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EEV Initiative: Paving the Way for Greener Mobility in Malaysia

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Some people may wonder what are 'green vehicles'? 'Green vehicles' is defined as Energy Efficient Vehicles (EEV) which produce minimal, if not zero, harmful impact to the environment and have the most efficient power with the lowest fuel consumption. This article discusses the importance of EEV in view of the CO2 emission requirement and shall consider whether Malaysia should have its own driving cycle since many developed countries including Japan, Europe and US have already developed theirs.

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Global greenhouse emission from both urban development and uncontrolled pollution has resulted in today's climate change. In addition, the increase in transport demands that utilize internal combustion engine has led to an escalating need for petroleum. This subsequently has resulted in the depletion of non-renewable resources. As one of the world's oil producing nations, Malaysia also needs to find an alternative way to reserve energy while at the same time, reduce harmful emission from fuel combustion. To achieve such an objective, the National Automotive Policy (NAP) was conceived in 2014 after much debate and discussion on the environmental devastation and climate change affecting the nation (Zainul Abidin, 2018). One policy which stood as NAP's main focus was to turn Malaysia into a regional hub of Energy Efficient Vehicles (EEV).

What is EEV?

People often wonder what EEV means aside from their benefits to the country's economy and environment. Energy Efficient Vehicles (EEV) are vehicles that bring minimal harmful impacts to the environment in terms of carbon emission level (g/km) and fuel consumption (l/100km) compared to normal internal combustion engine vehicles. In order to control and reduce carbon emission, Malaysia has been involved in advanced technology transfer with more developed countries in addition to endorsing the Kyoto Protocol in 2002 to reduce 70 million tonnes of CO2 emission over a 20-year period. The country has also tried to apply the Clean Development Mechanism (CDM) to cut down at least 5% of CO2 emission compared to the current level where such a mechanism is used in the form of carbon credits or Certified Emission Reduction (CERs). Developed by EU countries, carbon credits are given to a country that emits less than one tonne of CO2. Through development of EEV, emission of CO2 can further be controlled since the annual number of vehicles produced has significantly risen along with global population growth (Oh & Chua, 2010). Examples of EEVs include fuel efficient vehicles, hybrid electric vehicles and alternative fuel vehicles which use compressed natural gas (CNG), liquefied petroleum gas (LPG), biodiesel, ethanol, hydrogen and fuel cell.

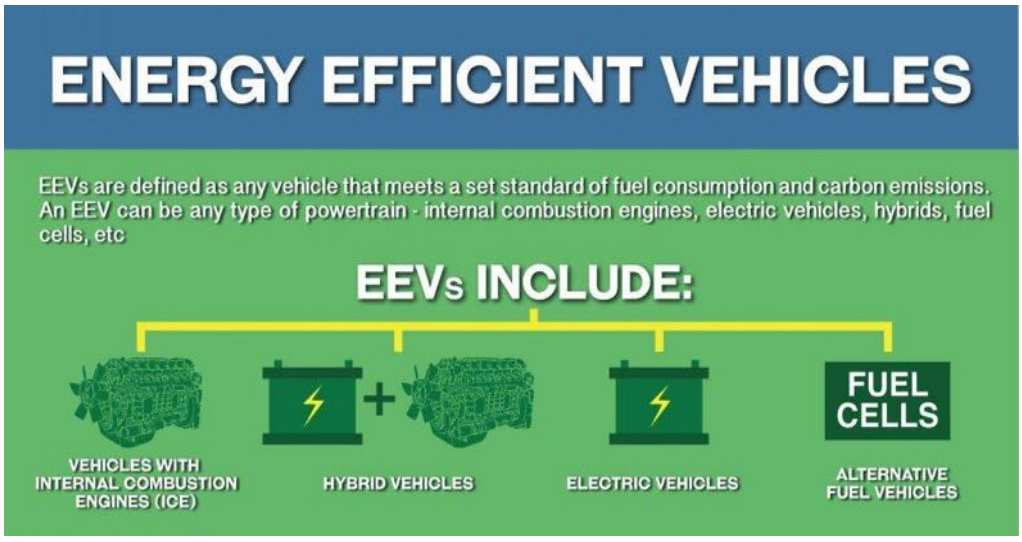

Figure 1: Malaysia's Energy Efficient Vehicles (EEV) concept (MAI, 2018)

