Global Trends toward Cleaner Fuels and Fuel Efficient Vehicles

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Malawi, 11 December 2017

GFEI
GLOBAL FUEL ECONOMY INITIATIVE

UN environment

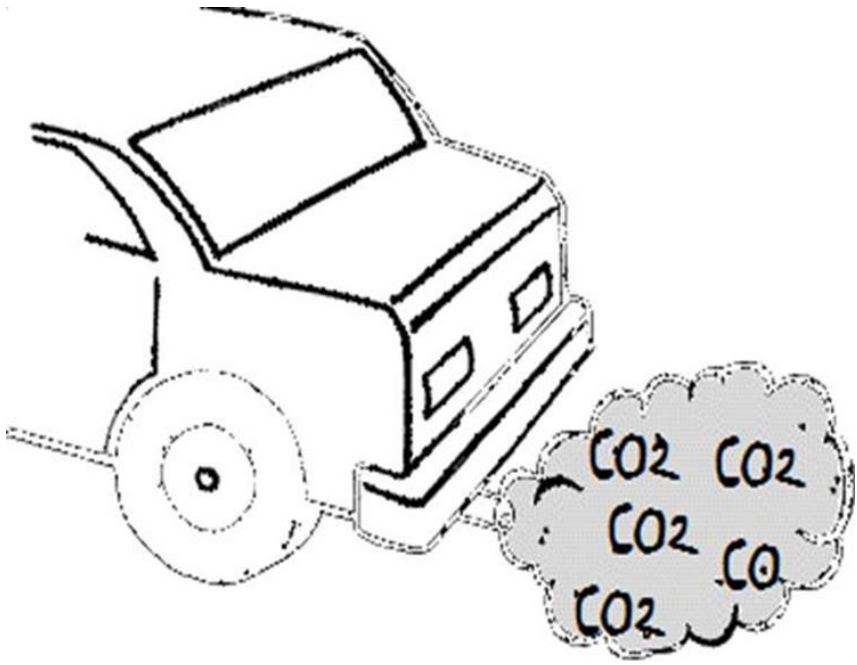
Impact of Transport

Air Quality & Health

- Largest source of air pollution in cities, exceeding WHO standards and costing more than 5% GDP

Climate Change

- Responsible for 23% global CO2 emissions & fastest growing sector in GHG emissions, 2.5% yearly until 2020



Why cleaner fuels and vehicles

- → 7 million people killed in 2012 from air pollution;
- → Small particulates (PM10 or PM2.5) estimated to cause over 3.7 million premature deaths each year worldwide;
- → In 2012, diesel PM was officially classified as carcinogenic (WHO);
- → The smaller part of PM is black carbon (BC), now believed the second most important climate pollutant;
- → Diesel vehicles responsible for significant PM pollution in cities

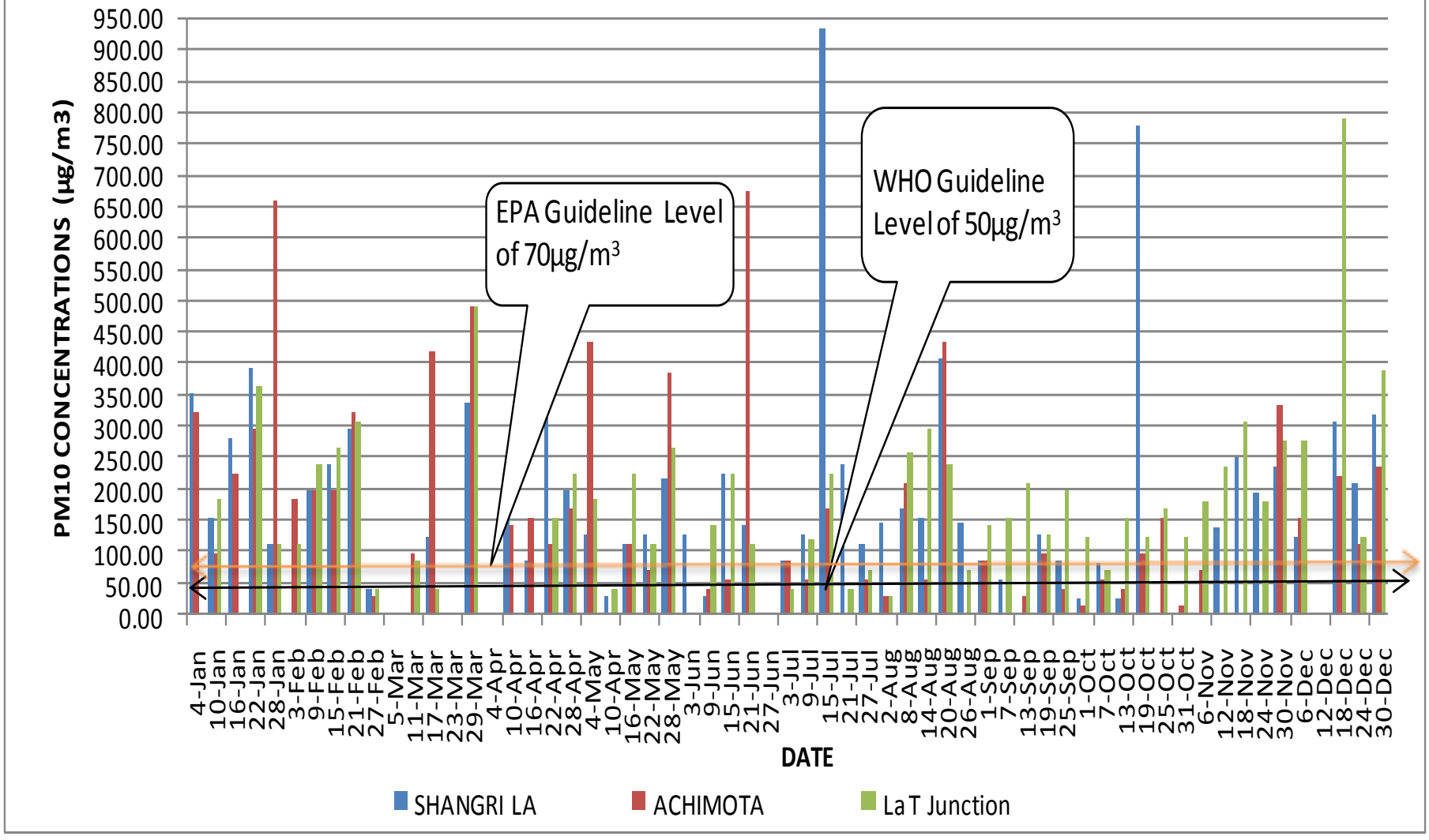
DISEASES DUE TO:

- O_3
- PM2.5 AIR POLLUTION

- Chronic obstructive pulmory diseazse (COPD)
- Childhood pneumonia
- Ischaemic heart disease
- Stroke
- Asthma
- Breathing problems airway inflammation
- Chronic respiratory illness
- Reduced lung function
- Low birth weight

