## WORK GROUP 4

## VEHICLE INVENTORY AND DEVELOPMENT OF A DATA ENTRY TOOL

## TEAM COMPOSITION - WGP 4

Representatives of
-National Transport Authority (Team Leader)
-Ministry of Social Security \& Environment and Sustainable Development

- Ministry of Finance and Economic Development
-Ministry of Industry and Commerce and Consumer Protection
-Ministry of Public Infrastructure and Land Transport
-Mauritius Revenue Authority
-University of Mauritius (Faculty of Engineering)


## Terms of Reference

## Vehicle Inventory in Mauritius

- Carried out in two phases
- Terms of Reference Phase 1 - to set up a vehicle data inventory for the years 2005, 2008, 2010 and 2012 for newly registered light duty vehicle (LDV).
- to use the vehicle inventory to develop baseline estimates for 2005 as per GFEI methodology.


## Terms of Reference

- Terms of Reference Phase II - to assess fuel consumption and $\mathrm{CO}_{2}$ emissions for both LDVs and Heavy duty Vehicles (HDVs) for the years 2014 and 2015.
- to develop a data entry tool for future vehicle imports
- to conduct a thorough review of existing regulations and incentives to promote cleaner and more efficient vehicles in Mauritius.
- to look into the modernization of public transport.
- Phase 1 completed August 2014

Phase II completed March 2017

## Vehicle Registered in Mauritius 2000-2015

| Types of vehicle | 2000 | 2005 | 2010 | 2015 |
| :--- | :---: | :---: | :---: | :---: |
| Cars and Dual purpose <br> Vehicle DPV) | 89,823 | 126,844 | 175,634 | 237,600 |
| Auto/motorcycles | 116,478 | 133,430 | 159,329 | 193,688 |
| Heavymotorcar and <br> bus | 29,292 | 3,605 | 4,094 | 4,264 |
| Van and Lorry | 3,310 | 36,036 | 39,100 | 41,601 |
| Other Vehicles | 5,115 | 5,581 | 5,958 | 8,991 |
| Total | 244,018 | 305,496 | 384,115 | 486,144 |



## LDVs Registered 2000-2015

| Year | Petrol | Diesel | Hybrid | Electric | LPG | Total | Annual <br> Growth Rate |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathbf{2 0 0 5}$ | 98,744 | 42,618 | 0 | 0 | 224 | 141,586 | - |
| $\mathbf{2 0 0 6}$ | 106,382 | 45,309 | 0 | 0 | 227 | 151,918 | $7.3 \%$ |
| $\mathbf{2 0 0 7}$ | 114,536 | 48,108 | 0 | 0 | 230 | 162,874 | $7.2 \%$ |
| $\mathbf{2 0 0 8}$ | 124,813 | 51,095 | 0 | 0 | 232 | 176,140 | $8.1 \%$ |
| $\mathbf{2 0 0 9}$ | 133,807 | 53,486 | 43 | 0 | 238 | 187,574 | $6.5 \%$ |
| $\mathbf{2 0 1 0}$ | 142,910 | 56,014 | 161 | 0 | 244 | 199,329 | $6.3 \%$ |
| $\mathbf{2 0 1 1}$ | 151,842 | 58,463 | 315 | 2 | 246 | 210,868 | $5.8 \%$ |
| $\mathbf{2 0 1 2}$ | 163,125 | 61,096 | 703 | 5 | 247 | 225,176 | $6.8 \%$ |
| $\mathbf{2 0 1 3}$ | 175,938 | 63,446 | 1,389 | 6 | 251 | 241,030 | $7.0 \%$ |
| $\mathbf{2 0 1 4}$ | 198,153 | 66,552 | 1,824 | 8 | 252 | 266,789 | $10.7 \%$ |
| $\mathbf{2 0 1 5}$ | 220,954 | 68,747 | 2,422 | 19 | 253 | 292,385 | $9.6 \%$ |