Introduction of EEV in Malaysia

Malaysia has successfully produced its own EEVs starting with the Perodua Axia in 2014. Such an achievement was followed by two other models, namely the Perodua Bezza and Perodua Myvi which were launched in late 2017. With their eco-driving mode, low fuel consumption and CO2 emissions, these cars are recognized as EEVs. Based on the European Union standard, there is no specific emission limit for a car to be certified as EEV. However, EU has set the regulation that emission of CO2 must be reduced from 130 g/km to 95 g/km in 2021 (The Guardian, 2012). This limit acts as a guideline in producing low carbon emission cars to achieve Malaysia's target in reducing up to 40% of CO2 emission in the year 2020 (Mustapa, & Bekhet, 2016). Besides local cars, few international models that have been certified as EEV cars in Malaysia includes the Mazda CX-5, Honda Civic, and Toyota Prius. By 2020, Malaysia expects to have 85% of EEV cars, as the figure reached 32.6% in 2015 and 42.8% in 2016. Table 1 shows both local and international car models certified as EEV in Malaysia (Lilly, 2018).

Table 1: Certified Energy Efficient Vehicles in Malaysia

Car make & model	Fuel consumption (km/L)	CO2 emission (g/km)
Perodua Axia 1.0	20.1	135
Perodua Bezza 1.3	22.0	113
Perodua Myvi 1.5	15.1	137
Toyota Prius 1.8	23.8	70
Honda Civic VTEC	15.9	117
Mazda CX-5 2.0	13.3	132

Because EEVs have better fuel economy and cleaner emission, EEV car makers are given special tax exemption and will be given license to setup a manufacturing plant in Malaysia. The government has also launched and built electric car charging stations in almost all Petronas fuel stations across Malaysia including in the Klang Valley, Penang, Malacca, Johor (MAI, 2018). In terms of vehicle percentage, most developed countries have begun producing EEVs earlier than Malaysia which include hybrid, electric and renewable energy powered vehicles.

Based on the UNR 101 standard, fuel efficiency is measured to meet EEV specifications. These specifications are classified based on car kerb weight standard (10 different classes) as well as engine size for two-wheel vehicles (4 different classes) as shown in Table 2 (Hafriz Shah, 2014).

Both emission and fuel consumption of a vehicle are influenced by the driving pattern and driving area. All the specifications provided from the standard are measured by the drive cycle, which is a method in determining the driving pattern to estimate pollution from a vehicle's exhaust emission and fuel consumption. Most developed countries have introduced their own driving cycle standard to estimate fuel consumption and emission of a car. However, a vehicle's driving pattern varies according to driving area and road condition such as driving in big cities, congested road, smooth or rough road surface. Therefore, the driving pattern of a certain area does not represent the actual situation if the driving cycle used is unsuitable with the driving area (Ghafar, 2015). Table 3 shows the types of drive cycle in different countries, whereby each drive cycle has similar target but comes with different application based on the country's weather and drive area condition.

Table 2: Energy Efficient Vehicle based on kerb weight

Four wheels vehicles				Two wheels vehicles	
Segment	**Car Classification**	**Vehicle Kerb Weight**	**Fuel efficiency (L/100 km)**	**Engine size**	**Fuel efficiency (L/100km)**
A	• Micro	<800	4.5	**50-100**	2.0
	• City	801-1000	5.0	**101-150**	2.2
B	• Super mini	1001-1250	6.0	**151-200**	2.5
C	• Small family	1251-1400	6.5	**201-250**	3.0
D	• Large family • Compact executive	1401-1550	7.0		
E	• Executive	1551-1800	9.5		
F	• Luxury	1801-2050	11.0		
J	• Large 4x4	2051-2350	11.5		
Others	Others	2351-2500	12.0		

