

Two Wheeler Technologies

An insight in to measures taken in India to lower the emissions of 2-stroke two wheelers



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(Particle) Emissions of 2-stroke Scooters
– science, problems, solutions & perspectives

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OVERVIEW

Introduction

Two Wheeler Industry

Two Wheeler Technology

Two Wheeler Exhaust Emission Norms

Future Technologies

Two Wheeler Manufacturers

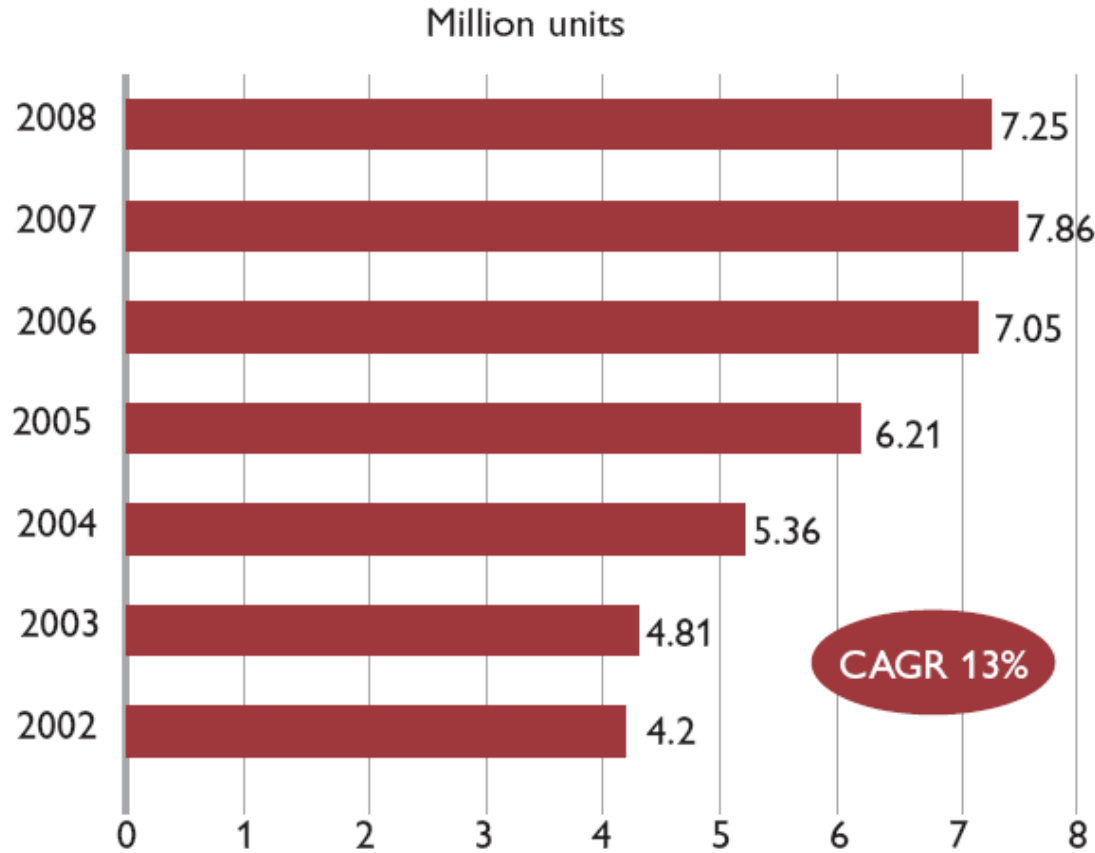
Conclusion

INDIAN TWO WHEELER INDUSTRY

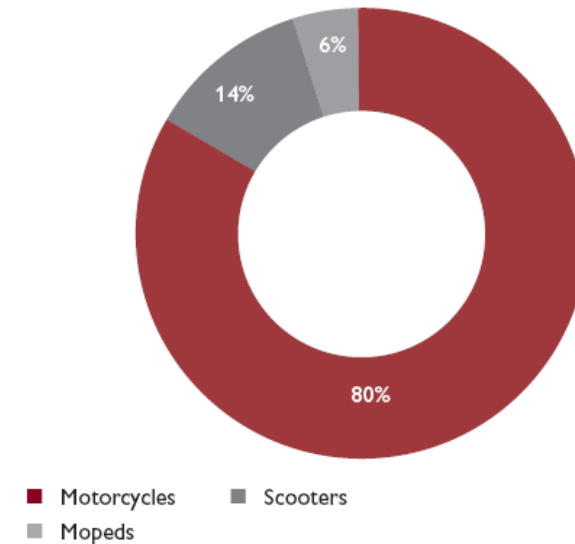
- India, is the second largest producer of two-wheelers in the world. In the last few years, the Indian two-wheeler industry has seen spectacular growth. The country stands next to China and Japan in terms of production and sales respectively.
- Majority of Indians, especially the youngsters prefer motorbikes rather than cars. Capturing a large share in the two-wheeler industry, bikes and scooters cover a major segment. Bikes are considered to be the favorite among the youth generation