## Overview of Fuel Consumption and $\mathrm{Co}_{2}$ Emissions (2015)

Final energy consumption by sector



## $\mathrm{CO}_{2}$ emission by source category 2015

|  | Gg |
| :--- | ---: |
| Transport | 1032.06 |
| Energy industries (electricity) | 2407.52 |
| Manufacturing industries | 337.78 |
| Other sectors | 198.2 |
| Total | $3,975.56$ |



## Share of $\mathrm{Co}_{2}$ emission by mode transport sector

# Minimum Vehicle Information Requirements for Data Inventory 

- Vehicle Make and Model
- Model Production Year
- Year of $1^{\text {st }}$ Registration
- Vehicle Identification Number
- Fuel Type
- Imported (New or Second Hand)
- Number of vehicles sold by model
- Body Type
- Engine Capacity
- Rated fuel economy per model and "test cycle" basis
- Fuel Injection type
- Transmission type
- Vehicle footprint
- Vehicle kerb Weight
- Emission Certificate Level


## Sources of fuel economy/ $\mathrm{Co}_{2}$ Emissions data

- Car $\mathrm{CO}_{2}$ Emissions (UK) - http://car-emissions.com
- US Environmental Protection Agency- http://www.fuel economy.gov
- Car Fuel Data, $\mathrm{CO}_{2}$ and Vehicle Tax Tools http://carfuel.data.direct.gov.uk
- World car specifications http://www.carfolio.com/specification

Data Source based on -

- New European Drive Cycle (NEDC)
- Japanese tests cycles (JCO8)


## Vehicle Population for data Inventory (Phase 1)

(1) LDVs imported in 2005 and 2013

|  | 2005 | 2013 |
| :--- | :---: | :---: |
| New Vehicles | 5,221 | 8,342 |
| Second Hand Vehicles | 5,312 | 7,512 |
| Total | 10,553 | 15,854 |

(2) Cumulative Total LDVs

|  | $\mathbf{2 0 0 5}$ | 2013 |
| :--- | :---: | :---: |
| New Vehicles | 104,314 | 159,289 |
| Second Hand Vehicles | 37,272 | 81,741 |
| Total | 141,586 | 241,030 |

(3) Fuel economy and Coz emissions data sought for 127 makes/model clusters. The process will be described under the Chapter Data Entry Tool.

## Breakdown of Cumulative of LDVs Fleet by fuel Type

| Year | Petrol | Diesel | LPG | LPG + <br> PETROL | Hybrid | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2005 | 98,740 | 42,618 | 209 | 15 | 4 | 141,586 |
| 2006 | 106,377 | 45,309 | 209 | 18 | 5 | 151,918 |
| 2007 | 114,531 | 48,108 | 210 | 20 | 5 | 162,874 |
| 2008 | 124,804 | 51,095 | 212 | 20 | 9 | 176,140 |
| 2009 | 133,795 | 53,486 | 213 | 25 | 55 | 187,574 |
| 2010 | 142,891 | 56,014 | 216 | 28 | 180 | 199,329 |
| 2011 | 151,822 | 58,463 | 218 | 28 | 337 | 210,868 |
| 2012 | 163,102 | 61,096 | 219 | 28 | 731 | 225,176 |
| 2013 | 175,915 | 63,446 | 223 | 28 | 1,418 | 241,030 |

Average fuel consumption and $\mathrm{CO}_{2}$ emissions for LDVs registered in 2005 and 2013

| Vear |  | Avarage $\mathrm{C}_{2}$ Emision $/$ g/m) |
| :---: | :---: | :---: |
| 205 | 1 | 186 |
| 2013 | 6.6 | 169 |

## Phase 2

- Vehicles inventory covers all vehicles registered in 2014 and 2015
- LDVs include two-wheelers
- Inventory includes HDVs as well but these are assessed separately from LDVs


## Vehicles registered in 2014 and 2015

|  | $\mathbf{2 0 1 4}$ | $\mathbf{2 0 1 5}$ |
| :--- | :---: | :---: |
| New Vehicles | 18,844 | 16,122 |
| Second Hand Vehicles | 7,556 | 9,891 |
| Total | 26,400 | 26,013 |

