Oil consumption in road transport
~ **45,638 ktoe**
(**57%** of total energy consumption in the transport sector)

Demand for oil in transport to increase by more than **2- fold** by **2032**

Transport sector, one of the highest emitters of GHGs in India (~**312 million tCO_2e** per annum)

1.4 million
deaths from air pollution in India in 2013*

14 of the 20
most polluted cities in India (in terms of PM2.5 conc.)

USD 560 billion
loss (PPP adjusted) to GDP in 2013 due to air pollution*

Sources: MOSPI, IESS 2047, World Bank, IHME, World Health Organization

*Includes impacts from both indoor and outdoor pollution

Green Vehicle Rating for 2 & 3 Wheelers

India's First Vehicle Rating System Based on Environmental Performance

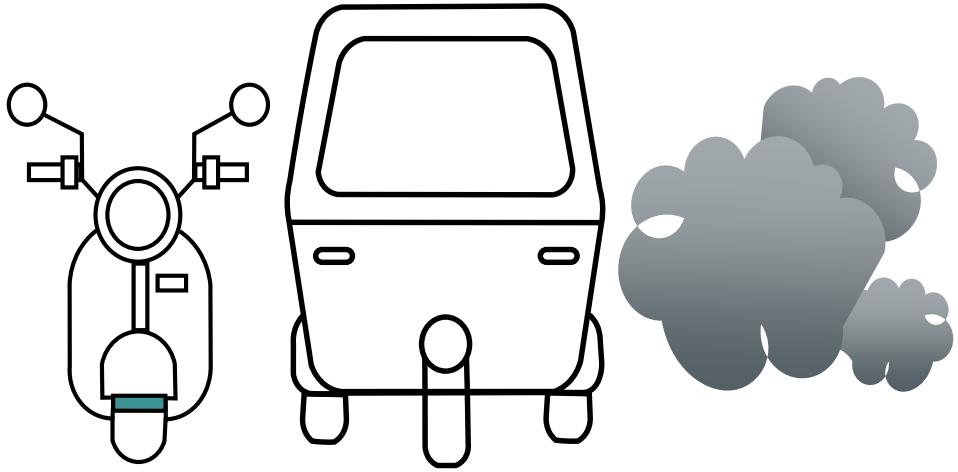
GREEN VEHICLE RATING

AN INITIATIVE BY Alliance for an Energy Efficient Economy

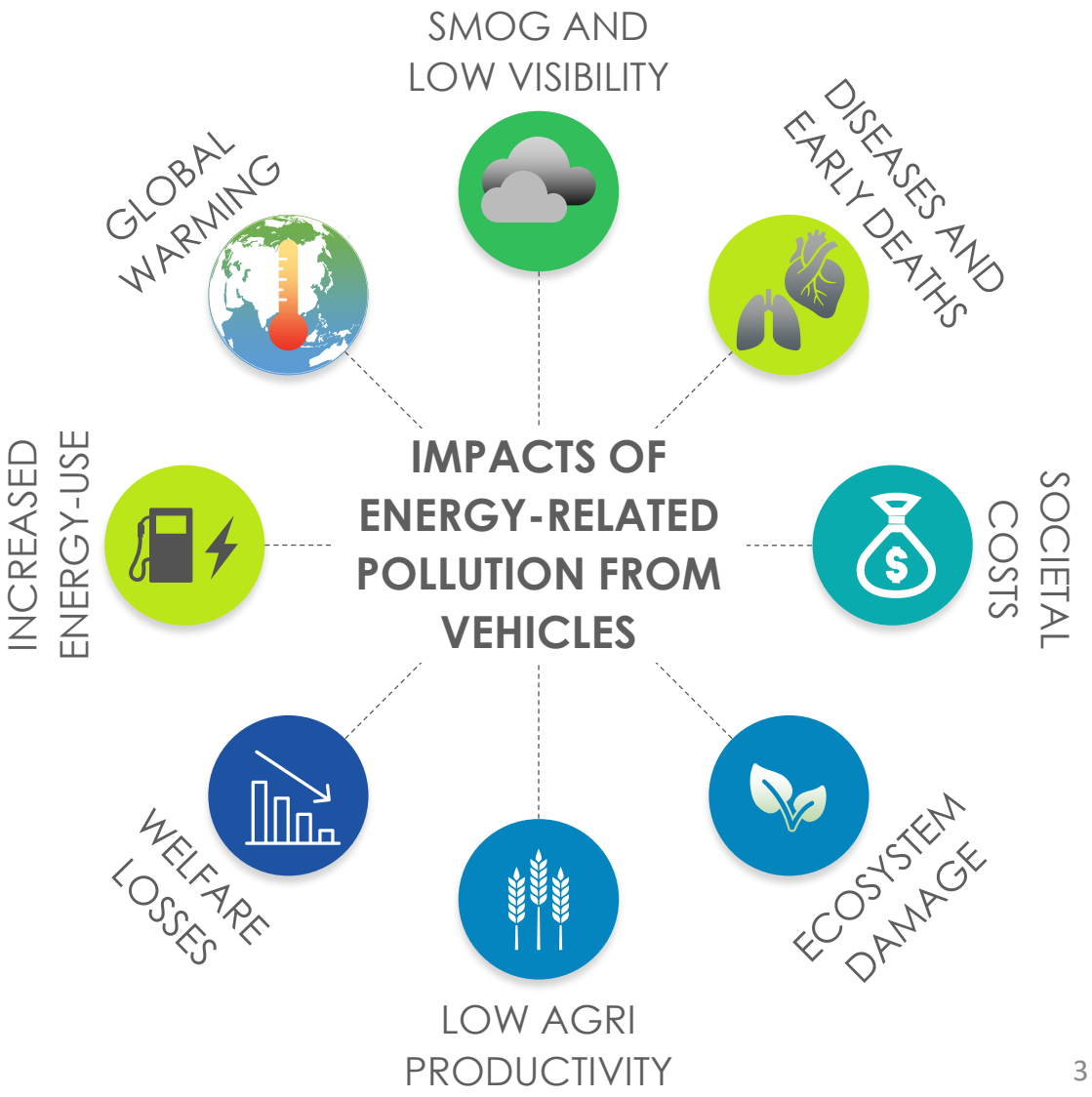
SHAKTI SUSTAINABLE ENERGY FOUNDATION

28th August, 2018

Impacts of Vehicular Fuel Consumption and Emissions



Tailpipe emissions:
criteria pollutants (NOx, CO, HC, PM)
and
GHGs (CO_2 & CH_4)



Importance of Public Information to Influence Vehicle Choice

Two main criteria currently used by consumers during vehicle purchase:

- Retail price-tags
- Self-reported mileage data of auto dealers

What

- Form 22 is a 'Road Worthiness Certificate'
- Issued by motor vehicle manufacturers **for every vehicle model**
- As per the Central Motor Vehicle Rules, 1989 (CMVR)

