Indian Emission Norms and Leapfrogging from BS-IV to BS-VI and Challenges for Two Wheeler

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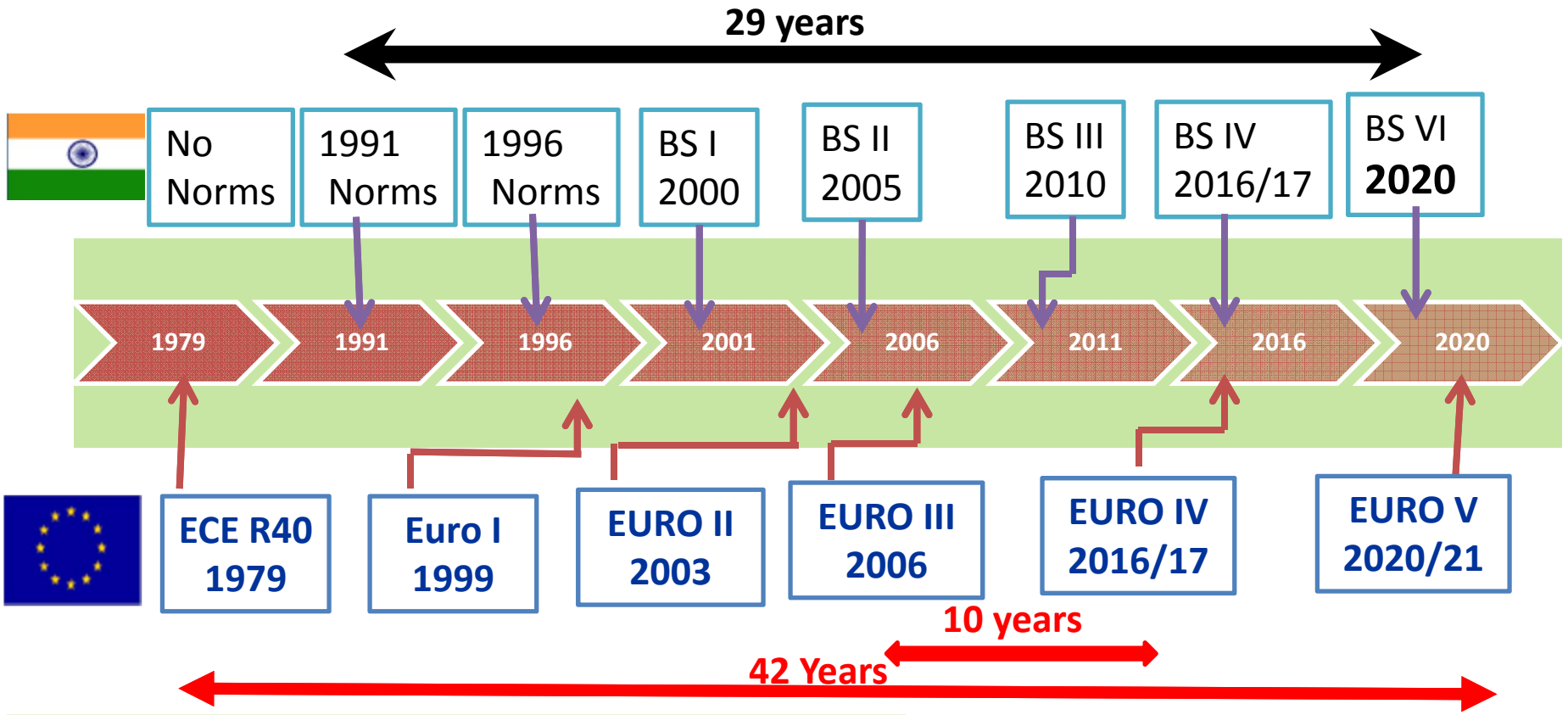
Emission Regulations in India