Trend in LDVs registration 2005-2015


Cumulative LDVs Estimates for Year 2030 and 2050

| Year | Cumulative Total LDVs Estimates |
| :---: | :---: |
| 2005 | 141,586 |
| 2015 | 292,385 |
| 2030 | 490,390 |
| 2050 | 775,720 |

On the basis of the best line of fit, it is forecast that the number of LDV registered in 2030 will be almost 500,000 (+67\%) and 775000 (+165\%) in 2050 under a Business As Usual (BAU) scenario

## Missing Fields

Number of vehicles for which data on fuel consumption and $\mathrm{CO}_{2}$ emissions not obtained

| Numbe of misising fidds for LDV ans and HDV segisted in 2014 and |  |  |  |
| :---: | :---: | :---: | :---: |
| Yearl | LDVs | HDVs | Total |
| 2014 | 7 | 57 | $64(0.24 \%)$ |
| 2015 | 0 | 26 | $26(0.09 \%)$ |

## LDVs and HDVs by class of Vehicle

|  | 201,4 | 2015 |
| :--- | :---: | :---: |
| Total Vehicles registered | 26,400 | 26,013 |
| Number of LDVs | $25,759(97.6 \%)$ | $25,596(98.4 \%)$ |
| Number of HDVs | $641(2.4 \%)$ | $417(1.6 \%)$ |

## Number of LDVs and HDVs by fuel type

| Year | Type of <br> Vehicles | Petrol | Diesel | Hybrid | Dlectric | LPG | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | All | 22,219 | 3,742 | 436 | 2 | 1 | 26,400 |
|  | LDVs | 22,215 | 3,106 | 435 | 2 | 1 | 25,759 |
|  | HDVs | 4 | 636 | 1 | 0 | 0 | 641 |
| $\mathbf{2 0 1 5}$ | All | 22,805 | 2,608 | 588 | 11 | 1 | 26,013 |
|  | LDVs | 22,802 | 2,195 | 587 | 11 | 1 | 25,596 |
|  | HDVs | 3 | 413 | 1 | 0 | 0 | 417 |

- Petrol driven vehicles constitute the vast majority
- Noteworthy increase in number of hybrid vehicles (from 55 in 2009 to 5,500 in 2017)

Average fuel consumption and $\mathrm{CO}_{2}$ emission for all vehicles registered in 2014 and 2015

## Average Fuel Consumption (/100 km)

2014 6.2

6.2

153

- Although Inventory not for same vehicle fleet mix as that for Phase I, the average fuel consumption and $\mathrm{CO}_{2}$ emission shows a decrease from $7 \mathrm{~L} / 100 \mathrm{Km}$ in 2005 to $6.2 \mathrm{~L} / 100 \mathrm{~km}$ in 2015 and $186 \mathrm{~g} / \mathrm{km}$ of $\mathrm{CO}_{2}$ emission to $153 \mathrm{~g} / \mathrm{km}$ respectively.


## Fuel economy and $\mathrm{CO}_{2}$ emission comparison for new and second hand vehicles 2014 and 2015

| Year | Vehicle <br> Type | Consumption <br> (I/100 km) |  |  | Average CO2 Emissions <br> (g/km) |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | All | New | Second <br> Hand | All | New | Second <br> Hand |
|  |  | 5.8 | 5.5 | 6.7 | 145 | 137 | 165 |
|  | HDVs | 21.5 | 20.9 | 24.6 | 612 | 593 | 695 |
| $\mathbf{2 0 1 5}$ | LDVs | 5.9 | 5.5 | 6.5 | 146 | 138 | 158 |
|  | HDVs | 22.7 | 22.5 | 24.7 | 645 | 640 | 687 |

- Second hand vehicles consume almost $20 \%$ more fuel than new vehicles and emit $15 \%$ more $\mathrm{CO}_{2}$ (LDVs)


