

# Energy and Environment in Thailand

Utai Unagul

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on November 25 , 2013 at 15.00 –17.00 time

# Content

1. Thailand Automotive Institute( TAI) Emission testing lab. Facility.
2. Country current emission standard and test type.
3. Sharing experience energy& environment concern
  - CO<sub>2</sub> , Fuel consumption issue
  - Fuel consumption study project

1.

# TAI Emission Testing Lab. Facilities

# TAI Test Capability

1. Motorcycles follow safety requirements ; emission from engine, Level 6 ; TIS 2350-2551 (2008) ,Equivalent COMMISSION DIRECTIVE 2003/77/EC, amending Directives 97/24/EC and 2002/24/EC (EURO III)
2. Positive ignition engine vehicles follow Safety requirements ; emission from engine, Level 8 ; TIS 2540-2554 (2011) ,Equivalent Directive 70/220/EEC ECE Regulation No.83, the 05 series of amendment (EURO IV)

# TAI Test Capability

3. Light duty compression ignition engine vehicles follow Safety requirements ; emission from engine, Level 7 ; TIS 2550-2554 (2011) Equivalent Directive 70/220/EEC (EURO IV) ECE Regulation No.83, the 05 series of amendment
4. Light motor vehicle equipped with positive ignition engines fuelled with natural gas or liquefied petroleum gas follow safety requirements ; emission from engine, Level 1; TIS 2555-2554 (2011) Equivalent Directive 70/220/EEC (EURO IV) ECE Regulation No.83, the 05 series of amendment

# TAI Test Capability

5. Heavy duty compression ignition engine vehicles follow safety requirements ; emission from engine, level 4 ; TIS 2315-2551 (2008) ,Equivalent ECE Regulation No.49 (EURO III)
6. Heavy Motor Vehicle Equipped with Positive Ignition Engines Fuelled with Natural Gas or Liquefied Petroleum Gas follow safety requirements ; emission from engine, Level 1; TIS 2315-2552 (2009) ,Equivalent ECE Regulation No.49 (EURO III)

# TAI Test Capability



Passenger & Light duty vehicle

(1x test cell for 2 WD Chassis Dyno)

Test available

- Type 1
- Type 2
- Type 3
- Type 4
- OBD simulation



2-Wheelers motorcycle

1 x test cell : Test available

- Type 1
- Type 2
- Evapulative



Commercial Vehicle 1 x test cell

ESC ETC & ELR cycle

# Enhance Capability of TAI Emission Testing Lab.

Project in year 2014

1. Upgrade new CVS & Analyzer for motorcycle emission testing laboratory.
2. Additional new VT-SHED for PI engine .
3. New emission testing laboratory for 4 wheel drive vehicle .
4. Fuel consumption equipment for direct measurement .



# Enhance capability of TAI Emission Testing Lab.

- ❑ Project : New emission testing laboratory for 4 wheel drive vehicle .
  - Standard Meet – EURO IV & EURO V (Type 1 ,Type 2 &Type 3)
  - Vehicle covering – 2WD & 4WD (PI ,CI ,HEV )
  - Fuel type – Gasoline ,Ethanol (E10-E85) ,Diesel & Bio-Diesel ,CNG & LPG
  - Main emission gas : CO ,HC ,Nox ,CH<sub>4</sub> ,CO<sub>2</sub> , O<sub>2</sub> and F/C (Indirect measure)
  - Available – 4<sup>th</sup> Quarter of year 2014
- ❑ Project : Fuel consumption equipment for direct measurement
  - Purpose – Direct F/C measurement for R&D ,Field test.
  - Fuel type – Gasoline ,Ethanol (E10-E85) ,Diesel & Bio-Diesel

2.