BS-VI Scenario

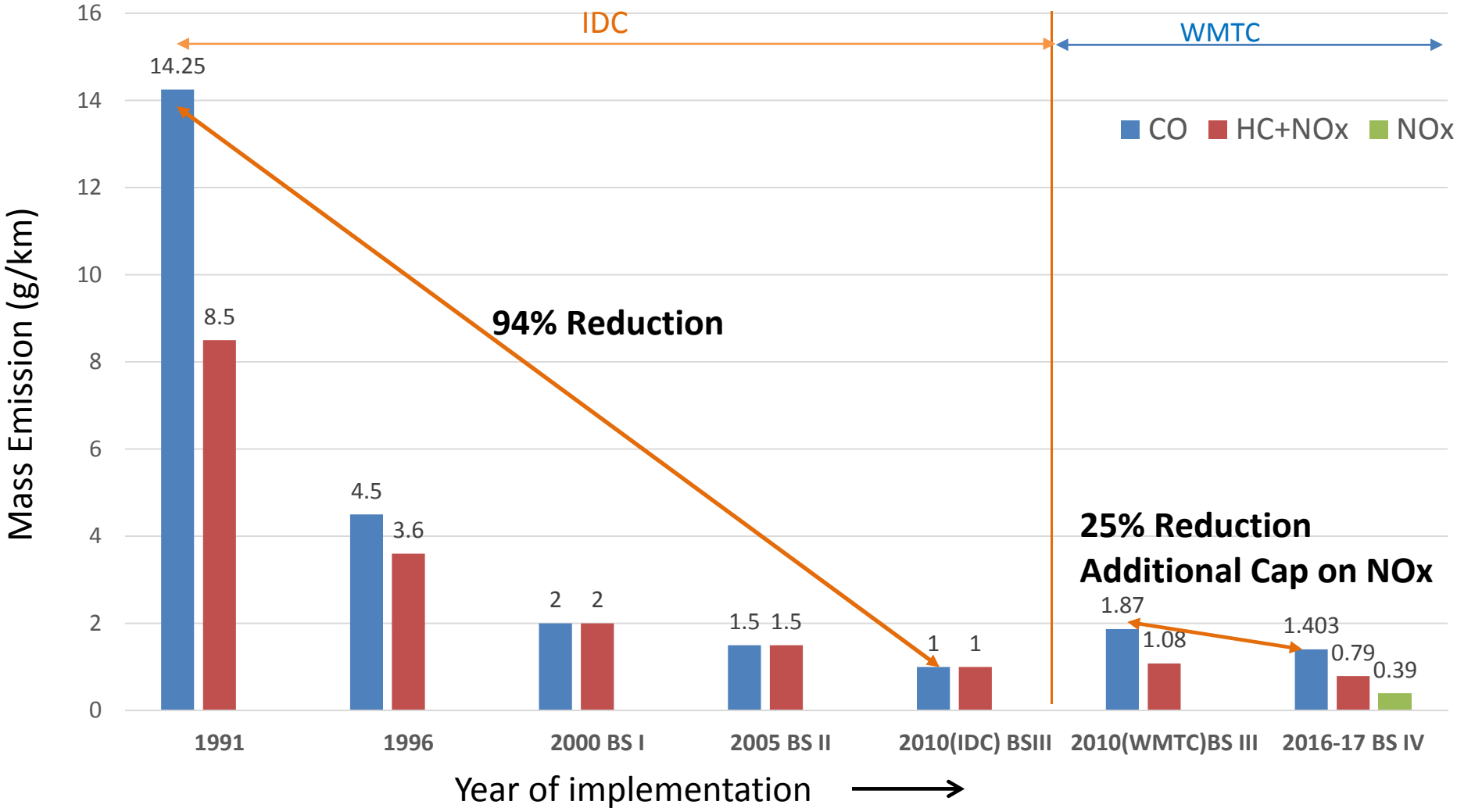
Emission Norms Progression of 2 Wheelers



- Indian emission norms for 2 Wheelers has been tighten periodically every 5 years.
- Indian 2 W are used for commuting purposes and hence Fuel Economy is very important.
- Indian Emission norms are made to keep the high level of fuel efficiency in tact.