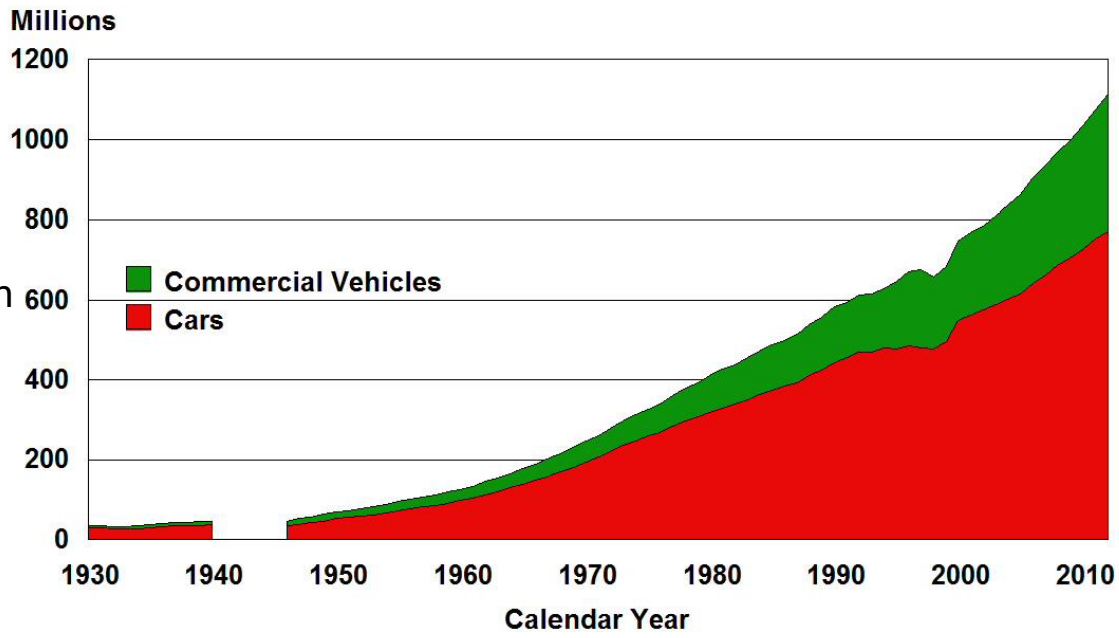
APPROXIMATE SHARE OF PREMATURE DEATH FROM **AIR POLLUTION** (YEAR 2012)

FIG. PM10 CONCENTRATIONS (µg/m3) RECORDED AT OTHER ROADSIDE MONITORING LOCATIONS JANUARY - DEC EMBER 2014.



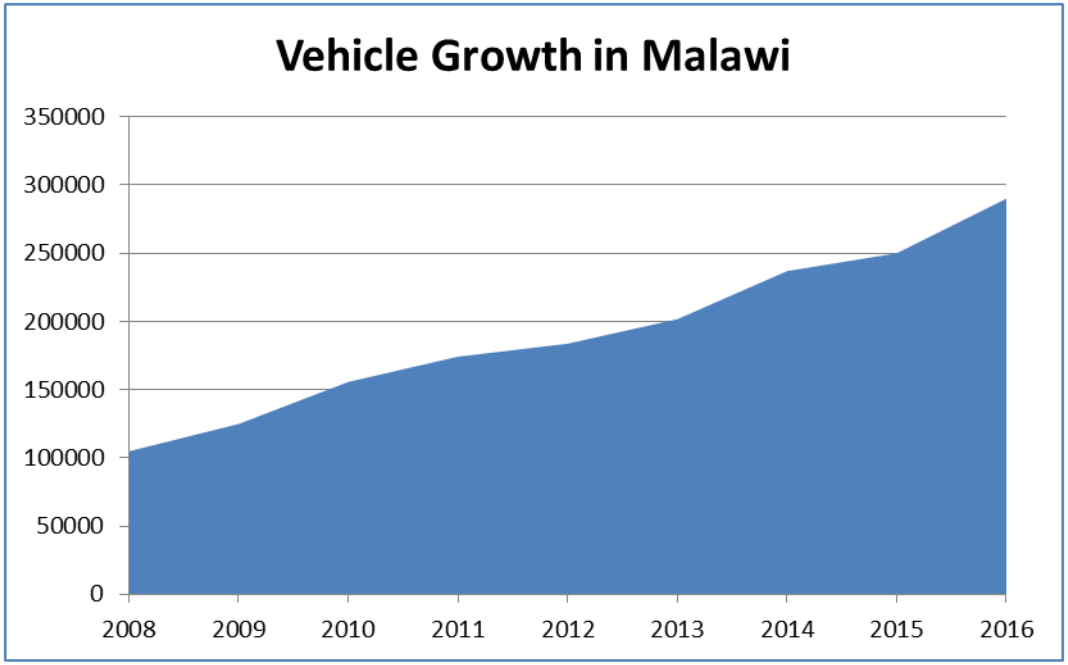
Historical High Growth Has Made Vehicles An Important Contributor To Local, Regional and Global Pollution

- Vehicle fleet to ***triple*** (from ~1 billion to ~3 billon)
- 90%+ of growth in non-OECD countries
- Very few non-OECD countries have policies