- Large variety of two wheelers are available in the market, known for their latest technology and enhanced mileage. Indian bikes, scooters and mopeds represent style and class for both men and women in India.

Growth of Two wheeler Industry

Domestic two-wheeler industry



Break up of the industry by segment



Source: SIAM, IMaCS analysis

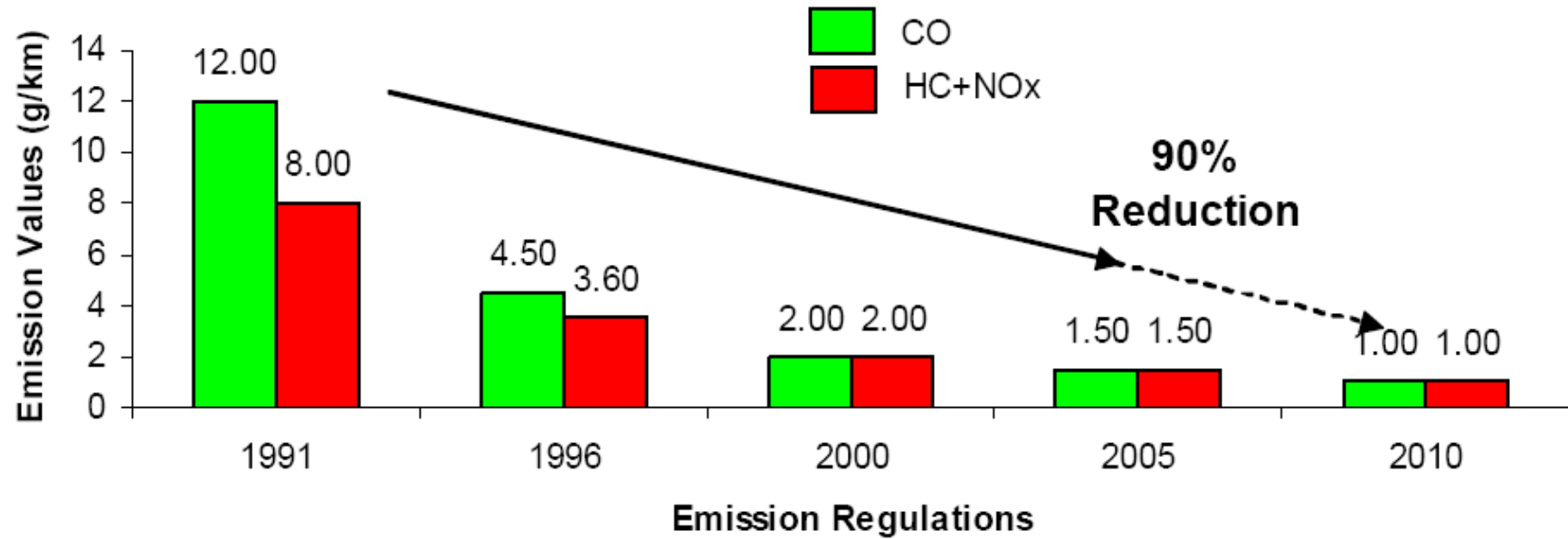
Sustaining of 2-Stroke Engine

- Two-stroke two-wheelers had higher emission levels than the four-stroke engines. As a result of tighter emissions norms, it was thought that the two-stroke engine will die a natural death.
- Technological capabilities of the Indian automakers with tremendous R&D work to put 2-stroke engines and they are continuing with their two-stroke models.
- BS-I Catalytic converters
- BS-II -Combination of bigger sized catalysts, dual catalyst system and secondary air injection as needed to reduce emissions
- BS-IV BACK TWO – STROKE ENGINE TECHNOLOGY

