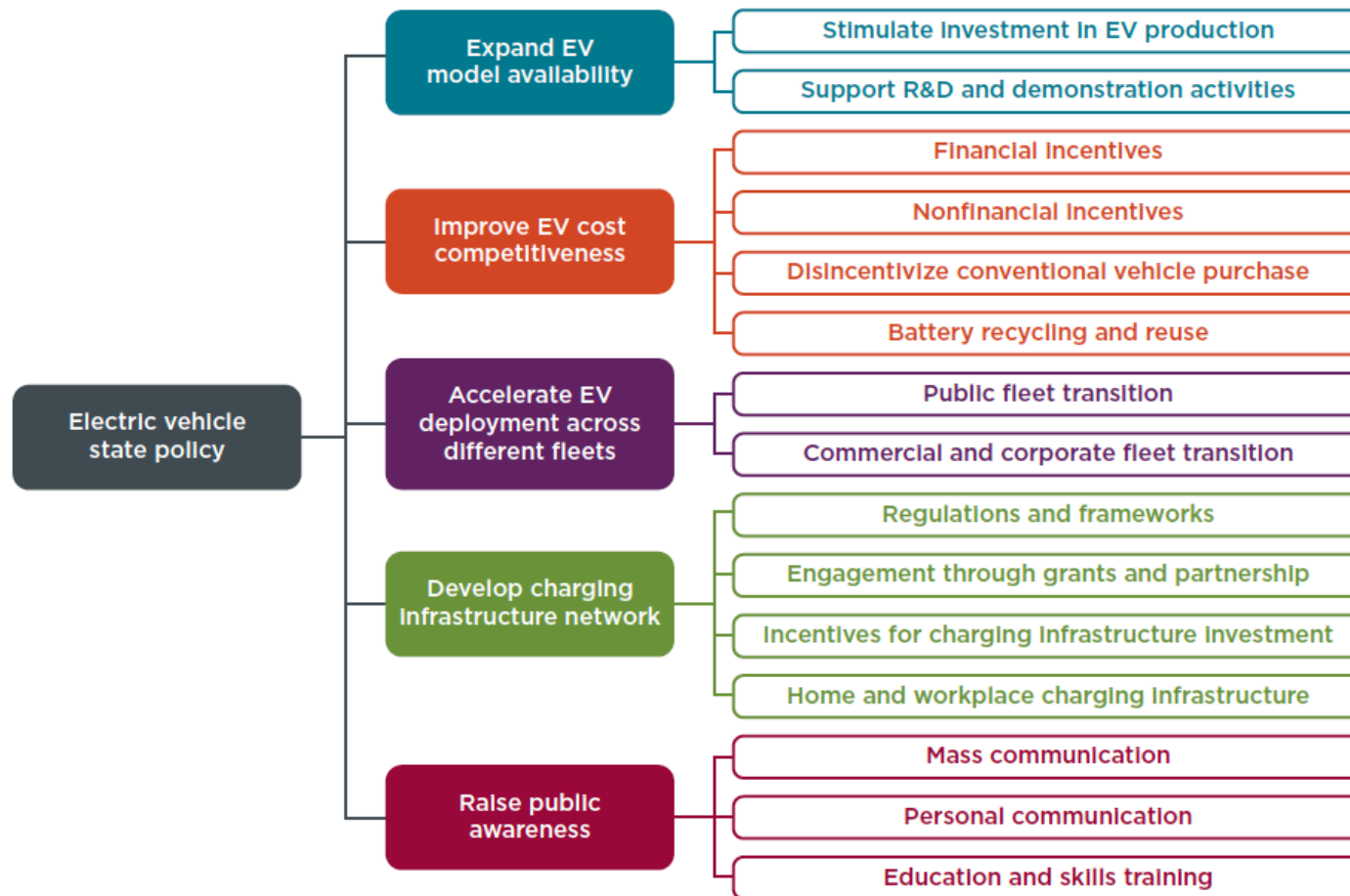
Average Li-ion battery prices have come down by ~89% in the last decade – on track to ~\$100/kWh by 2024



Source: BloombergNEF

➤ <https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/>

A variety of state-level actions needed to promote electrification



➤ <https://theicct.org/publications/electric-vehicle-guidebook-indian-states>