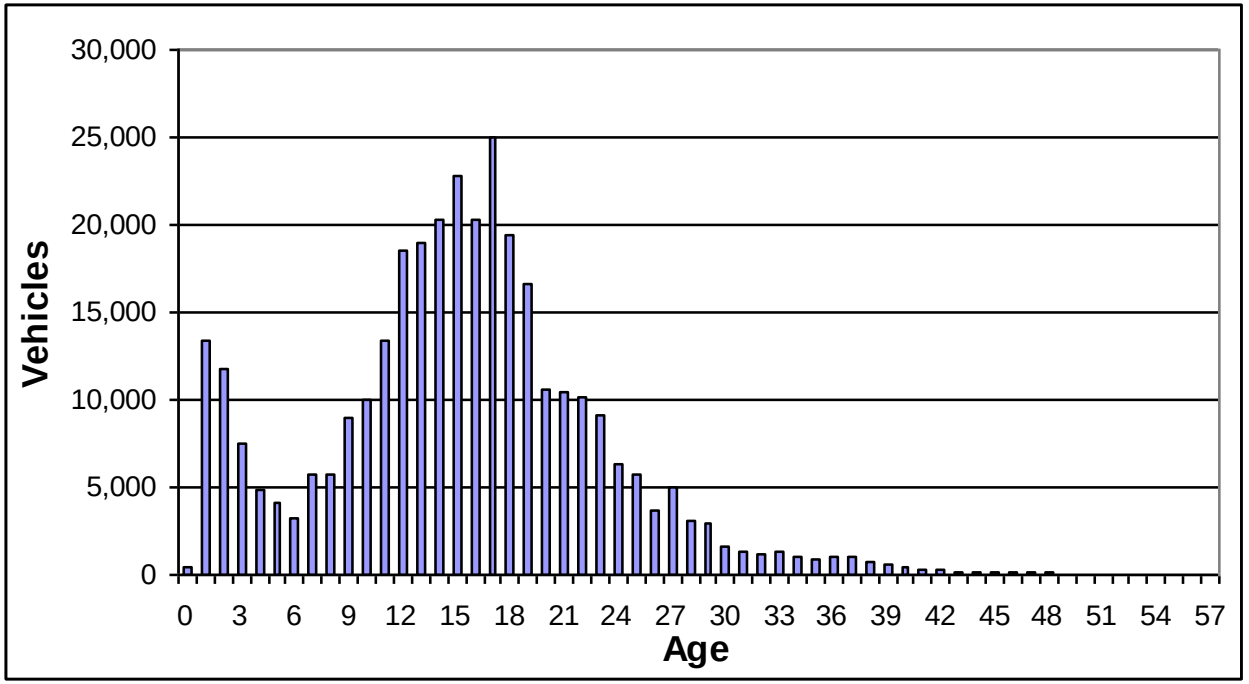


Source: Mike Walsh

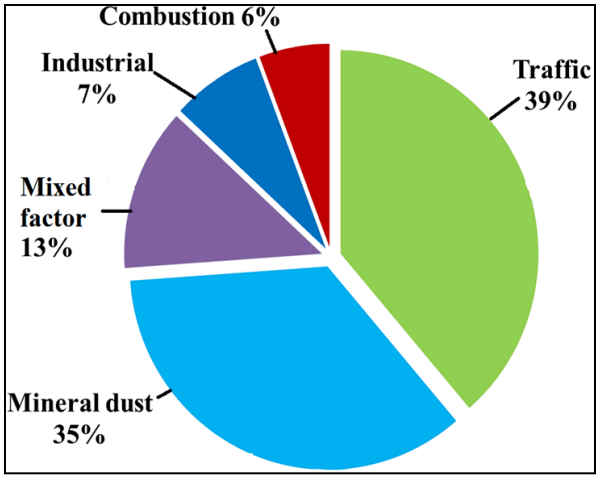
Vehicle Growth in Malawi



Africa's Aging Vehicle Fleet



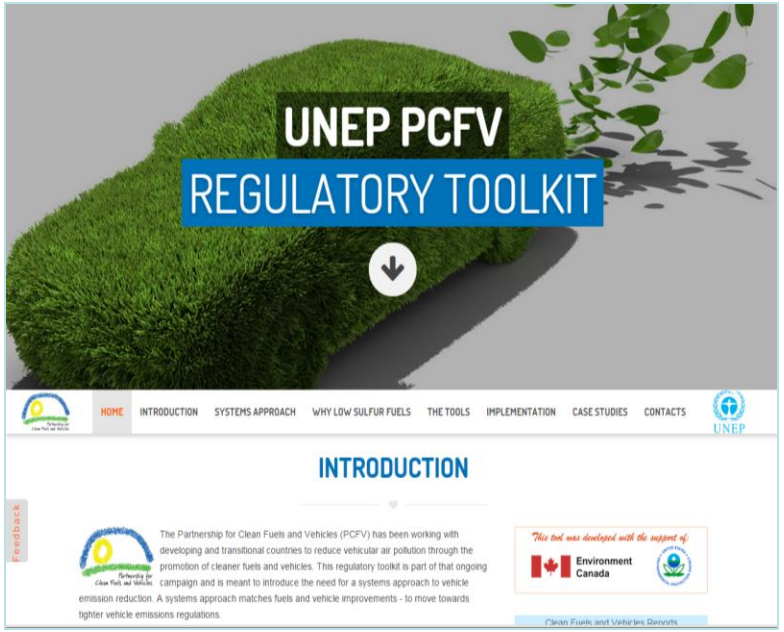
Tanzania



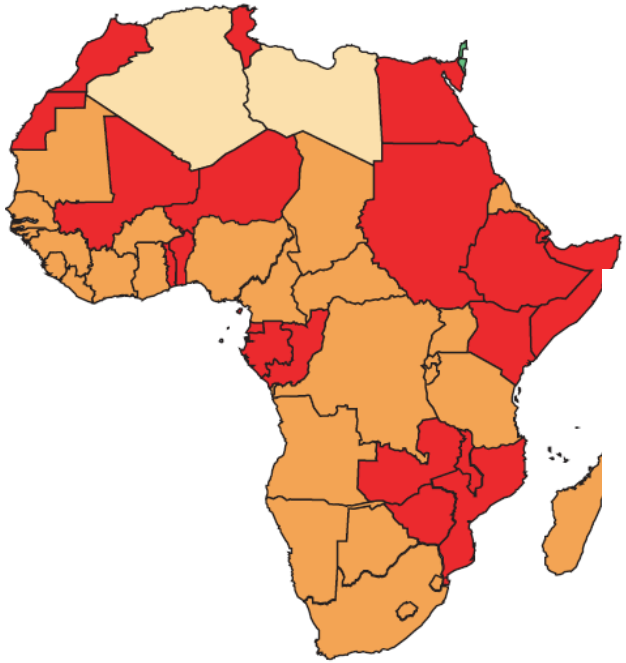
Nairobi

Systems Approach to Clean Fuels and Vehicles

- Systems approach links fuel quality to vehicles emission standards for max emission reduction benefits
- Countries need to develop long term roadmaps to reduce vehicle emissions, that include Inspection & Maintenance / testing programs