# Thailand Emission Standard & Type of Test

# Thailand Emission standard

## for passenger & light duty vehicle & type of test

Limit value for emission pollutant for type approval test (EURO IV)

Fuel	Type I						Type II		Type III	Type IV
	Reference Mass (RW)	Carbon Monoxide (CO)	Hydrocarbons (T.HC)	Oxides of Nitrogen (NO <sub>x</sub> )	Hydrocarbons and Oxides of Nitrogen (HC+NO <sub>x</sub> )	Particulates	Low Idling Speed Carbon Monoxide (CO)	High Idling Speed Carbon Monoxide (CO)	The pressure in the crankcase shall be measured	Hydrocarbons (T.HC)
	kg	g/km	g/km	g/km	g/km	g/km	Vol%	Vol%		g/Test
Gasoline & CNG	<i>passenger vehicle with gross mass not over 2500 kg</i>						3.5	4.5	None	2.00
	All	1.00	0.20	0.08						
	<i>passenger vehicle with gross mass over 2500 kg or truck and vehicles modified from truck with gross not over 3500 kg</i>									
	RW ≤ 1350	1.00	0.10	0.08						
	1350 < RW ≤ 1760	1.81	0.13	0.10						
1760 < RW	2.27	0.16	0.11							
Diesel	<i>passenger vehicle with gross mass not over 2500 kg</i>									
	All	0.50		0.25	0.30	0.03				
	<i>passenger vehicle with gross mass over 2500 kg or truck and vehicles modified from truck with gross not over 3500 kg</i>									
	RW ≤ 1350	0.50		0.25	0.30	0.03				
	1350 < RW ≤ 1760	0.63		0.33	0.39	0.04				
1760 < RW	0.74		0.39	0.46	0.06					

Type I : Verifying The Average Exhaust Emissions After A Cold Start  
Type II : Carbon Monoxide Emission at Idling Speed

Type III : Emissions of Crankcase Gases  
Type IV : Evaporative Emissions

# Thailand Emission standard

## for passenger & light duty vehicle & type of test

Limit value for emission pollutant for type approval test

Fuel	Type I (OBD)					
	Reference Mass (RW)	Carbon Monoxide (CO)	Hydrocarbons (T.HC)	Oxides of Nitrogen (NO <sub>x</sub> )	Hydrocarbons and Oxides of Nitrogen (HC+NO <sub>x</sub> )	Particulates
	kg	g/km	g/km	g/km	g/km	g/km
Gasoline & CNG	<i>passenger vehicle with gross mass not over 2500 kg</i>					
	All	3.20	0.40	0.60		
	<i>passenger vehicle with gross mass over 2500 kg or truck and vehicles modified from truck with gross not over 3500 kg</i>					
	RW ≤ 1350	3.20	0.40	0.60		
	1350 < RW ≤ 1760	5.80	0.50	0.70		
	1760 < RW	7.30	0.60	0.80		
Diesel	<i>passenger vehicle with gross mass not over 2500 kg</i>					
	All	3.20	0.40	1.20		0.18
	<i>passenger vehicle with gross mass over 2500 kg or truck and vehicles modified from truck with gross not over 3500 kg</i>					
	RW ≤ 1350	3.20	0.40	1.20		0.18
	1350 < RW ≤ 1760	4.00	0.50	1.60		0.29
	1760 < RW	4.80	0.60	1.90		0.28

# Thailand Emission standard for motorcycle and type of test

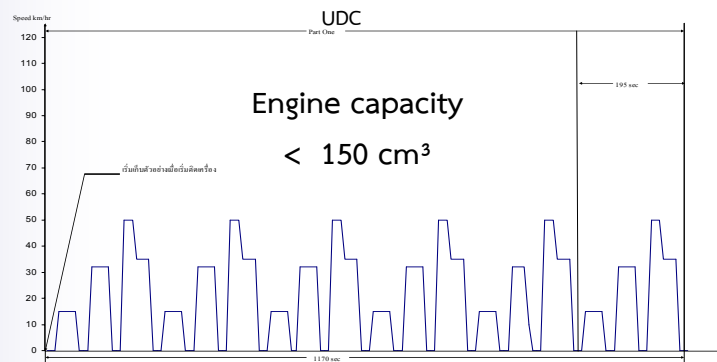
Limit value for emission pollutant for type approval test ( EURO III)