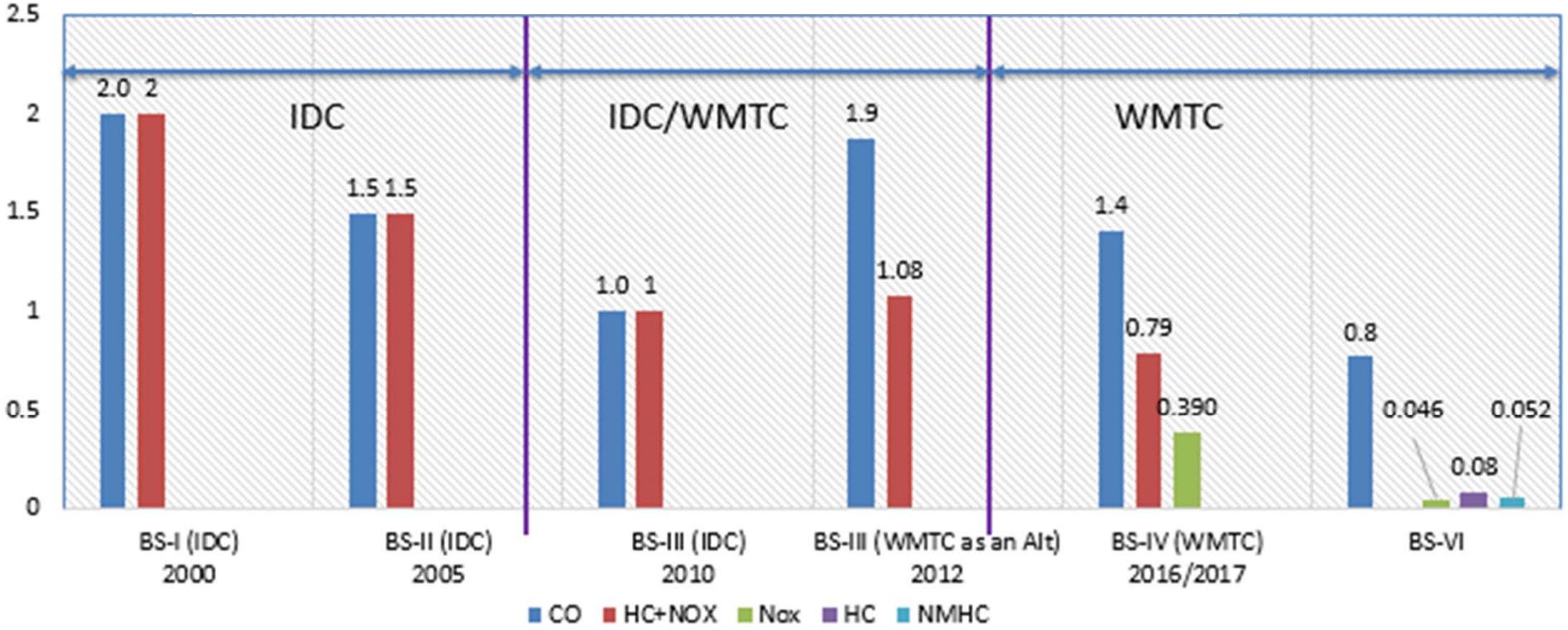
- EU has taken 42 years to reach EURO-V standards starting from year 1979.
- European 2 W are primarily used for leisure purposes and no specific focus of Fuel Economy.

INDIAN TWO WHEELER EMISSION NORMS PROGRESSION TILL BS-IV (1/2)



WMTC Norms shown only for class 1, 2-1 which constitute ~92% of Indian vehicle production

INDIAN TWO WHEELER EMISSION NORMS PROGRESSION TILL BS-IV (2/2)