Progress in Lowering Sulphur in Diesel in Africa



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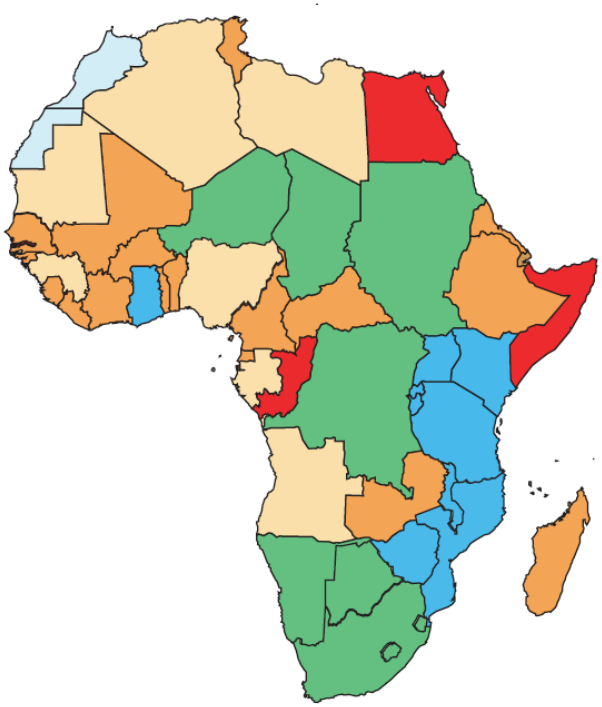
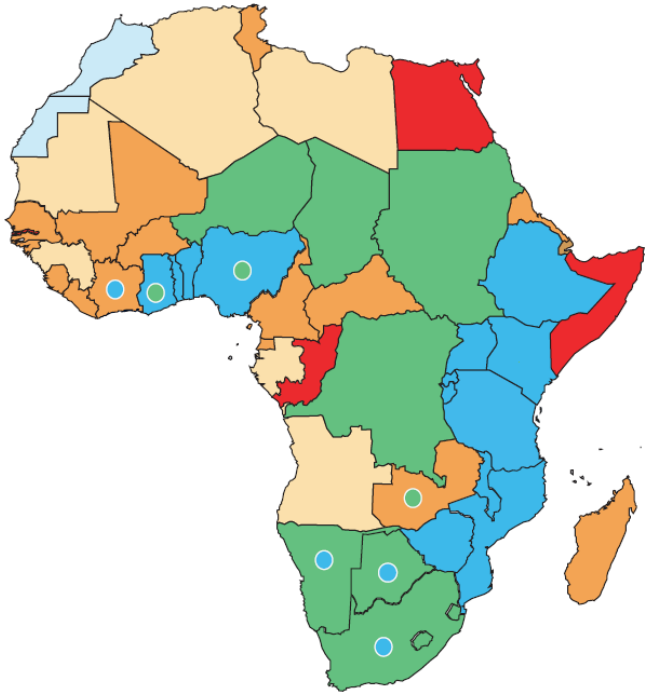


1 Nov 2017



Commitments 2017/2018

15 & Below*

>15 - 50

> 50 - 500

> 500 - 2000

> 2000 - 5000

> 5,000 & Above

* Information in parts per million (ppm)

Stringent emission standards can reduce pollution by over 85%

No retrofit system
Uncontrolled Diesel Exhaust
(Level 1)

Old technlogy
Little black carbon removal
Little ultrafine PM removal
Does not remove lube oil ash

Retrofitted with
Diesel Oxidation Catalyst (DOC)
(Level 1)

Old technlogy
Little black carbon removal
Little ultrafine PM removal
Does not remove lube oil ash

Retrofitted with
Partial Filter
(Level 2)

Little black carbon removal
Little ultrafine PM removal
Does not remove lube oil ash

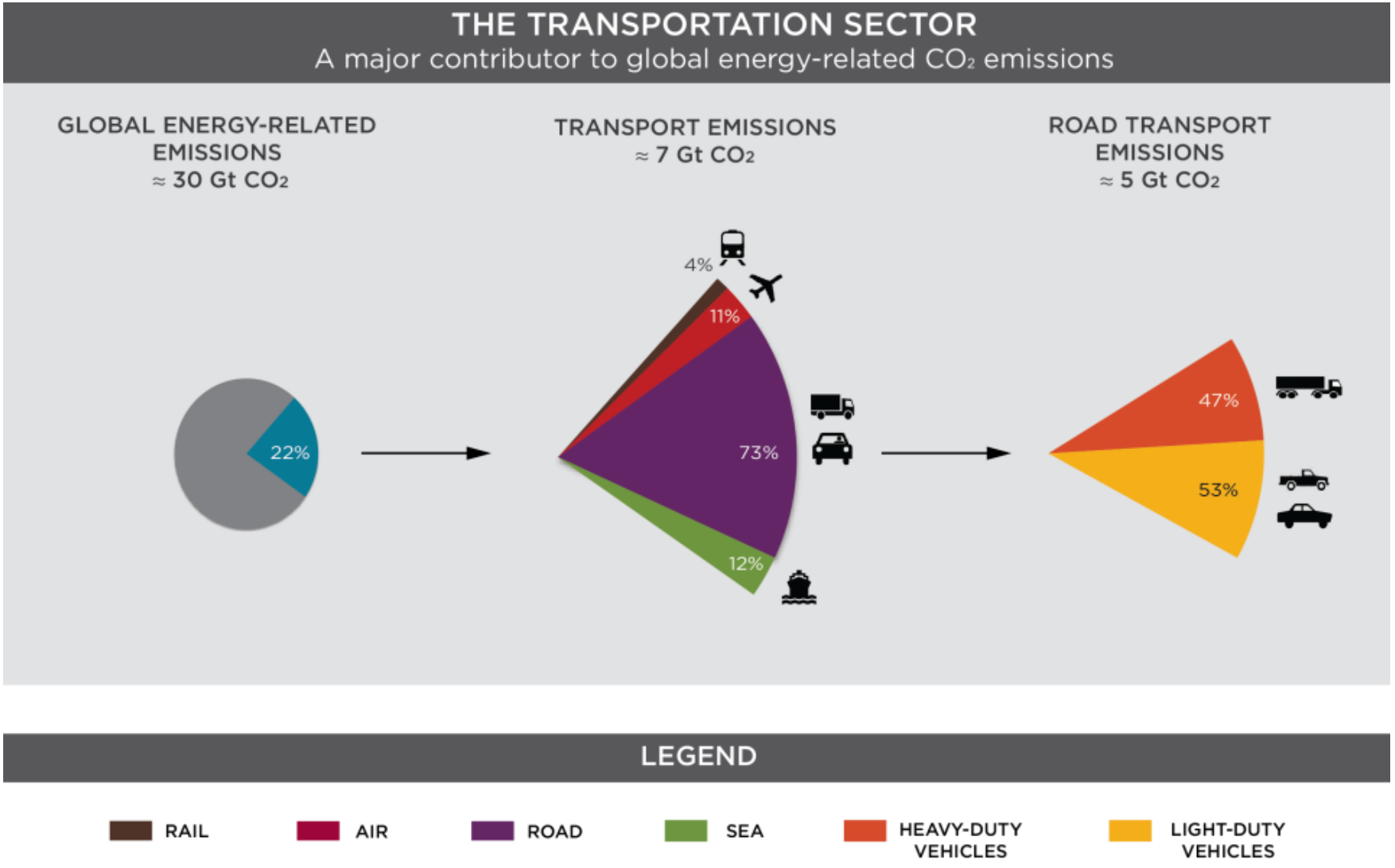
Retrofitted with
Diesel Particulate Filter (DPF)
(Level 3)

New Technology
Used on all new trucks since 2007
>85% black carbon removal
>85% ultrafine removal
>85% lube oil ash removal

Diesel particulate filters are needed to meet Euro 5 standards for light-duty vehicles and Euro VI standards for heavy-duty vehicles. Filters require diesel with sulfur content less than 50ppm, and require 10ppm diesel for optimal performance.