Table 3: Types of drive cycle in different countries

Drive cycles	Description
Japan J10	- Used for emission certification for light duty vehicle. - Cycle start with 15 minutes warm up at 40 km/h; each segment repetition covers distance of 0.664 km at average speed of 17.7 km/h lasts 135s.
Japan J10-15	- Used for light duty vehicle for emission and fuel consumption measurement. - Derived from 10-mode cycle by adding 15 mode segment of maximum speed of 70 km/h.
Japan JC08	- Use for light vehicles (<3500 GVW). - Test includes idling periods and alternating acceleration and deceleration of the car; test begins with cold start and warm start; used for emission and fuel consumption measurement.
Europe ECE+ EUDC	- Test for emission and fuel consumption for light duty vehicles. - Performed on chassis dynamometer; entire cycle included 4 ECE segments repeated without interruption followed by EUDC; vehicle is soak for 6 hours at 20-30ºC before the test and allow for idle for 40 seconds.
Europe NEDC	- Idling period eliminated; engine start at 0 second and emission sampling begins at the same time; test start with 4 repetitions of ECE cycle. - ECE is an urban driving cycle known as UDC; UDC is a device represents the city driving conditions which characterized by low speed, low engine load and low exhaust gas temperature vehicles. - The 4th ECE cycle was added by EUDC to account for more aggressive, high speed driving modes; maximum speed for EUDC cycle is 120km/h.
US (FTP-75)	- Test for emission and fuel consumption for cars and light duty vehicles. - Emission of HC, CO, NOx and PM measured by using the CAFE-corporate average fuel economy; it has three phases of tests, cold transient, cold stabilized and hot start.
US (SFTP)	- Represent engine load and emission associates with air-conditioning usage over FTP-75.
US (US06)	- Similar to FTP-75 in represent aggressive, high speed or high acceleration driving behaviours.
US (IM-240)	- Chassis dynamometer schedule for emission testing for light duty vehicles.
California (LA 92)	-More aggressive than FTP-75 characterize by high speed, high acceleration, fewer stops per mile and less idle period.

Should Malaysia develop her own drive cycle?

Malaysia is currently in the initial stage of fuel economy driving cycle. Every drive cycle resembles the specific road and condition of a particular place. Lack of budget and data has impeded the development of Malaysia drive cycle (Ghafar, 2015). The country currently uses the drive cycle standards from both EU and US. Developing driving pattern of a specific area can create a guideline for vehicle manufacturers to design 'local cars' with better fuel consumption and low emission engine for EEV production. Malaysia has many small towns and several big cities such as Kuala Lumpur and Penang and this results in significantly different vehicle driving pattern in Malaysia than in other countries. In addition, EEVs are slightly more expensive compared to conventional gasoline/diesel vehicles. This has become the main reason why EEVs cannot be rapidly developed in Malaysia. By having our own driving cycle, such a problem can be solved by producing vehicles to suit the local weather, road condition and socio-economic standards of Malaysians.

There have been few attempts in the country to collect data by using the urban drive cycle where driving conditions were recorded along different routes, areas by considering factors such as congestion, population, and car engine size by measuring vehicle speed, engine speed, accelerator pedal traces, torque and fuel consumption (Abas et al., 2014). Data obtained from the drive cycle can be used for emission calculation. The first step of calculation is by identifying emission source such as from a car under different driving conditions. The next method is by selecting the calculation approach through direct monitoring of tested vehicles.

Next, data is collected and emission factors are chosen. Calculation tool is then applied by multiplying the estimated/actual activity data with the emission factors (NRE, 2014). Compared to other countries' drive cycle, Japan drive cycle (JC08) and US drive cycle (US TF75) have been widely used. Table 4 shows the emission standard for a new diesel or petrol car for JC08 for light weight vehicles and passenger vehicles (TransportPolicy.net, 2017).

Table 4: Emission standard for a new diesel or petrol car for JC08 for light weight vehicles and passenger vehicles (International Council on Clean Transportation, 2017)

Curb weight	Carbon emission (max) (g/km)
<1250 (Diesel)	0.63
>1250	0.63
<1700	0.63
>1700	0.63
>1000 (Gasoline)	1.92

Moving Forward

Increased harmful emission and fuel consumption along with escalating vehicle demand have led to today's environment problems that affect the entire world. Therefore, several alternatives have been developed including the introduction of Energy Efficient Vehicles (EEVs) as a means to produce vehicles with the lowest emission and fuel consumption. In producing EEVs to suit a country's condition, drive cycles are designed by several countries and a similar drive cycle is proposed to be introduced in Malaysia. This is because Malaysia has great potential in producing its own local car using the EEV concept for cleaner environment.

Since the country has a different population size and various landscapes, Malaysia needs to have its own drive cycle to create a guideline for car manufacturers. However, lack of budget and data has impeded development of a drive cycle in Malaysia although several drive cycle attempts have been made in a few areas in the country. This signifies Malaysia's potential to develop a drive cycle by referring to the standards from other developed countries including Japan, Europe and the United States.

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