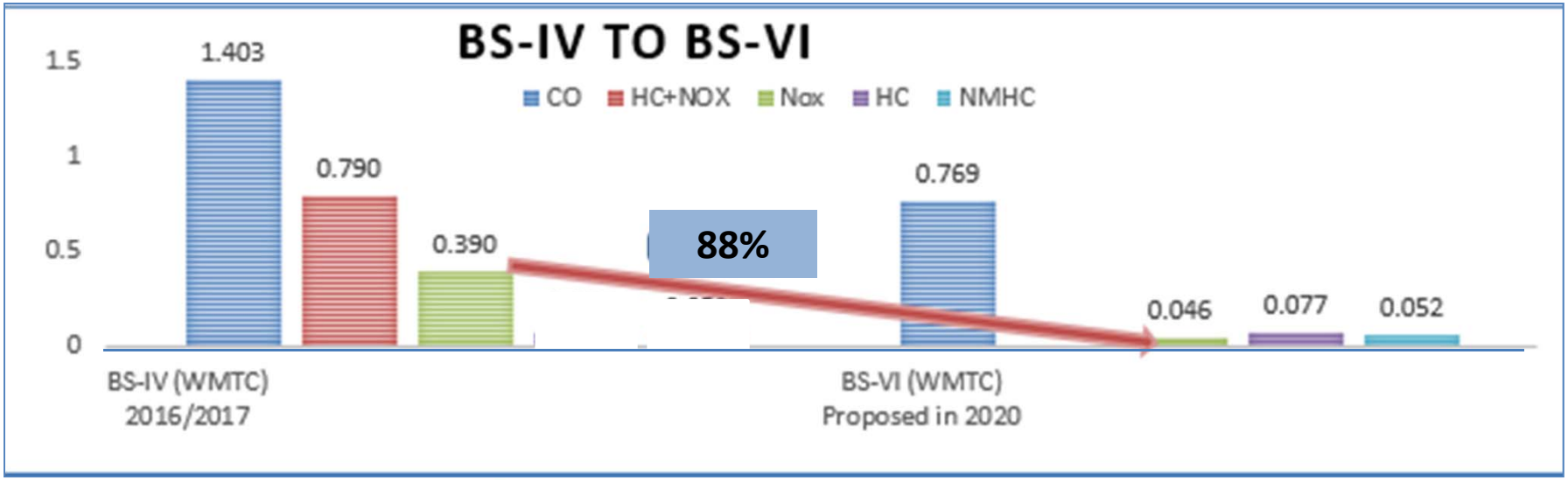
- Indian 2W emission norms have been progressively tightened every 5 yrs.
- Indian Emission norms are made to keep the high level of fuel efficiency till BS-IV hence…
- Till BS-IV, limits for combined HC + NOx was specified, for retaining superior FE.
- Indian 2 W are used mainly for commuting purposes and hence Fuel Economy is an important factor.

BS-IV Conclusion

- Driving Cycle – Only WMTC
- 25% Reduction from BS-III
- Additional cap for NOx limits.
- Evaporative limits for THC<2g/Test
  - (Alternate THC<6g/Test with additional tightening HC+NOx by 0.2g/km)
- Zero Crankcase Emissions

Leapfrogging from BS-IV to BS-VI

- 88% Reduction in NOx
  - 0.39g/km → 0.046g/km
- 40% reduction in SHED test limit
  - 2g/test → 1.2g/test
- Introduction of OBD
  - In use performance ratio monitoring
  - Catcon Monitoring
  - Misfire Detection



Leapfrogging From BS-IV to BS-VI

- MoRTH Notified BS-VI skipping BS-V
- Effective 1st Apr 2020 (3yrs lead time from BS-IV)
- MoRTH Notified that BS-IV Veh produced before 1st Apr2020 to be registered within 3M **(This notification has been over ruled by Honourable SC on 24th Oct 2018)**
- MoRTH has also assured BS-VI fuel availability as per Notification ?
- This is major change in the history of Emission progression in India
- BS-VI Norms aligned with latest Europe Norms i.e. EU-5 (2020/21) (There is no EU6 for 2Ws)
- BS-VI Challenges
  - EU-5 norms are not even final yet and subject to review
  - Technologies do not exist today even in Europe
- BS-VI will have further FE drop w. r. to BS-IV due to stringent NOx limits.

BS-VI Emission Norm GSR 889(E) dt 16th Sep 2016 (Gasoline)

	CO (mg/km)	HC (mg/km)	NMHC (mg/km)	NOx (mg/km)	PM* (mg/km)	Durability (km)	Evapo (mg/test)
Class1&2	1000	100	68	60	4.5	20,000	1500
Class 3	1000	100	68	60	4.5	35,000	1500
DF	1.3	1.3	1.3	1.3	1	---	300**

Vehicle should equipped with OBD .
*PM is applicable to gasoline DI engines.
** Additive DF

- Date of Manufacturing, 1st April 2020 for all models.
- OBD
  - OBD-I, 1st April 2020
  - OBD-II, 1st April 2023 with threshold limits

- **As per Notification GSR178(E) dt 20th Feb 2018**
  - Registration BS-IV ,for fully build Veh , upto 30th Jun20
  - Registration of BS-IV M n N Category , Drive away chassis upto 30th Sep20
- **This notification has been over ruled by Honourable SC on 24th Oct 2018**