Why

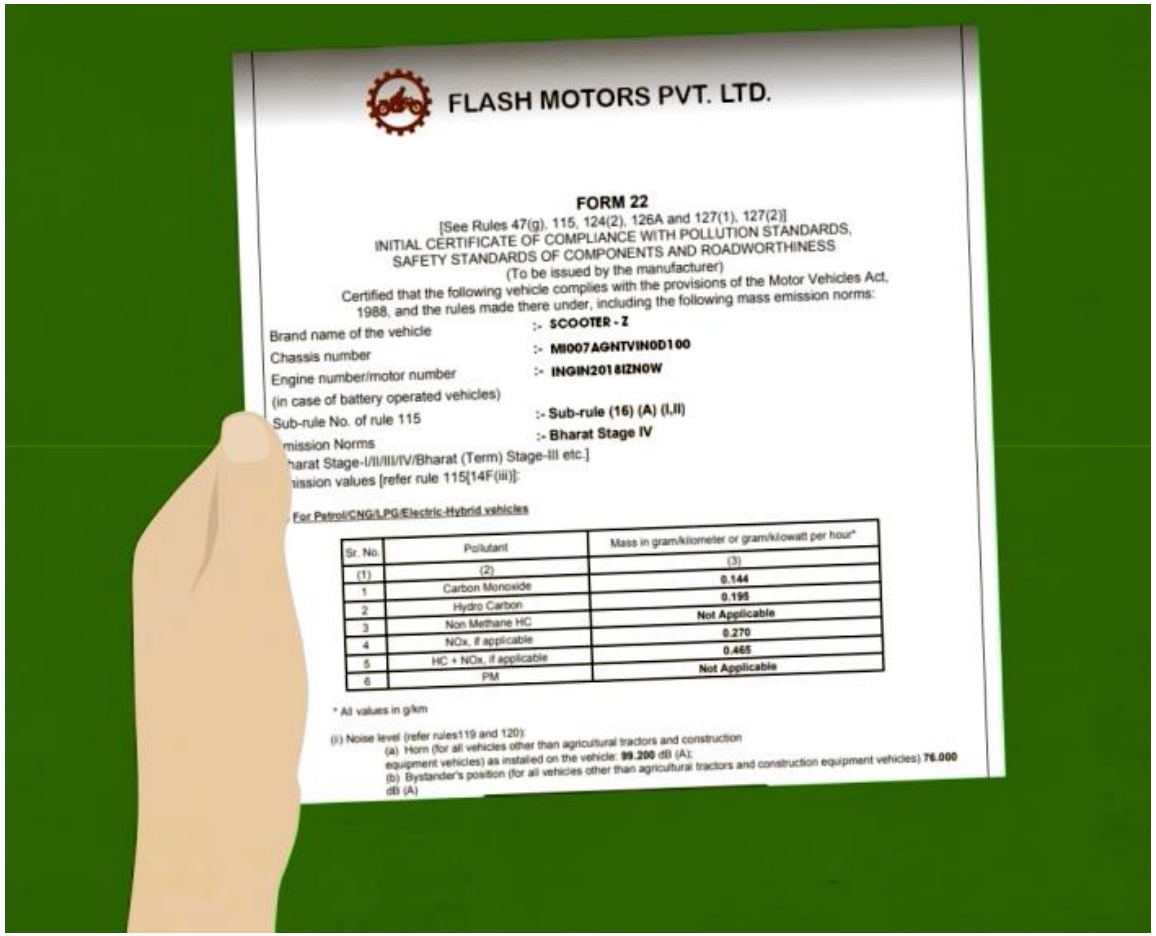
It shows the pollutant levels (gm/km) of:

- carbon monoxide (CO)
- hydrocarbons (HC)
- nitrogen oxides (NOx)
- Non-Methane HC released
- Particulate Matter (PM) - only for diesel vehicles

Where

- Available with **auto dealers**
- Consumers should check prior to purchasing vehicles
- Also used for registering the vehicle with the Regional Transportation Office (RTO)

Form 22 'Road Worthiness Certificate' – mandated by Ministry of Road Transport and Highways (MoRTH) since April 2017



FLASH MOTORS PVT. LTD.

FORM 22

[See Rules 47(g), 115, 124(2), 126A and 127(1), 127(2)]
INITIAL CERTIFICATE OF COMPLIANCE WITH POLLUTION STANDARDS, SAFETY STANDARDS OF COMPONENTS AND ROADWORTHINESS
(To be issued by the manufacturer)

Certified that the following vehicle complies with the provisions of the Motor Vehicles Act, 1988, and the rules made there under, including the following mass emission norms:

Brand name of the vehicle :- SCOOTER - Z
Chassis number :- MI007AGNTVIN0D100
Engine number/motor number :- INGIN2018IZN0W
(in case of battery operated vehicles)
Sub-rule No. of rule 115 :- Sub-rule (16) (A) (I,II)
mission Norms :- Bharat Stage IV
harat Stage-I/II/III/IV/Bharat (Term) Stage-III etc.]
ission values [refer rule 115[14F(iii)]:

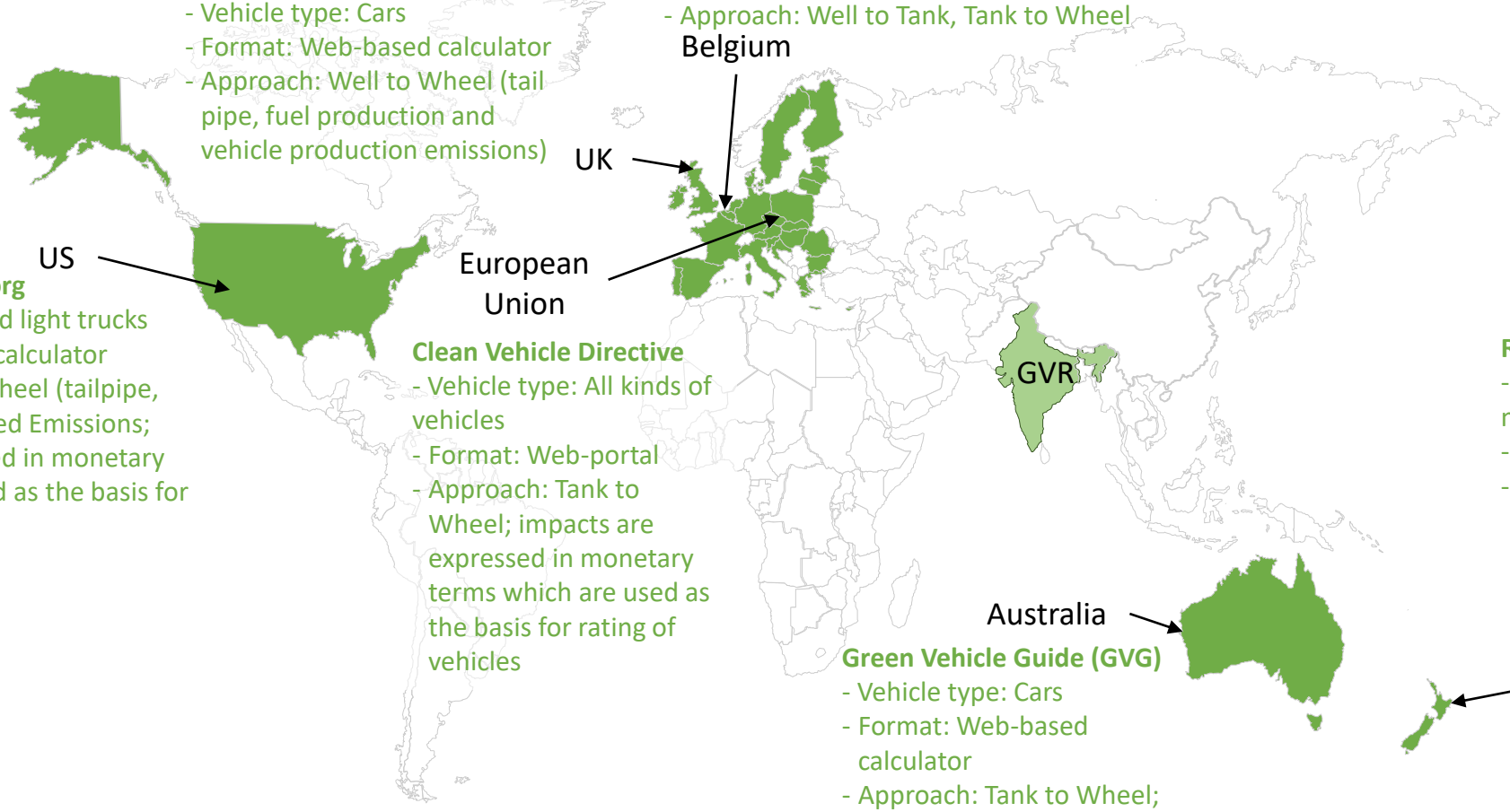
For Petrol/CNG/LPG/Electric-Hybrid vehicles

Sr. No.	Pollutant	Mass in gram/kilometer or gram/kilowatt per hour*
(1)	(2)	(3)
1	Carbon Monoxide	0.144
2	Hydro Carbon	0.195
3	Non Methane HC	Not Applicable
4	NOx, if applicable	0.270
5	HC + NOx, if applicable	0.465
6	PM	Not Applicable

* All values in g/km

(i) Noise level (refer rules119 and 120):
(a) Horn (for all vehicles other than agricultural tractors and construction equipment vehicles) as installed on the vehicle: 99.200 dB (A);
(b) Bystander's position (for all vehicles other than agricultural tractors and construction equipment vehicles) 76.000 dB (A)

International Vehicle Rating Programs



EcoScore
- Vehicle type: Light duty vehicles - cars
- Format: Web-based calculator and downloadable data
- Approach: Well to Tank, Tank to Wheel