- Cleaire Advanced Emission Controls LLC

CO2 Emissions from Transport



Sources:
ICCT (2014). Global Transportation Roadmap Model. Version 2.0. More information available at http://www.theicct.org/global-transportation-roadmap-model.
IEA (2012). CO2 Emissions from Fuel Combustion: Highlights. 2012 edition. Retrieved from https://www.iea.org/co2highlights/co2highlights.pdf.

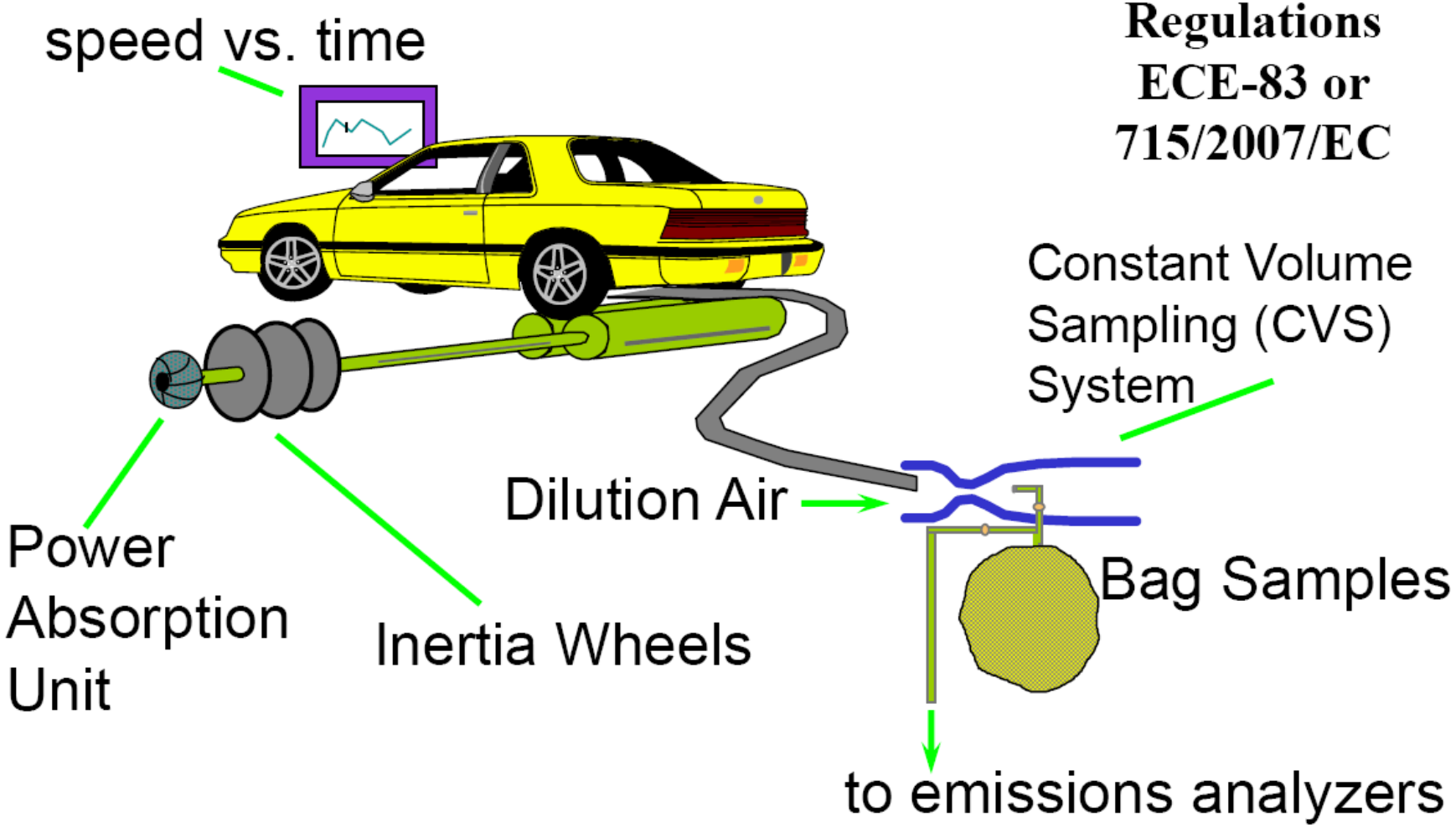
What is fuel economy?

- Vehicles use energy, and fuel economy measures energy per unit of vehicle travel. It is the RATE of energy use.
  - Litres per 100km (Europe)
  - Km per litre (Japan)
  - Miles per gallon (United States)

- Fuel economy, fuel efficiency, fuel intensity are all fairly interchangeable terms.