BS-VI (Package) OBD requirements for BS-VI

Monitoring Items	OBD Stage I (BS VI) 1st April, 2020	OBD Stage II (BS VI) 1stApril, 2023
Circuit continuity for all emission related power train component (if equipped)	√	√
Distance travelled since MIL(Malfunction indicator lamp) ON	√	√
Electrical disconnection of Electronic evaporative purge control device (if equipped and if active)	√	√
Catalytic converter monitoring	X	√
EGR system monitoring	√	√
Misfire detection	X	√
Oxygen sensor deterioration	X	√

OBD-II Threshold Limit				
	CO (mg/km)	NMHC (mg/km)	NOx (mg/km)	PM* (mg/km)
Class 1, 2 and 3	1900	250	300	50

EU-5 Changes affecting BS-VI

- BS-VI is aligned with EU-5 (latest in 2Ws)
- BS-VI date of implementation is one year ahead of EU-5
- EU-5 is under review and many changes are expected due to technological constraints.

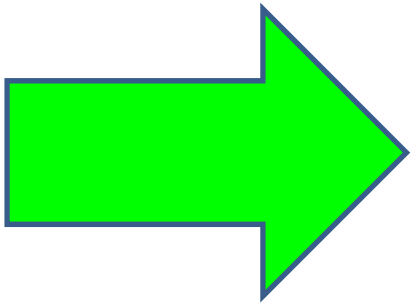
EU Change	Proposed New Dates (EU5)		EU-5 Finalization Date	BS-VI Notified Dates
	New Models	Existing Models		
Weighing Factor 50:50 changed to 30:70 for Class 1 & 2	2020	2021	Dec 2017 **(Already finalised**	2020
Durability AMA cycle Retained for Class 1&2	2020	2021	Dec 2017 **(Already finalised**	2020
Engine Mis-fire region	2020	2021	Dec 2017 **(Already finalised**	2023
OBD Cat Con Monitoring	2024	2025	1st quarter 2019	2023
EU-5 Threshold (OBD-II)	2024	2025	1st quarter 2019	2023
Fixed DF deletion from	2025	2025	1st quarter 2019	--
IUPRM	2024	2024	1st quarter 2019	2023

Technologies to Comply BS-VI Emission Norms

- Engine Fine Tuning
- Fuel Injection
- Three Way Catalytic Converter
- Crank Case Measure: Same as BS-IV
- Evaporative Countermeasure:
  - Same as BS-IV with improved Canister
- OBD Development

From carburetor system to closed loop FI system

BS-IV
Carburetor System



BS-VI
Closed loop Fuel Injection System

After Treatment Devices

- **Improvement of Substrate design:**

- **Use of O_2 Sensor:**

Conclusion /Challenges for BS-VI (1/2)

1. India is skipping BS-V and leapfrogging from BS-IV to BS-VI in 3yrs.
2. India is continuously upgrading emission norms after every 5 years while Europe has taken EU3->EU4 , 10 years and EU4->EU5 is 4yrs , India has only 3years?
3. EU5 has Phasing of New and All models by one year ,India BS-VI all models effective 1st Apr 2020.
4. 3Month window has been allowed for BS-IV registration till 30th Jun2020
5. BS-VI aligned with EU5 , which is still not final and based Euro Commission, changes already finalized in Dec 2017 / Timing will be finalized by Early 2019.
6. India is predominantly at Carbureted Engine with 2ways Cat ,where as EU has migrated to FI , hence India's challenge is much bigger.
7. OBD first time on 2Ws
8. Additional Control on NMHC.

Conclusion /Challenges for BS-VI (2/2)

9. Indian 2Ws , BS-VI will have lesser Fuel Economy because of very stringent Nox.
10. BS-VI Gasoline with 91 Octane Number (EU-6 Fuel 95 Octane), hence low hanging solution to recover Fuel Economy is not available.
11. BS-VI Fuel availability is ??
12. Biggest Challenges –
    1. No Readymade Solution across the Globe, needs own researched solution
    2. Large Volume of 2Ws and all supply chain updation
    3. Meticulous planning and execution
    4. Need for extremely Low variation in Emission related Components critical dimension

Thank you