Next Green Car
- Vehicle type: Cars
- Format: Web-based calculator
- Approach: Well to Wheel (tail pipe, fuel production and vehicle production emissions)

ACEEE's greenercars.org
- Vehicle type: Cars and light trucks
- Format: Web-based calculator
- Approach: Well to Wheel (tailpipe, upstream) + Embodied Emissions; impacts are expressed in monetary terms which are used as the basis for rating of vehicles

Clean Vehicle Directive
- Vehicle type: All kinds of vehicles
- Format: Web-portal
- Approach: Tank to Wheel; impacts are expressed in monetary terms which are used as the basis for rating of vehicles

Rightcar NZ
- Vehicle type: Passenger cars, mini bus, vans/ light trucks
- Format: Web-portal
- Approach: Tank to Wheel; rating done on the basis of CO_2 and pollutants level

Green Vehicle Guide (GVG)
- Vehicle type: Cars
- Format: Web-based calculator
- Approach: Tank to Wheel; rating done on the basis of CO_2 and pollutants level

The boundaries, colours, denominations, and other information shown on this map do not imply any judgement on the part of AEEE or Shakti concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Green Vehicle Rating

- Green Vehicle Rating (GVR) is an information tool that can potentially reshape consumer knowledge on vehicles
- It serves two functions:
  - ✓ To find ranks of vehicle models based on their environmental performance
  - ✓ To inform/ educate the buyers about the health and environmental costs of vehicular emissions

For this analysis, GVR takes a composite approach with pollutant emissions data from Form 22 and fuel efficiency data as reported by auto dealers and online auto marketplaces.

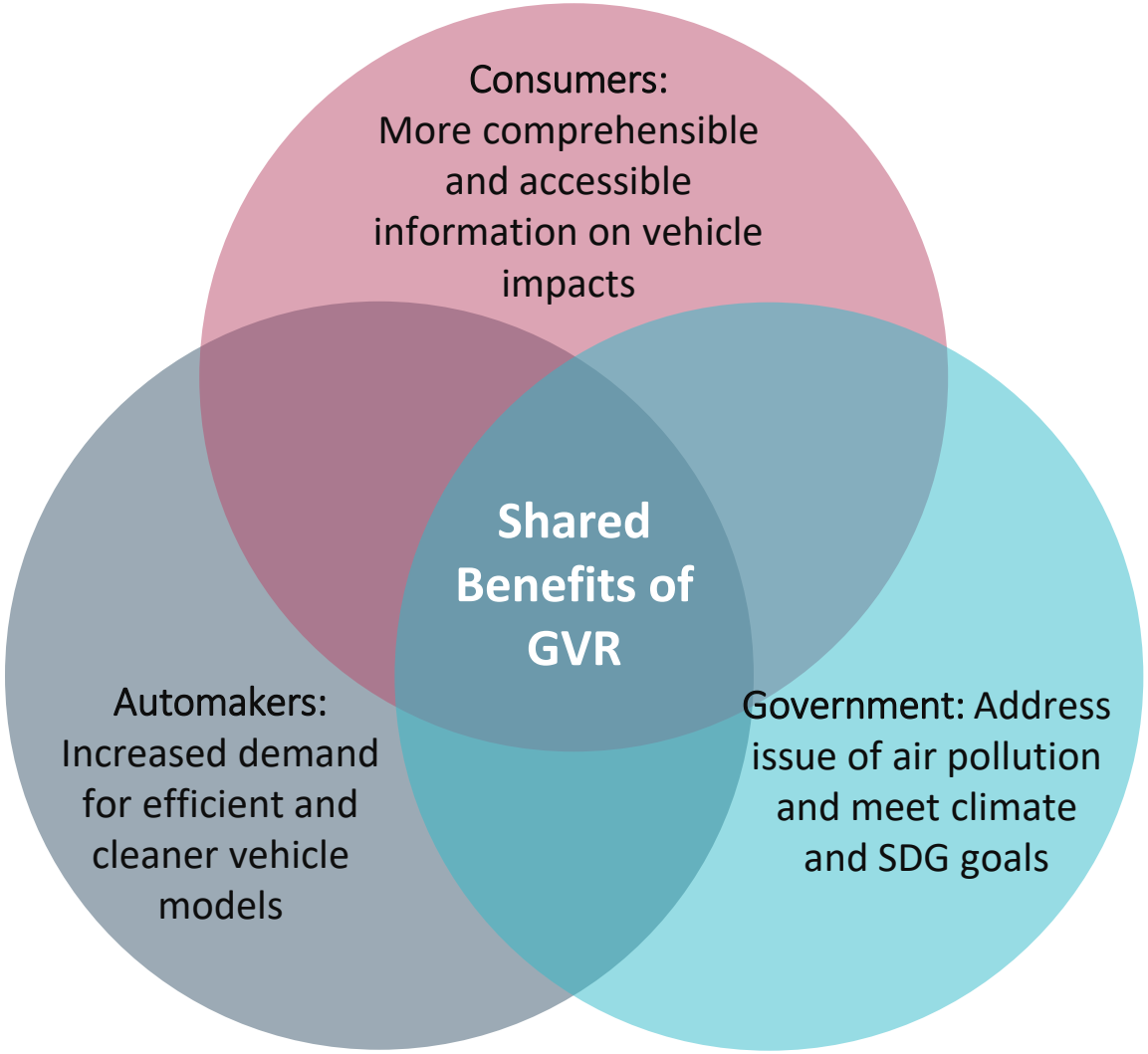
MISSION
Green vehicle rating for two and three wheelers in India