Engine capacity	Clause 6.1			Clause 6.2				Clause 6.3
	Carbon Monoxide (CO)	Hydrocarbons (T.HC)	Oxides of Nitrogen (NO <sub>x</sub> )	Low Idling Speed		High Idling Speed		Hydrocarbons (T.HC)
	g/km	g/km	g/km	Carbon Monoxide	Hydrocarbons	Carbon Monoxide	Hydrocarbons	
				% Vol	ppm	% Vol	ppm	g/Test
Engine capacity < 150 cm <sup>3</sup>	2.00	0.80	0.15	2.5	1000	2.5	1000	6.00
Engine capacity ≥ 150 cm <sup>3</sup>	2.00	0.30	0.15					2.00

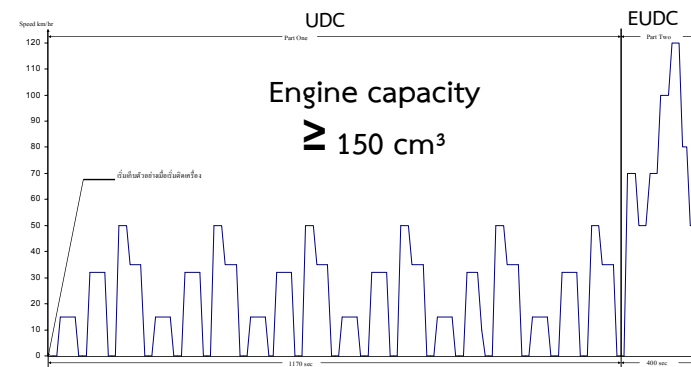
Clause 6.1 : Verifying The Average Exhaust Emissions After A Cold Start

Clause 6.2 : Carbon Monoxide Emission at Idling Speed

Clause 6.3 : Evaporative Emissions



Elementary Urban Cycle (Part One) (UDC)



Extra-Urban Cycle (Part Two) (EUDC)

# Thailand Emission standard for truck & bus and type of test

Limit value for emission pollutant for type approval test (EUROIII)

Fuel	Cycle Test	Carbon Monoxide (CO)	Hydrocarbons (HC)	Non-Methane Hydrocarbons (NMHC)	Methane (CH <sub>4</sub> )	Oxides of Nitrogen (NO <sub>x</sub> )	Particulates	Smoke
		g/kWh	g/kWh	g/kWh	g/kWh	g/kWh	g/kWh	m <sup>-1</sup>
Diesel	ESC	2.10	0.66			5.00	0.10/ 0.13 <sup>(1)</sup>	
	ELR							0.80
	ETC	5.45		0.78		5.00	0.16/0.21 <sup>(1)</sup>	
NG	ETC	5.45		0.78	1.60	5.00		

Remark <sup>(1)</sup> For engines having a swept volume of less than 0.75 dm<sup>3</sup> per cylinder and a rated power speed of more than 3,000 min<sup>-1</sup>

ESC mean European Steady State Cycle

ELR mean European Load response Cycle

ETC mean European Transient Cycle

# 3. Sharing experience Energy & Environments concern

- ❑ Board of Investment (BOI) under Ministry of Industry start up the project “ ECO Car ” in year 2007 ( Phase 1) to promote investment for car manufacturers focus on emission limit ,fuel consumption apart from safety concern( Front & Side crash test) and manufacturer can produce in year 2010.

Criteria :

- CO<sub>2</sub> ≤ 120 g/km ,Fuel consumption ≤ 5 ltr/100 km
  - Emission limit : EURO IV (type 1)
- ❑ Department of Alternative Energy Development and Efficiency (DEDE) under the Energy Ministry more aware about any products that mainly concern energy consume. The key is how to promote and enforce the car producer in term of energy saving ,then DEDE start up consider and study how to set the criteria for High - Low Fuel consumption (MEPS ,HEPS) by start study with car first in a past few years ago .



## Industry

- The Excise Department under the Ministry of Finance will enforce new excise tax by considering the emission gas CO<sub>2</sub> amount instead engine capacity & power performance for car manufacturer and will effective in year 2016
- BOI announce the promotion investment to offering car manufacturer incentive “ The project ECO Car (phase 2) “ in year 2013 and manufacturer who interest must applied before 31 March 2014 which more strick than Eco car phase 1 in term of both emission level , CO2 & fuel consumption

Criteria :

- CO<sub>2</sub> ≤ 100 g/km ,F/C ≤ 4.3 l/100km
- Emission limit : EURO V (Type 1)