Scenario in 1990

- Before 1990 – 2-stroke engines are lower fuel efficiency- higher pollution
- Rapid growth in motor vehicle and other energy intensive activities has caused air quality to deteriorate rapidly in Indian cities.
- In Delhi, suspended particulate matter (PM) levels more than WHO limit
- 2- stroke engines were widely used in both two-wheelers and three wheelers recognized main contribution for more emissions and visible smoke
- NGOs actively involved in controlling air pollution
- Supreme court directives become legislation

Emission Regulations of Two-Wheelers



Emission control in Two-Stroke - Year : 1991

- o Engine tuning
- o Low dosage of lubricating oil for 2-stroke engine.
- o The newly developed low dosage oil reduced 50 percent of lubricating oil consumption.
- o Engine technology developed to control precise requirement of lubricating oil by introducing mechanically actuated Auto lube system.
- o Over dosage was prevented by premixing of lubricating oil in the petrol filling station itself.
- o The above measures considerably reduced PM and HC emissions, and visible smoke

Emission control in Two-Stroke - Year : 1996

- ❑ Re-designed ports (increased No. of ports)
- ❑ Exhaust system improvements for effective scavenging and reduced mixture short-circuiting
- ❑ Improved carburetion to produce leaner air–fuel mixtures
- ❑ Higher compression ratios
- ❑ Electronic ignition
- ❑ Combustion chamber and spark-plug location re-designed
- ❑ Piston re-design to minimise crevice volumes and friction losses
- ❑ Intake and exhaust system designs (reed valves)
- ❑ Introduction of catalytic converters in 4 Metro

Emission control in Two-Stroke - Year: 2000

- ❖ Engine optimization for increasing fuel efficiency
- ❖ Unleaded gasoline introduced across the country
- ❖ Intake, exhaust and combustion system optimization
- ❖ Oxidation catalysts were additionally employed on both two- and four-stroke engines
- ❖ Stringent norms for new vehicles and retro fitment for in-use vehicles

Indian Auto Policy 2002

The Government of India approved a comprehensive automotive policy in March 2002, the main proposals of which are as under:

Foreign direct investment : Automatic approval is proposed to be granted to foreign equity investment up to 100% for manufacture of automobiles and components.

Import tariff : Import tariffs are proposed to be fixed at a level such that they facilitate the development of manufacturing capabilities as opposed to mere assembly.

Incentives for R&D : The weighted average tax deduction under the Income Tax Act, 1961 for automotive companies is proposed to be increased from current level of 125% (The weighted average deduction for R&D was increased to 150% in the Union Budget 2004-05). Further, the policy proposes to include vehicle manufacturers for a rebate on the applicable excise duty for every 1% of the gross turnover of the company expended during the year on R&D.

Environmental aspects : Adequate fiscal incentives are proposed to promote the use of low-emission auto fuel technology (in line with the Auto Fuel Policy). The auto policy states the Government's intent to align domestic policy with the international practice of imposing higher road tax on old vehicles so as to discourage their use.

Emission control in Two-Stroke - Year: 2005

- ✓ Transformation and innovation and adopt new technology
- ✓ Fuel efficient vehicles
- ✓ Improvements in Fuel quality :
 - ✓ Reduction of Fuel Sulphur <150 ppm
 - ✓ Reduction of benzene contents
- ✓ Secondary air injection into catalytic converter
- ✓ Improved Catalytic Converters
- ✓ Durability / warranty for exhaust gas treatment devices
- ✓ Alternative fuels (ethanol in gasoline)

Few specific technologies used in the present day two-wheelers in India

- Digital Twin Spark Ignition (DTSi)
- Variable Timing (VT-i)
- Electronic Fuel Injection
- 3- Valve Engines
- Over Square Engines