IDENTIFY
high performers: Fuel economy, pollution, operating costs

INFORM
consumer decision with a web-based rating

INCREASE
the demand for greener variants and help the market internalise costs from energy and emissions

Benefits of GVR



CONSUMERS

- Offers understandable information -> comparative rating of vehicles
- Expands the common notion of cost of owning a vehicle
- Provides health and environmental costs of vehicles in ₹/km
- Simplifies emissions data for inclusion in purchase decisions

AUTOMAKERS

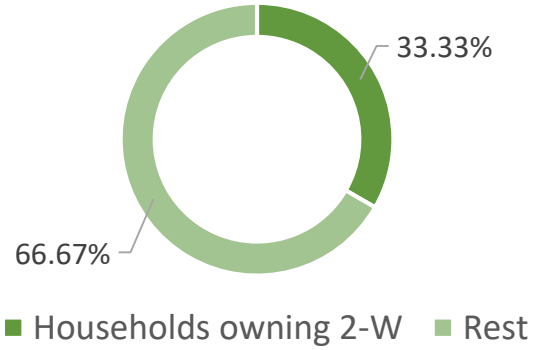
- Puts spotlight on high performers for consumer knowledge
- Highlights the costs and benefits of top selling models
- Symmetric information -> coordinated policy actions
- Catalyses willingness to pay for cleaner vehicles and fuel

GOVERNMENT

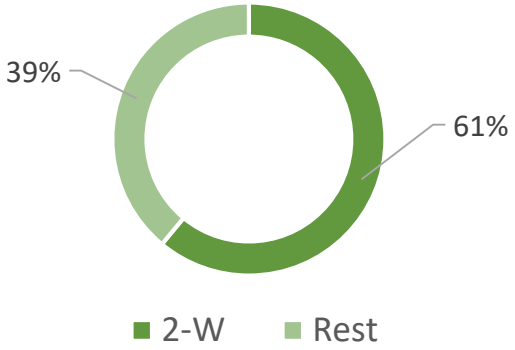
- Catalyses a well-informed consumer base
- Helps grow the share of efficient and less polluting vehicles
- Integrates government intent and auto market capabilities
- Facilitates research on cost-benefit of environmental regulations for vehicles

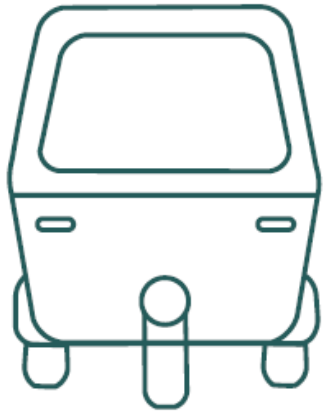
Importance of Targeting 2-Wheeler and 3-Wheeler Segments