## Background & Overview

- Thailand Automotive Institute (TAI) had funded by Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, to establish an appropriated draft of fuel efficiency standard for motor vehicles to support the mandatory fuel efficiency labeling and enforcement of Minimum Energy Performance Standards; according to the 20-Year Energy Efficiency Development Plan (2011 - 2030).
- The standard should compatible to the current motor vehicles emissions standard enforced by Thailand Industrial Standard Institute (TISI) which equivalent to Euro 4.
- The standard defines fuel efficiency in term of fuel economy (unit km/l) calculated from exhaust emissions by carbon balance approach.
- The standard is weight-bin based structure and developed for positive and compress ignition engined vehicles separately.
- Currently, the draft standard is on legislation process.

## Objectives

- Define the Minimum Energy Performance Standard (MEPS)  
Any vehicles must to conform the MEPS standard for permissible to sale.
- Define the High Energy Performance Standard (HEPS)  
Vehicles which conform the HEPS standard will obtain some intensives and promotions from Ministry of Energy.

## Testing standard

- TIS 2560-2554 (2011) Exhaust emissions from motor vehicles: Test method  
Equivalent to ECE R.83
- TIS 2335-2550 (2007) Passenger cars powered by an internal combustion engine or hybrid cars, M1 and N1 vehicles powered by electric: Emission of carbon dioxide, Fuel consumption, Electric energy consumption and electric range  
Equivalent to ECE R.101

## Vehicle Grouping

- Weight-bin based structure, vehicles will be grouped by “Reference mass” to 22 groups as,

Group No.	Reference Mass (kg)
1	<480
2	>480-540
3	>540-595
4	>595-650
5	>650-710
6	>710-765
7	>765-850
8	>850-965
9	>965-1,080
10	>1,080-1,190
11	>1,190-1,305

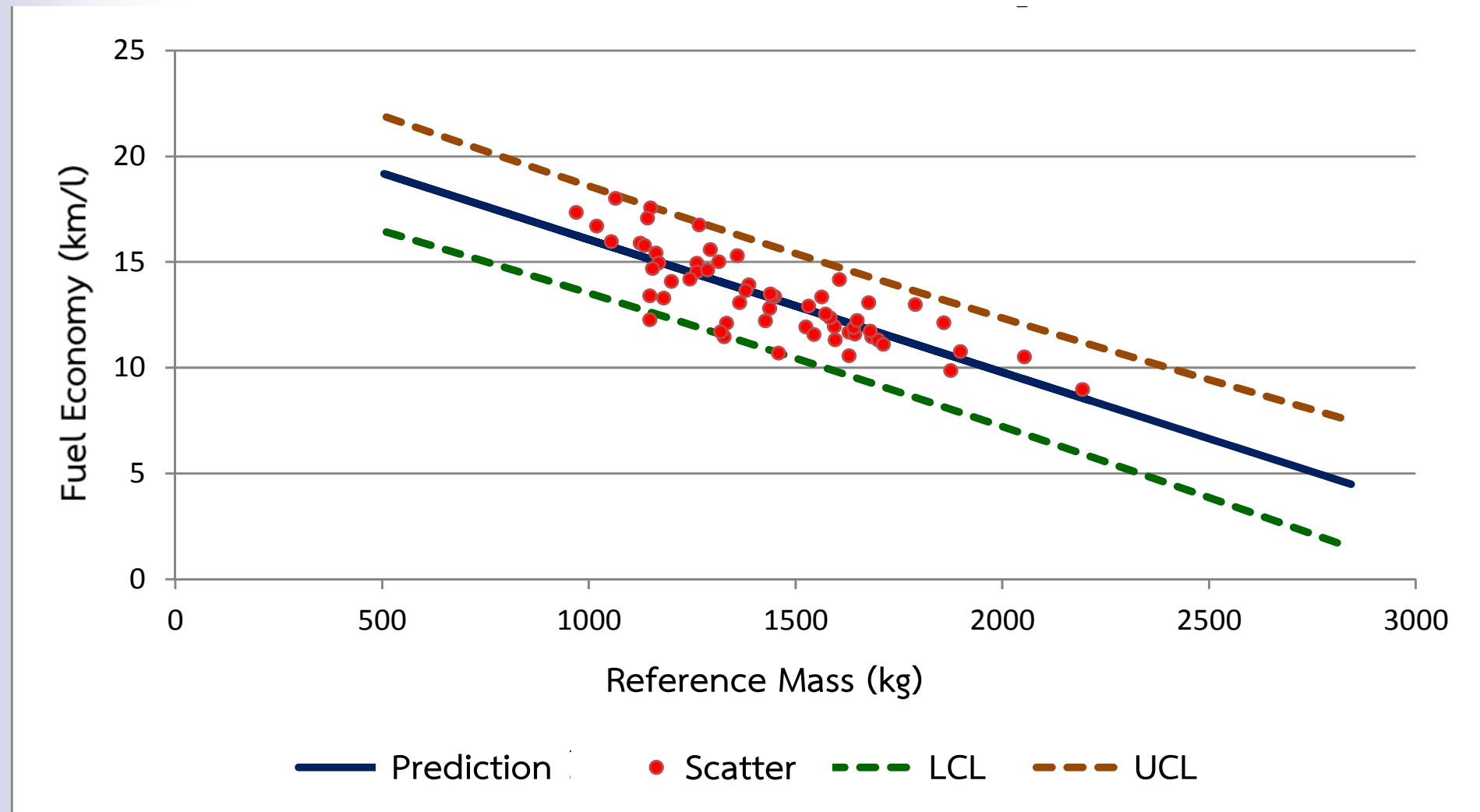
Group No.	Reference Mass (kg)
12	>1,305-1,420
13	>1,420-1,530
14	>1,530-1,640
15	>1,640-1,760
16	>1,760-1,870
17	>1,870-1,980
18	>1,980-2,100
19	>2,100-2,210
20	>2,210-2,380
21	>2,380-2,610
22	>2,610