Fuel Economy
a major driving
factor

Emission control in Two-Stroke - Year: 2010

- o Fuel Sulphur < 50 ppm
- o Several options for fuel injection system for two stroke engines.
- o The injection could be Direct or in the transfer port.
- o Best results can be achieved by in-cylinder injection which could be mechanical, pneumatic/compressed air assisted, or electronically controlled.
- o Use of gaseous fuels (LPG / CNG)
- o Improved after treatment system

FUTURE TECHNOLOGIES

Future Technologies

2-Stroke

- Effective three-way catalytic converter
- Electronic Air Assisted Direct fuel injection with oxidation catalytic converter.
- LPG , CNG
- CNG+H₂

4-Stroke

- Port fuel Injection with 3-way catalyst converter
- Air assisted direct injection with oxidation / 3-way catalyst converter
- Gaseous fuels technology (CNG, LPG). CNG+H₂
- Safety systems

Future Technologies

Battery electric two wheelers may dominate the two wheeler mobility beyond 2015

- ≡ Nickel metal hydride battery
- ≡ Lithium ion and Lithium polymer batteries
- ≡ Size, Weight, Vehicle range, Cost and Life are the issues
- ≡ Hybrid electric technology

Manufacturers of Electric Two-Wheelers

Scooters India

Hero Electric

BSA Motors

Luminous Power Technologies

TVS Motors

Ultra Motors

Indus Elec-Trans

Bajaj auto ltd



TVS – Scooty Teenz Electric



YoSmart electric scooter - Indus



Hero Ultra Velocity Electric Scooter



Ultra Motors Marathon electric scooter

Conclusions

- ≡ Two –wheeler industries are technology driven
- ≡ Well established R&Ds for taking any challenge and integrated manufacturing system.
- ≡ Advanced manufacturing system for quality product
- ≡ Products are performance driven
- ≡ Future technology for near zero emission with advanced engine technology and electric-power 2-wheeler



THANK YOU

Two Wheelers – Comparative Characteristics

	Moped	Scooter	Motorcycle
Stroke	2-stroke	2-stroke, 4-stroke	Mainly 4-stroke
Engine Capacity (cc)	50, 60	90-150	100, 125, > 125
Ignition	Kick/Electronic	Kick/Electronic	Kick/Electronic
Engine Power (bhp)	2-3	6.5-9	7-8 and above
Weight (kg)	60-70	90-100	> 100
Fuel Efficiency (km per litre)	70-80	50-75	50-80+
Load Carrying	Low	High	Highest

Evolution of 2- Stroke Technology

1945, Trading company by Bajaj Auto Limited,

1959, They obtained government approval to manufacture of Two and Three-wheelers, under license from Piaggio of Italy (the maker of the famous Vespa scooters)

1970 Bajaj Auto Limited developed own models

Until 1980s, Few manufacturers- catering for a modest, predominantly domestic market, characterised by government restrictions on production capacities, tariffs, and low levels of competition.

1980 OEMs collaborate / joint venture with Japanese two wheeler manufacturer for technology up-gradation

Four stroke engine technology introduced by JVC of Hero-Honda a well engineered and fuel-efficient 100 cc four-stroke motorcycle of Japanese design

2000 De-licensed -Industries established own R&D

Today more than 10 major manufacturer – 2-Stroke and 4-stroke two wheeler

TWO WHEELER EXHAUST EMISSION NORMS

Exhaust Emission Norms in India - Year : 1991

Vehicle	Pollutants	1991	1996	2000	2005*	2010**
Two-wheelers (gm/Km)	CO	12 -30	4.5	2.0	1.5	1
	HC + NO _x	8-12	3.6	2.0	1.5	1

Exhaust Emission Norms in India - - Year : 1996

Vehicle	Pollutants	1991	1996	2000 BS-II	2005 BS-III	2010
Two-wheelers (gm/Km)	CO	12 -30	4.5	2.0	1.5	1
	HC + NO_x	8-12	3.6	2.0	1.5	1

Emission standards have been made particularly stringent, and have been tightened. Achieved with four-stroke motorcycles, due to the superior emission characteristics

India 2000 Norms

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Bharat Stage – III

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