Share of households owning a 2-W in India

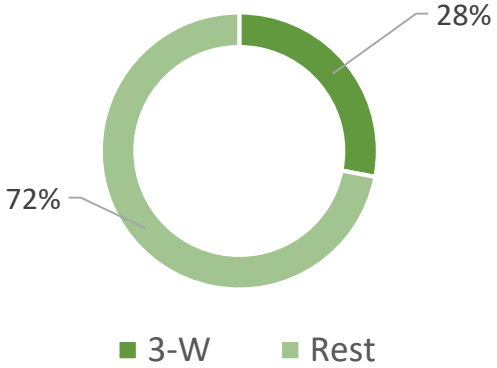


Petrol sales in India





Diesel consumption in transport in India



Combined growth rate in sales of 2 and 3-wheelers (*i.e.* 7.76% CAGR over 2012-13 to 2017-18) surpasses the overall rate of increase of vehicle sales in India

Overview of Rating Methodology

Alliance for an Energy Efficient Economy

Data survey and inventory creation

- Data on tail pipe emissions of pollutants (CO, HC, NOx, PM) sourced from Form 22
- Values for GHG emissions derived from the mileage data reported by auto dealers
- Tech. specifications

Expressing impacts in monetary terms

- Social Impacts = Human Health + Environmental Impact (encompassing climate change, visibility, and crop damages)
- Damage cost method applied wherein the marginal social costs of pollutants and GHG emissions are used to estimate the cost of health and environmental impact

Normalisation

- Health and environmental costs of vehicle models are normalized against that of a reference vehicle; the latter adhering to stringent emission standards and fuel consumption norms.
- Health costs given 60% and environmental costs 40% weightages to compute the Damage Scores of vehicle models

Ranking and calculating RCO

- Damage Scores used to rank the vehicles
- Real Cost of Ownership (RCO) = Social Cost of Impacts + TCO*

*Total Cost of Ownership (TCO) includes fuel costs, maintenance, finance, and depreciation.

GVR Outputs

Tank to Wheel Emissions | Impacts in Monetary Terms | Environmental Economics Approach

Tailpipe Pollutants and GHGs (each in gm/km) **X** Marginal Social Costs of Pollutants and GHGs (₹/gm) **=** *Cost of Health and Environmental Impact (₹/km)*

GREEN VEHICLE RATING

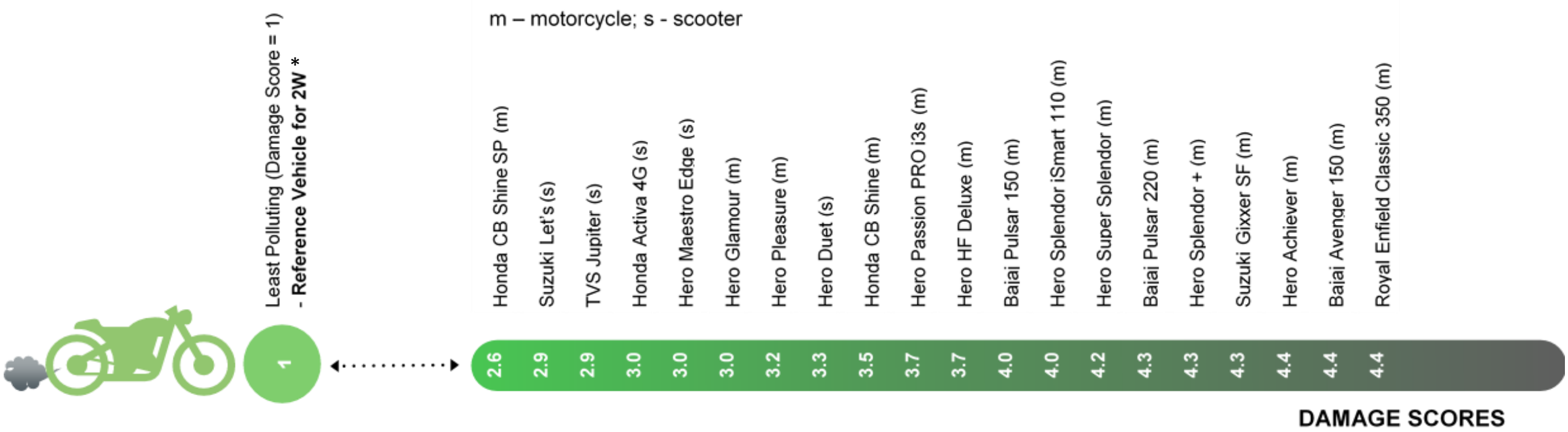
Output 1: Comparative Rating for 22 Top Models