## Statistical Information

- Number of samples:
  - Positive ignition engined vehicles 63 models with reference mass > 965 kg
  - Compress ignition engined vehicles 48 models with reference mass > 1,640 kg
- “Simple Regression Analysis” will be introduced to;
  - Verify that, reference mass of vehicles is the major parameter of fuel economy (> 50%).
  - Determine, fuel Economy and reference mass have linear correlation and what is their correlation equation.

## Statistical Information

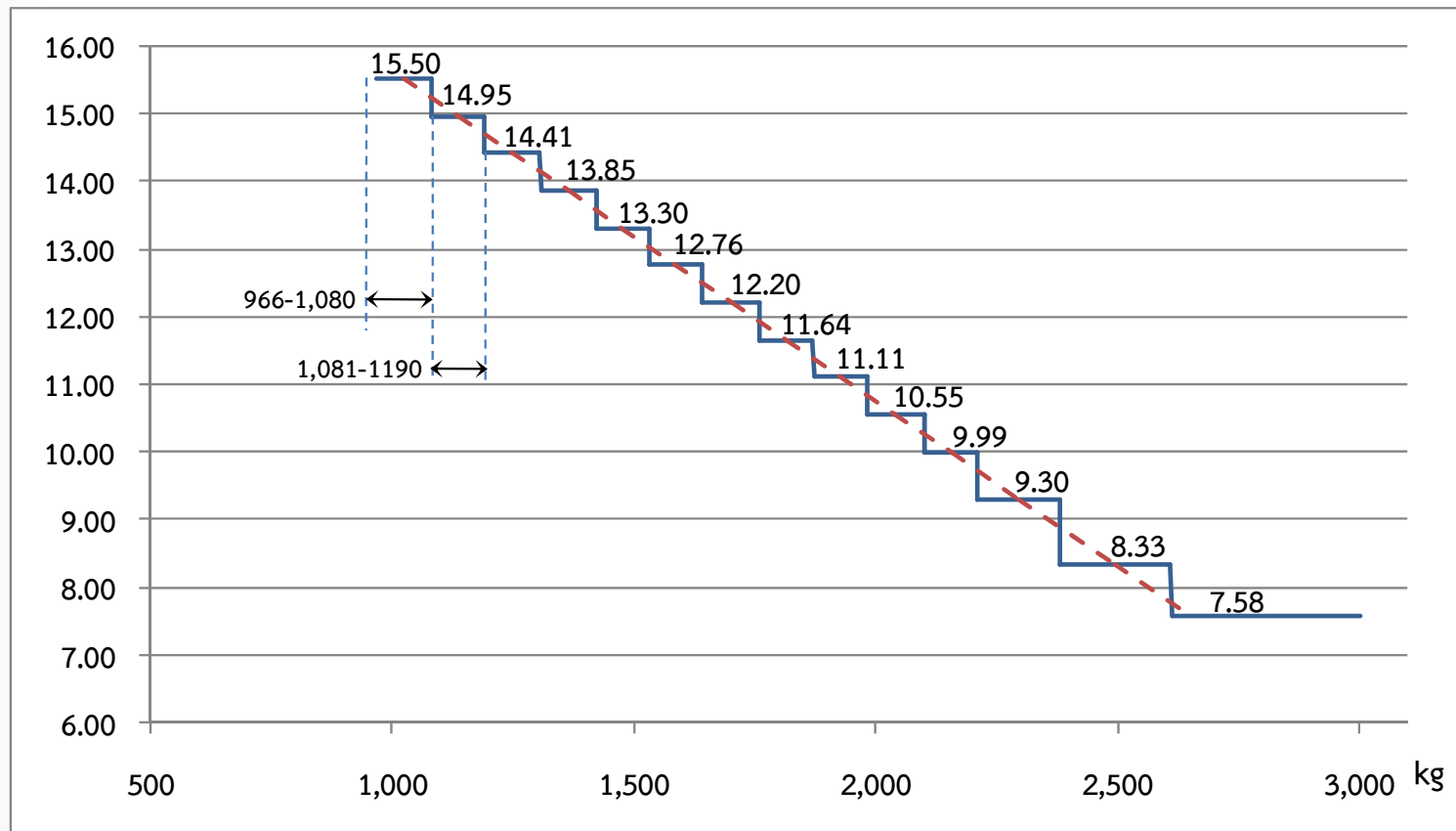
MEPS & HEPS are Lower Confidence Limit (LCL) and Upper Confidence Limit (UCL)



## Statistical Information

Example: Fuel economy of 9<sup>th</sup> Group (Reference mass 966-1,080 kg) is predicted fuel economy of average reference mass between 966-1,080 kg.