- Also measured in CO2 emissions=CO2 g/km

Typical Light Duty Vehicle Test Facility



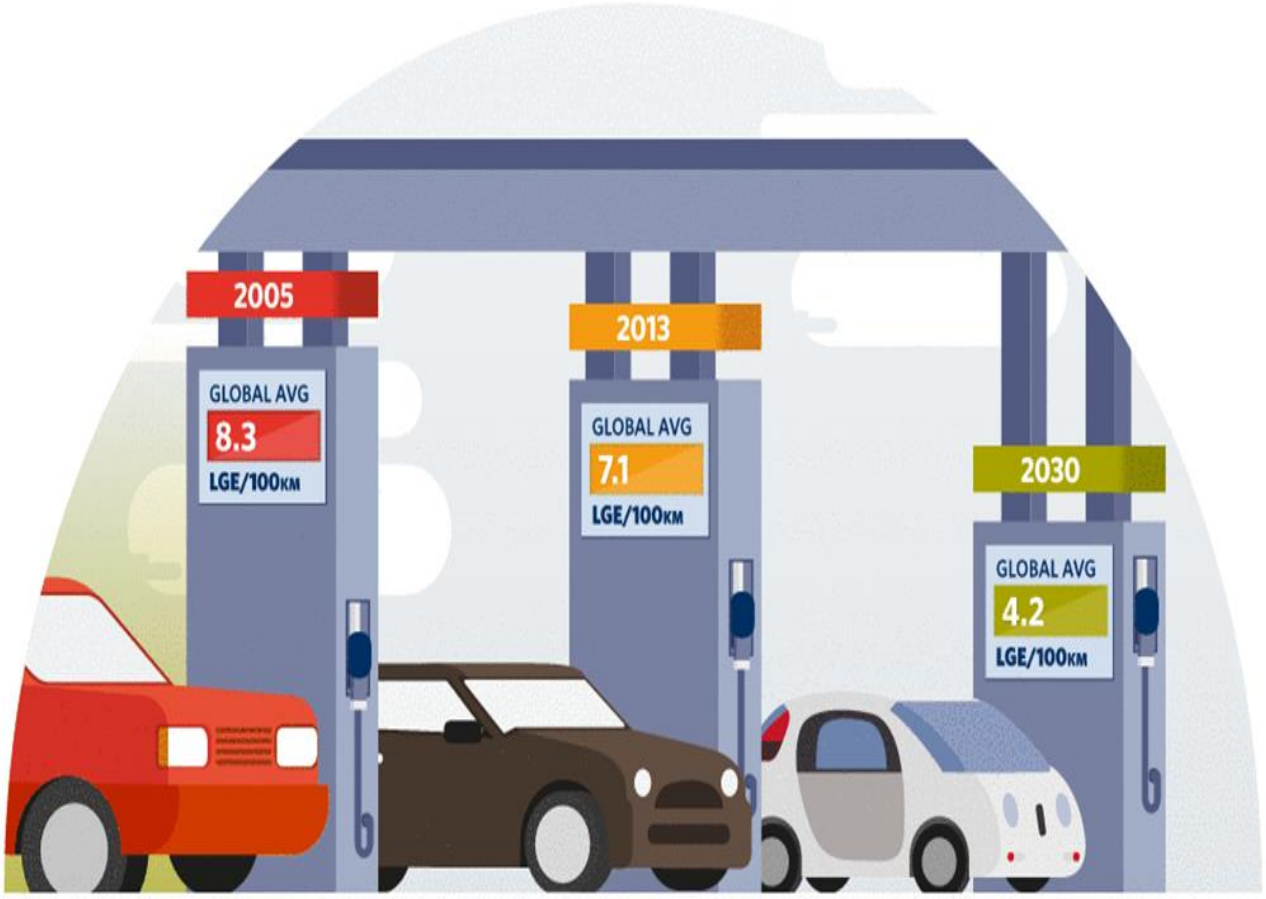
- Measurements in g/km, mg/km or #/km

Source: Stuart Rayner, NAAMSA

THE GLOBAL GOALS:
FUEL ECONOMY

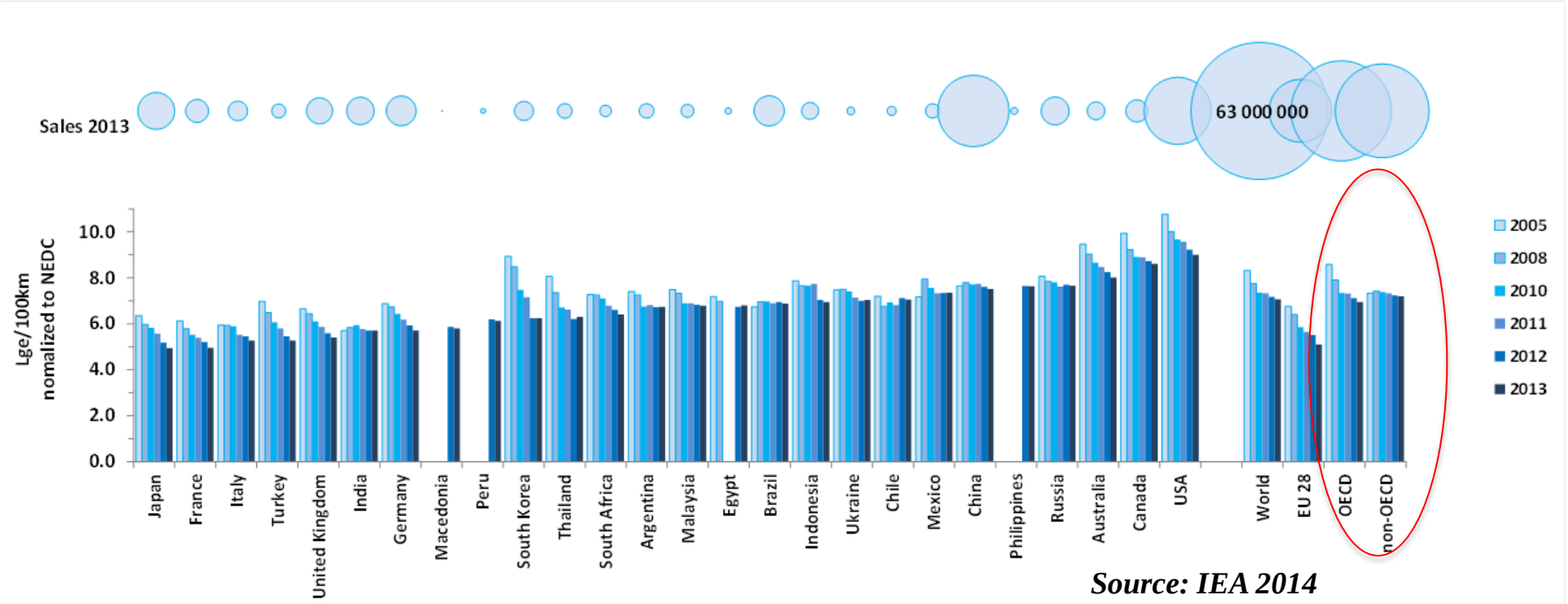
DOUBLE AVERAGE FUEL ECONOMY

OF NEW CARS BY 2030 AND ALL CARS BY 2050



Regional fuel economy trends

- Countries with FE policies in place show encouraging improvement rates
- Size shift vs. technology evolution moderates non-OECD improvement