## Fuel economy and $\mathrm{CO}_{2}$ emmission by fuel type

|  |  | Average Fuel Consumption <br> （ $/ 100 \mathrm{~km}$ ） |  |  |  | Average $\mathrm{CO}_{2}$ Emissions （g／km） |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Year | Vehicle <br> Type | $\begin{array}{ll} \text { D } \\ 0 \\ 0 \\ 0 \end{array}$ | $\begin{array}{ll} \text { 己 } \\ 0 \\ 0 \\ 0 \\ 0 & 0 \\ 0 \end{array}$ | $\begin{aligned} & \text { 弟 } \\ & ~ \end{aligned}$ |  |  | $\begin{array}{ll} \text { 悉 } \\ 0 \\ 0 & 0 \\ 0 & 0 \\ 0 \end{array}$ | 或 | 苞 |
| 2014 | LDVs | 5.7 | 7.0 | 4.2 | 4.2 | 142 | 174 | 102 | 99 |
|  | HDVs | 32.7 | 21.5 | 10.4 | 0 | 927 | 611 | 0 | 0 |
| 2015 | LDVs | 5.9 | 6.9 | 4.0 | 6.6 | 145 | 168 | 95 | 163 |
|  | HDVs | 0 | 22.8 | 0 | 0 | 0 | 646 | 0 | 0 |

－Highlights boldly the low fuel consumption of hybrid LDVs and low $\mathrm{CO}_{2}$ emissions－ $4 \mathrm{~L} / 100 \mathrm{~km}$ and $95 \mathrm{~g} / \mathrm{km}$ more $\mathrm{CO}_{2}$ in 2015

## Fuel Economy and $\mathrm{CO}_{2}$ emissions by engine displacement

|  | $2014$ |  |  | $2015$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Number of Vehicles | Average Fuel Consumption ( $\mathbf{1} 1 \mathbf{1 0 0} \mathrm{~km}$ ) | Average $\mathbf{C O}_{2}$ Emissions (g/km) | Number of Vehicles | Average Fuel <br> Consumption <br> ( $\mathbf{1} 1 \mathbf{1 0 0} \mathbf{~ k m}$ ) | Average $\mathrm{CO}_{2}$ Emissions (g/km) |
| $\leq 100$ | 2629 | 3.0 | 79 | 1954 | 3.2 | 83 |
| 101-500 | 6798 | 5.1 | 131 | 6120 | 5.1 | 130 |
| 501-1000 | 1607 | 6.3 | 153 | 3137 | 6.4 | 157 |
| 1001-1500 | 9008 | 6.6 | 162 | 9086 | 6.3 | 155 |
| 1501-2000 | 3339 | 6.8 | 164 | 3296 | 6.8 | 164 |
| 2001-2500 | 1421 | 7.7 | 189 | 1536 | 7.1 | 177 |
| 2501-3000 | 654 | 8.1 | 205 | 425 | 7.8 | 194 |
| 3001-3500 | 250 | 8.4 | 205 | 14 | 8.0 | 201 |
| 3501-4000 | 116 | 12.5 | 339 | 58 | 9.2 | 233 |
| 4001-5000 | 152 | 18.2 | 510 | 134 | 20.5 | 578 |
| 5001-10000 | 320 | 22.0 | 625 | 165 | 22.5 | 647 |
| >10000 | 45 | 35.3 | 1000 | 51 | 32.8 | 920 |

- Reveals valuable information on consumer's choice
- Mainly for - two-wheelers of 101-500 cc
- cars of 1001 - 1500 cc
- Decline in number of vehicles of 3000 cc or more
- Improvement in fuel consumption and $\mathrm{CO}_{2}$ emission of vehicles in the range $1001-1500 \mathrm{cc}$


## The need for a breakdown of inventory data

- Vehicle registration data has been worked out
- by class of vehicle
- by class subdivided into HDVs and LDVs
- by fuel type
- by engine technology
- Fuel economy and $\mathrm{CO}_{2}$ Emission have been detailed
- by class of vehicle registered
- by new and second hand vehicle
- by fuel type both for LDVs and HDVs
- by engine displacement
- by engine displacement and fuel type