km/L





## Fuel Efficiency Standard

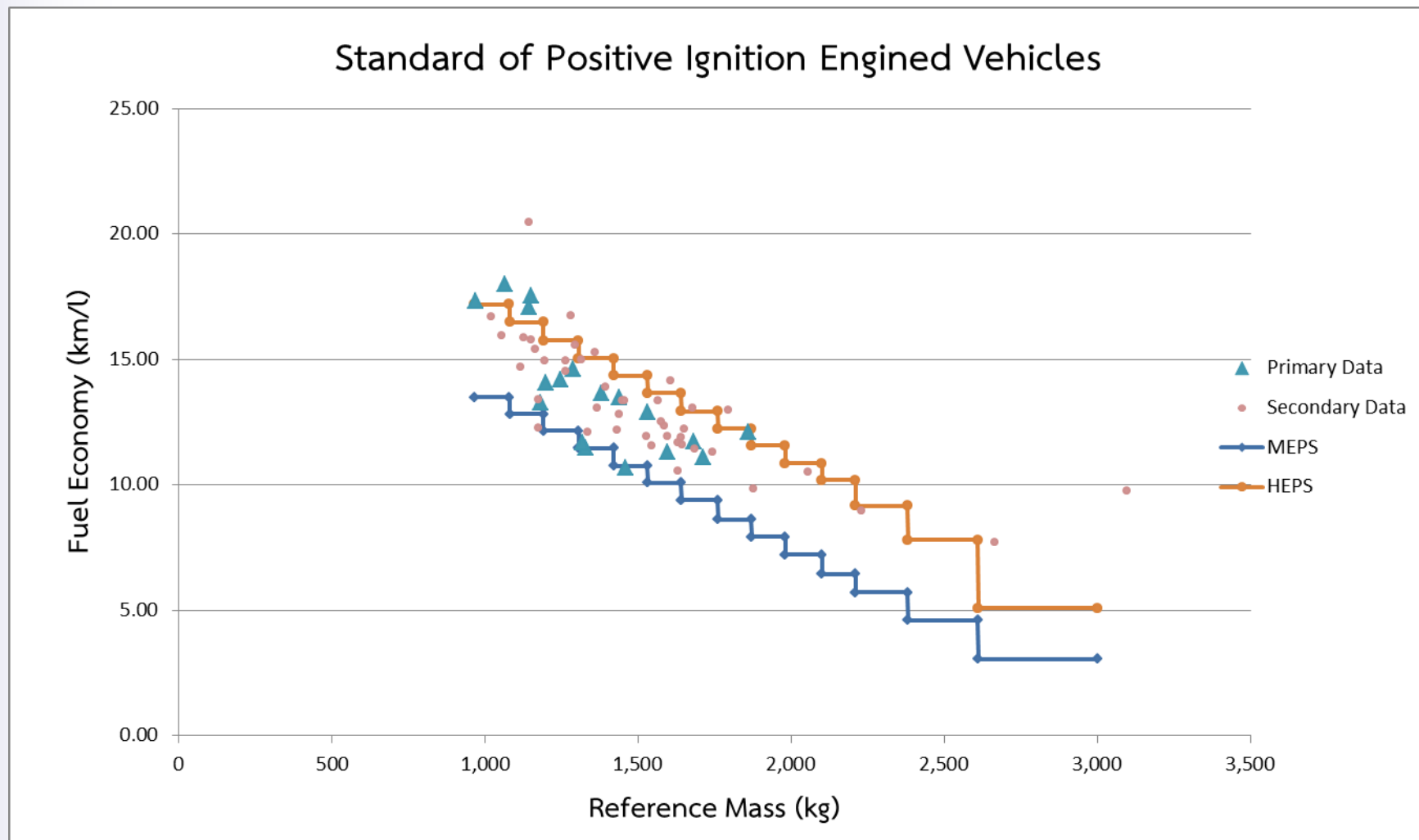
Standard of positive ignition engined vehicles

Reference Mass (kg)		MEPS	HEPS
-	≤ 480	-	-
> 480	≤ 540	-	-
> 540	≤ 595	-	-
> 595	≤ 650	-	-
> 650	≤ 710	-	-
> 710	≤ 765	-	-
> 765	≤ 850	-	-
> 850	≤ 965	-	-
> 965	≤ 1,080	13.49	17.19
> 1,080	≤ 1,190	12.81	16.48
> 1,190	≤ 1,305	12.15	15.75

Reference Mass (kg)		MEPS	HEPS
> 1,305	≤ 1,420	11.45	15.03
> 1,420	≤ 1,530	10.75	14.34
> 1,530	≤ 1,640	10.07	13.66
> 1,640	≤ 1,760	9.38	12.92
> 1,760	≤ 1,870	8.62	12.24
> 1,870	≤ 1,980	7.92	11.57
> 1,980	≤ 2,100	7.21	10.84
> 2,100	≤ 2,210	6.44	10.18
> 2,210	≤ 2,380	5.71	9.17
> 2,380	≤ 2,610	4.59	7.80
> 2,610	-	3.05	5.08