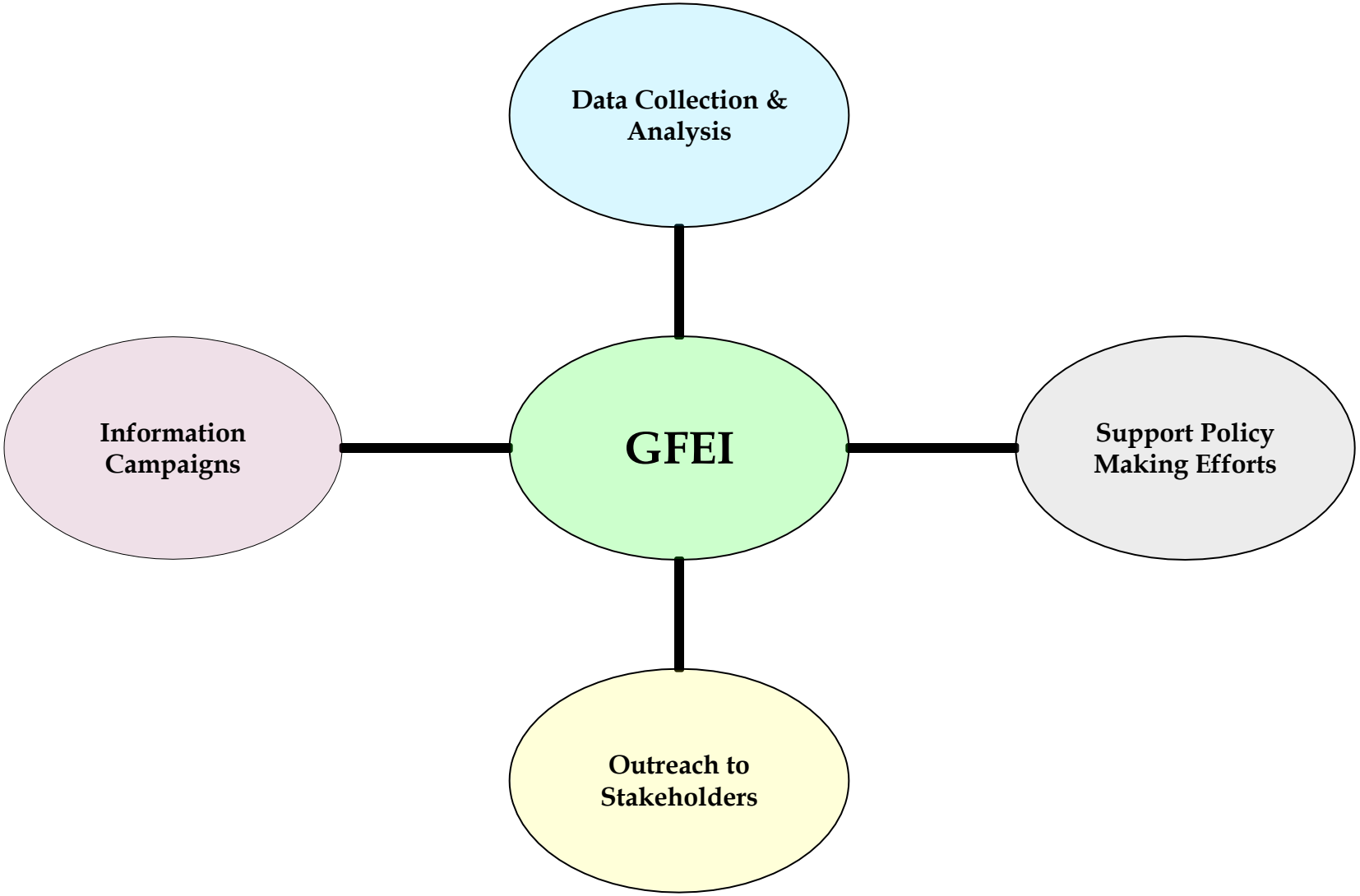


Source: IEA 2014

GFEI Country Engagement

countries with ongoing projects	new countries 2016/2017	Countries expressed interest
1Chile	28Malaysia	63Panama
2Ethiopia	29Bangladesh	64Iran
3Indonesia	30Kazakhstan	65Angola
4Kenya	31Mali	66Bhutan
5Georgia	32Nigeria	67Burkina Faso
6Ivory Coast	33Togo	68Burundi
7Mauritius	34Tanzania	69Cambodia
8Jamaica	35Rwanda	70Cameroon
9Montenegro	36Bolivia	71Cape Verde
10Macedonia	37Argentina	72D.R. Congo
11Costa Rica	38Ecuador	73Eritrea
12Vietnam	39Ukraine	74Fiji
13Morocco	40Jordan	75Guinea
14Bahrain	41Colombia	76Iran
15Tunisia	42Djibouti	77Kyrgyzstan
16Thailand	43Dominican Republic	78Laos
17Peru	44Guatemala	79Lesotho
18Russia	45Moldova	80Marshall Islands
19Benin	46Pakistan	81Mongolia
20Algeria	47Barbados	82Namibia
21Uruguay	50St. Lucia	83Niger
22Nepal	51Lebanon	84Papua New Guinea
23Paraguay	52Zambia	85Senegal
24Sri Lanka	53Ghana	86Sierra Leone
25Philippines	54Malawi	87Solomon Islands
26Uganda	55Zimbabwe	88South Africa
27Egypt	56Honduras	89Tajikistan
	57Nicaragua	90Turkmenistan
	58El Salvador	91Turkey
	59Botswana	92Armenia
	60Mozambique	93Azerbaijan
	61Myanmar	94Serbia
	62Liberia	95Samoa
		96Gambia
		97Uzbekistan
		98Bosnia-Herzegovina
		99Albania

Summary of GFEI Implementation



The GFEI Process

- Data Collection
  - Baseline Setting - 2005
  - Analysis of Trend (2008, 2011, 2013, 2016)
- Overview of
  - Vehicle fleet
  - Vehicle regulations
  - Fiscal incentives
  - Fuel standards
- Policy Options
- National Consultations
- Regional Consultations

Vehicle Data Categories

- Data to be collected is for all vehicles entering a country for the first time:
  - new vehicles manufactured in the country
  - new vehicles imported
  - second hand vehicles imported into the country
  - car that is already in-country, but re-registered because re-sold should not be counted
- Useful to keep separate track of these three categories of vehicles, as well as creating a combined average set of information

Minimum information required

- Vehicle make and model
- Model production year
- Year of first registration
- Fuel type (petrol or diesel)
- Engine size
- Domestically produced or imported
- New or second hand import
- Rated Fuel Economy per model and test cycle basis
- Number of sales by model

Estimating average fuel economy

- Look for the tested fuel economy number for the vehicle model
- If not available the fuel economy figures for a given make, model and year can usually be retrieved from the vehicle manufacturers
- GFEI partners are compiling a list of fuel economies into a common database for use by countries undertaking baseline-setting exercise
- For the sake of comparison, all drive cycle data obtained be converted to the NEDC cycle
- Conversion factors can be downloadable from ICCT website www.theicct.org/info/data/GlobalStdReview_Conversionfactor.xlsx

Additional information

- http://www.carfolio.com/specifications/models; www.edmunds.com/toyota;
- http://www.carfolio.com/specifications/models/?man=4131
- http://www.epa.gov/fueleconomy/gas-label-1.htm; and
- http://www.carfolio.com/

- A Test Cycle Conversion Tool: www.theicct.org/info/data/GlobalStdReview_Conversionfactor.xlsx

- A global comparison of Vehicle Fuel Economy Standards: http://www.theicct.org/passenger-vehicles/global-pv-standards-update/

- South African Comparative Passenger Car Fuel Economy AND CO2 Emissions Data: http://www.naamsa.co.za/ecelabels/

- U.S. Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends (1975 through 2010): http://www.epa.gov/OMS/fetrends.htm