## The need for a breakdown of inventory data

- It enables development and implementation of targeted policies/strategies to promote fuel economy and $\mathrm{Co}_{2}$ abatement.
- It enables influencing consumer choice towards vehicles with higher fuel economy and lower $\mathrm{CO}_{2}$ emission through public information/fiscal incentives.
- Breakdown of Inventory data reveals important information as to which segment of vehicle population has the maximum potential for fuel economy and $\mathrm{CO}_{2}$ emission reduction.
- It reduces the country's reliance on fossil fuels and expenditure on importation of such fuels.
- It enables the country to reap environmental benefits through lesser $\mathrm{CO}_{2}$ emissions


## Trend of fuel economy and $\mathrm{CO}_{2}$ Emissions 2005 - 2015 LDVs

|  | 2005 | 2013 | 2015 |
| :--- | :---: | :---: | :---: |
| Fuel Economy L/100 Km) | 7.0 | 6.6 | 5.9 |
| Co $_{2}$ Emission (g/km) | 186 | 169 | 145 |
| All vehicles (2015) - 6.2L/100 km and $153 \mathrm{~g} / \mathrm{km}$ |  |  |  |

## Comparison of fuel economy with global average (LDV only) (L/100 km)

|  | $\mathbf{2 0 0 5}$ | $\mathbf{2 0 0 8}$ | $\mathbf{2 0 1 1}$ | 2013 | 2014 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Global Average | 8.07 | 7.67 | 7.2 | 7.1 | - |
| OECD Average | 8.1 | 7.6 | 7.0 | 6.9 | - |
| Non OECD Average | 7.8 | 7.6 | 7.5 | 7.2 | - |
| Mauritius | 7.0 | - | - | 6.6 | 5.8 |

- Source GFEI presentation (Malawi)


## Fuel economy policies can work substantially



## Development of a Data Entry Tool

- NTA database provides detailed information on all vehicles registered
- During Phase 1 of the Inventory -
> Additional function developed in vehicle registration software in format required for GFEI inventory
> This function enable the registered vehicles to be clustered by make, model, engine capacity, Country of origin, new or second hand, fuel type etc.
> This information was generated on MS Excel
> Fuel Economy and $\mathrm{Co}_{2}$ Emission data were sought for each cluster of vehicles to constitute the Inventory


## THE PROCESS STEPWISE

Step 1: On the Registration and Licence System menu of the vehicle registration system, go to the Query tab and click on Global Fuel Economy Initiative from the dropdown row.


Step 2: Once in the Global Fuel Economy Initiative menu, type in the Class of vehicle and the year bracket on the Date of Registration fields.

## Fis Registration A Licence System - [FLUIO1-Ghobal Fuel Lconomy Initiative]




Global Fuel Economy Initiative menu within the NTA vehicle registration system

Step 3: Click on the File Name field to open the GFEI folder to select the required Common Separated Values (CSV) file and year bracket



Sample vehicle data stored within CSV file of 1975-2013. The CSV files store tabular data for all types of vehicles as shown above. It is noted that fuel consumption and $\mathrm{CO}_{2}$ emission fields are missing.

Step 4: Once the selected CSV file is imported in the DET software, press the Print File button on the Global Fuel Economy Initiative menu at Step 2. This will generate the vehicle data sheet in MS Excel as shown below.


## Sample of data collected after extracting into MS Excel format.

Sample of registration data for vehicles


## Further Enhancement of Software

- The date entry tool is being further enhanced
- Two additional fields are being provided - one for fuel economy and one for $\mathrm{Co}_{2}$ Emissions.
- Vehicle importers and dealers to supply mandatorily fuel economy and $\mathrm{CO}_{2}$ Emission data for all new and second hand vehicles being registered for first time in Mauritius.
- Information keyed in when vehicle being registered
- Software also being enhanced to capture in-use vehicle emission data from periodic vehicle roadworthiness test.
- Accurate fuel economy $\mathrm{CO}_{2}$ emission data available both for vehicle inventory and other climate change reporting needs.


## THANK YOU