## Fuel Efficiency Standard

Standard of positive ignition engined vehicles



## Fuel Efficiency Standard

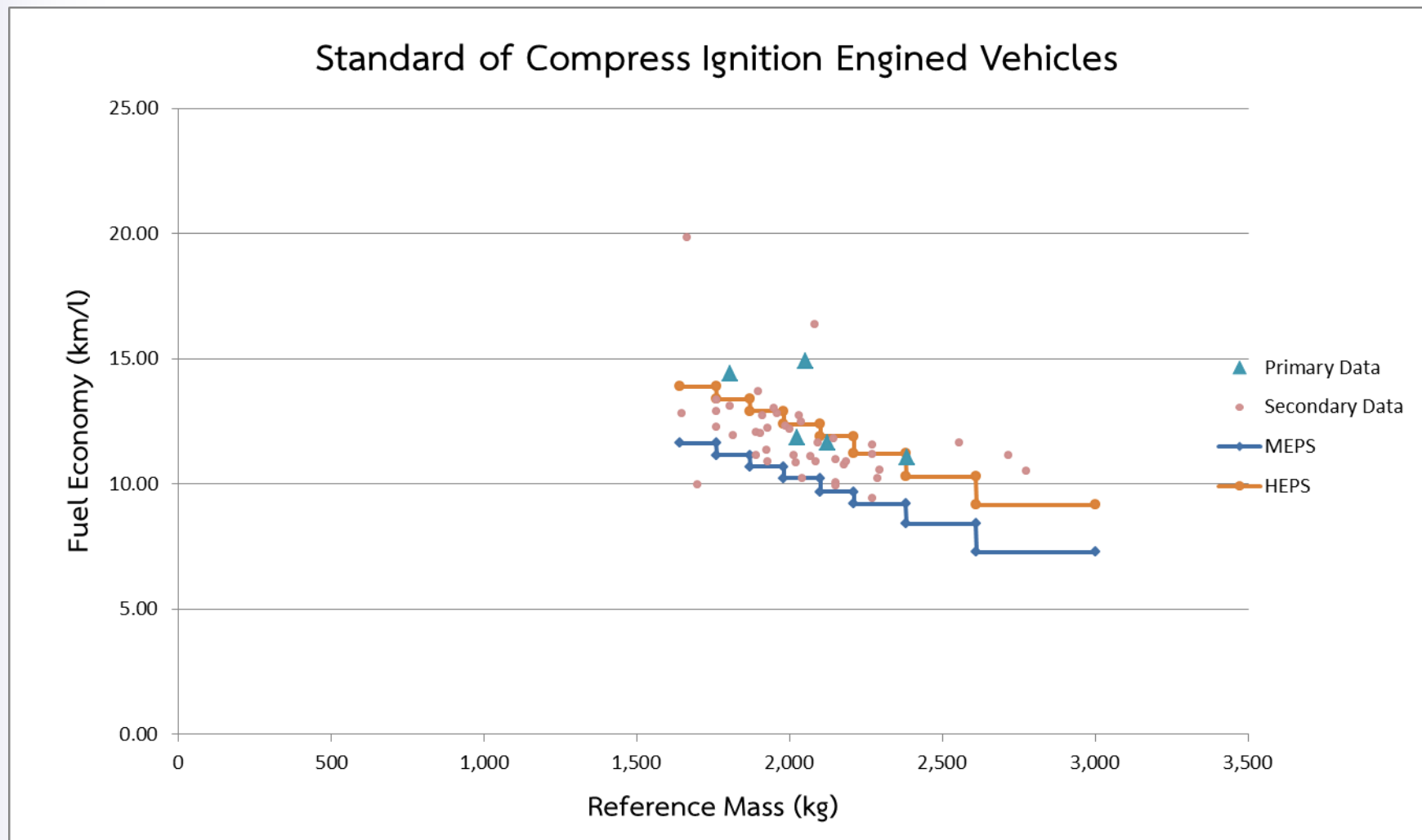
Standard of compress ignition engined vehicles

Reference Mass (kg)		MEPS	HEPS
-	≤ 480	-	-
> 480	≤ 540	-	-
> 540	≤ 595	-	-
> 595	≤ 650	-	-
> 650	≤ 710	-	-
> 710	≤ 765	-	-
> 765	≤ 850	-	-
> 850	≤ 965	-	-
> 965	≤ 1,080	-	-
> 1,080	≤ 1,190	-	-
> 1,190	≤ 1,305	-	-

Reference Mass (kg)		MEPS	HEPS
> 1,305	≤ 1,420	-	-
> 1,420	≤ 1,530	-	-
> 1,530	≤ 1,640	-	-
> 1,640	≤ 1,760	11.62	13.88
> 1,760	≤ 1,870	11.14	13.38
> 1,870	≤ 1,980	10.69	12.89
> 1,980	≤ 2,100	10.22	12.37
> 2,100	≤ 2,210	9.69	11.91
> 2,210	≤ 2,380	9.19	11.20
> 2,380	≤ 2,610	8.40	10.28
> 2,610	-	7.27	9.17

## Fuel Efficiency Standard

Standard of compress ignition engined vehicles



# Thank You

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