- U.S. Fuel Economy Policy: http://www.fueleconomy.gov/

- U.S. Fuel Economy Regulations: http://www.epa.gov/oms/climate/regulations.htm

- U.S. Auto Fuel Economy Database: http://www.fueleconomy.gov/feg/findacar.htm

Final Data

Make	Model	Condition	Body Type	Engine CC	Fuel Type	Model Year	Registration Date	L/100km	CO2
BMW	316I	Used	S.WAGON	1596	Petrol	1989	2005	7.5	176
CHEVROLET	OPTRA	Used	SALOON	1799	Petrol	2005	2005	6.2	145
CHEVROLET	NULL	Used	S.WAGON	1799	Petrol	2005	2005	6.2	145
NISSAN	SUNNY	Not Specified	SALOON	1970	Diesel	1998	2005	6.6	177
MITSUBISHI	LANCER	Used	SALOON	1600	Diesel	1998	2005	6.9	185
SKODA	OCTAVIA	Used	SALOON	1800	Diesel	2004	2005	7.0	188
SKODA	OCTAVIA	Used	SALOON	1800	Diesel	2005	2005	7.0	188
TOYOTA	COROLLA	New	S.WAGON	1970	Diesel	1998	2005	7.0	188
TOYOTA	COROLLA	New	SALOON	2000	Diesel	1998	2005	7.0	188
FORD	RANGER	New	VAN	2500	Petrol	2005	2005	8.1	170
HONDA	CR-V	NULL	S.WAGON	1970	Petrol	1998	2005	9.3	217

Average fuel economy

At the simplest level, taking a weighted average (by sales) of all new (including newly imported second hand) vehicles in the database will provide the average fuel economy of new vehicles sold in the country in the given year:

$$Harmonic\ average\ annual\ fuel\ economy = \frac{Total\ sales\ in\ the\ year}{\sum_1^n \frac{sales\ model\ i}{fuel\ economy\ model\ i}}$$

In a similar way, average CO_2 intensity can be obtained through weighted average with the sales of each model:

$$Average\ annual\ emission = \frac{\sum_1^n sales\ model\ i * emission\ model\ i}{Total\ sales\ in\ the\ year}$$

Example of final data: Kenya Fuel Economy

Year	Average fuel consumption metric combined (L/100km)	Average CO_2 emission (g/km)
2010	7.4	178.2
2011	7.6	182.0
2012	7.7	185.4
Grand Average	7.5	181.7

Year of vehicle registration	Fuel Type		
	Diesel	Petrol	Grand Average
2010	8.0	7.2	7.4
2011	7.9	7.5	7.6
2012	8.0	7.6	7.7
Grand Average	8.0	7.4	7.5

Year of vehicle Registration	New	Used	Grand Average
2010	7.0	7.4	7.4
2011	6.6	7.6	7.6
2012	6.3	7.7	7.7
Grand Total	6.6	7.6	7.5

Fuel Economy Levels

Global	2005	2008	2011	2013
Average (l/100km)	8.07	7.67	7.2	7.1
OECD Average	8.1	7.6	7.0	6.9
Non-OECD Average	7.5	7.6	7.5	7.2

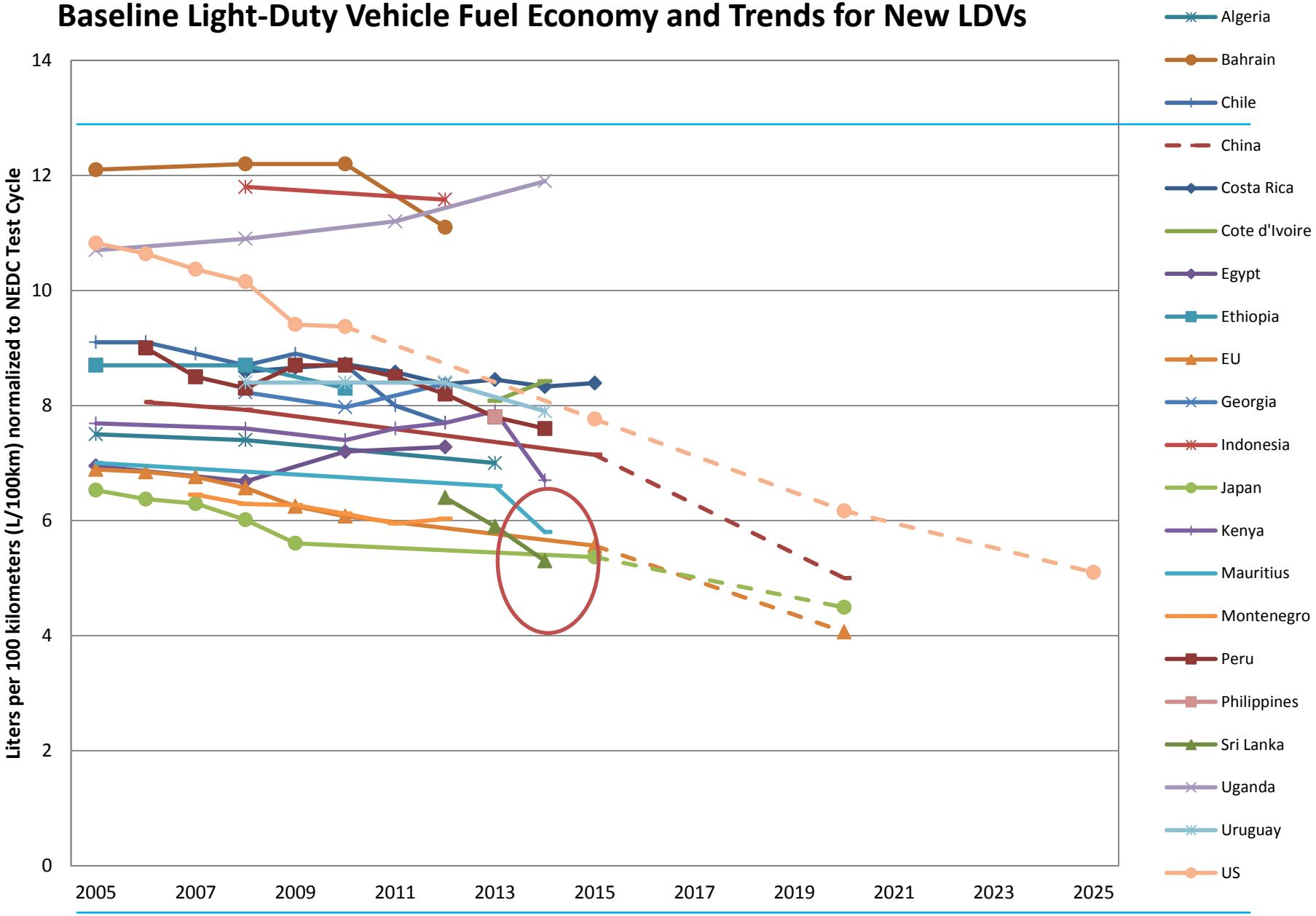
Mauritius	2005	2013	2014
Average (l/100km)	7.0	6.6	5.8

Uganda	2005	2008	2011	2014
Average (l/100km)	10.94	11.14	11.34	12.15

Algeria	2005	2008	2013
Average (l/100km)	7.5	7.4	7.0

Kenya	2010	2011	2012
Average (l/100km)	7.4	7.6	7.7

Baseline Light-Duty Vehicle Fuel Economy and Trends for New LDVs



Source: UNEP, 2017 (unpublished).

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