Least Polluting — Vehicle Rank 1 — Vehicle Rank 2 — Vehicle Rank 3 — Vehicle Rank 4 — **Most Polluting**

Output 2: Real Cost of Owning a Vehicle in ₹/Km

COST OF OWNERSHIP + HUMAN HEALTH AND ENVIRONMENT COSTS OF POLLUTION EMISSION = REAL COST OF OWNERSHIP

Results: Rating of Top-selling 2-W Models for Year 2017



*Reference vehicle for 2-W is assumed to be BS VI compliant and have fuel efficiency of 100 km/L

Results: Rating of Top-selling 3-W Models for Year 2017

Ranking (2017)	Damage Score (rated against reference vehicle*)	Model Name	Type	Human Health Costs per Km	Environmental Costs per Km	Composite Damage Costs (CDC) per Km	Total cost of ownership (TCO) per Km	Real Cost of Ownership (RCO) per Km
1	1.7663	Bajaj RE Compact LPG 4S	Passenger Autorickshaw	₹ 0.0018	₹ 0.2248	₹ 0.2267	₹ 2.8000	₹ 3.0267
2	1.9624	Bajaj RE Compact Diesel		₹ 0.0892	₹ 0.1994	₹ 0.2886	₹ 2.8000	₹ 3.0886

*Reference vehicle for 3-W is assumed to be BS VI compliant and have fuel efficiency of 40 km/ L

How to Leverage GVR for Policy & Regulatory Reforms

Alliance for an Energy Efficient Economy

- Creating "*feebate*" system
  - Based on the "*polluter pays*" principle wherein higher taxes are imposed on more polluting vehicle models
  - Revenue collected utilized to provide incentives to cleaner technologies and fund R&D activities
  - Effective in a number of countries and regions around the world
  - Exploratory study done by NITI Aayog in partnership with RMI on a potential national feebate policy
  - In addition, waiving the registration fee for greener variants of vehicles

- Introducing a composite labelling program
  - Based on the pollutant emissions profile and fuel economy of the vehicle models
  - Making the current S&L program's assessment framework composite and expanding its ambit; currently applicable for appliances, administered by BEE

- Developing dedicated Corporate Average Fuel Economy (CAFE) standards for 2-W & 3-W
  - Extending the CAFE standards to include 2-W and 3-W, currently covering only passenger cars

Aforesaid interventions should be complemented by some specific actions:

- ✓ More aggressive campaign to raise consumer awareness about Form 22
- ✓ Mandating the reporting of particulate emissions on Form 22 across fuel types (presently applicable only for diesel vehicles)
- ✓ Real driving emission testing for more accurate data on pollution levels, *etc*.

Possible Future Work

- Expanding the scope of GVR to include other vehicle segments

- Revising the vehicle ratings periodically
  - To reflect any improvement in engine technologies, fuel quality and transition to more stringent emissions norms

- Studying the costs of externalities from energy-related pollution impacts in India
  - Large scale studies to evaluate the external costs of air pollutants and GHGs in India recommended
  - The National Clean Air Program of MoEFCC will benefit
  - Diverse set of expertise and complex modeling required
  - Major vehicle markets such as Europe and the United States executed such evaluation

- Accounting GHG and pollutant emissions based on Life Cycle Analysis
  - To understand emissions released at different stages of the value chain of a vehicle
  - Taking into account direct and indirect (upstream and downstream) emissions of pollutants and GHGs
  - Subsequent application of damage cost method
  - Similar accounting undertaken in other international ratings

Alliance for an Energy Efficient Economy™

CONNECT WITH US

Green Vehicle Rating web-portal

Click here:

Disclaimer:
This piece of work is purely a research initiative without any prejudice to a company, technology or practice. Alliance for an Energy Efficient Economy and its research activities do not intend to favour or disfavour any corporate entity or product.

Thank You!

Q&A