

# ENVIRONMENTAL IMPACT ASSESSMENT IN AUTOMOTIVE INDUSTRY IN MALAYSIA

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## ABSTRACT

The environment issue became very popular topic in many conferences and conventions in the world since many decades ago. This paper review on environmental issues, the process of car manufacturing industries, waste water effluent from automobile work, the quality management on environment implement in various countries. Then the environmental impact assessment in car manufacturing industries in Malaysia also will be issued for protect the environment quality with cooperation with others government agencies and companies.

**Keywords:** Environmental issues, Car Manufacturing Industry, Environmental Impact Assessment, Malaysian Agency.

## 1. Introduction

The car manufacturing on the demand were still increase when the number of peoples were increased especially in developing countries, contributed about 27% of CO<sub>2</sub> emissions in the world (Kastensson 2014). Effluent is defined as a waste component from a manufacturing or processing activity includes biogas and bio hydrogen generation (Bajaj and Winter 2013), high suspended and dissolved solids and high COD content, heavy metals and organic micro pollutions from painting section in automotive industry (Güven et al. 2017). The issue of the end of life vehicle (ELV) product were dumped in landfill and incineration (Wong, Al-Obaidi, and Mahyuddin 2018) became the issue in Malaysia since the lack of these ELV management.

In Malaysia since Proton in 1985, Perodua in 1993 and now NAZA and MODENAS which total of 4 companies for automotive manufacturer in Malaysia. Therefore the aim of these study is to identify the car manufacturing process that contribute to the emission; what kind of assessment used in analysed the emission; the relevant protocol and regulation in control the environment issues in the world as general; how the car manufacturer adopt design consideration in car production in reducing the emission level in various countries; how the implementation in Malaysia specifically in order to manage the such kind of waste from automotive manufacturing industry.

## 2. Methodology

The automobile sector with definition based International Standard Industrial Classification (ISIC) covered the vehicle production and parts and accessories production, manufacture motor vehicles, trailers and semi-trailers. However in this study tend to focus for passenger car that became highly used on the road about 459,558 that manufacture and assembled in Malaysia by 2017. The material processes as the first stage industrial that need to comply with relevant standard to get the liaison as legally operated but due to environment impact it continuous in the road application till End of Life Vehicle (ELV), recycle, recovery and reuse in car manufacturing again. How these cycle repeated to ensure the environment like air, water, and so on. Therefore, the relevant policy and car manufacturer, investor always collaborative in driving toward economy, environment and social as sustainable of the car manufacturing in Malaysia. In spite of this the review on relevant issue on environment in car manufacturing were review in many countries in the world and how the Malaysia's agency related to on going toward the environment act and policy to monitor car manufacturing and its product that includes in 19 activities subjected under the Environment Impact Assessment 1987 under section 34A (Environmental Quality Act, 1974) (Department of Environment Ministry of natural resources and Environment Malaysia 2007).

### 2.1. Car Manufacturing Process

The life cycle of car could be divided into 5 stages; mineral mining, materials producing, product manufacturing, transportation and using stage (Zhu 2013). Life cycle assessment measured the acidification of the lightweight of passenger car. Table 1 shows the estimation parameters of passenger cars in China.

Table 1. Parameters of passenger cars (Zhu 2013)

Model	Curb mass (kg)	Crew size (person)	Fuel consumption(L/km)	Material structure	
				Steel	Iron
Front Engine, FWD	1300	5	13	70	30

This high strength steel body became the basis body in white (BIW) of passenger car as Project 1 with curb mass is 1300 kg, while the Project 1, Project 2, Project 3 and Project 4 are modified passenger car with aluminium alloy, recycled aluminium alloy, advanced high strength steel with curb mass are 980.3kg, 980.3kg and 1166.40 kg respectively. Figure 1 depicted the acid-gas emission in 5 stage activity involve the process of car manufacturing.

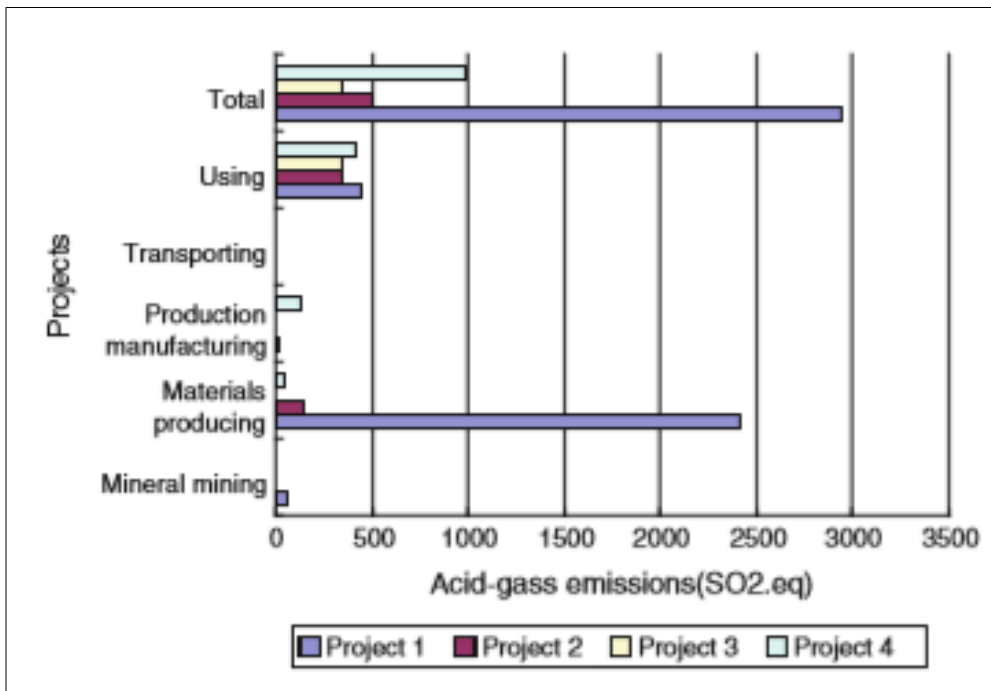


Figure 1. Acid gas emissions based on project studies (Zhu 2013)

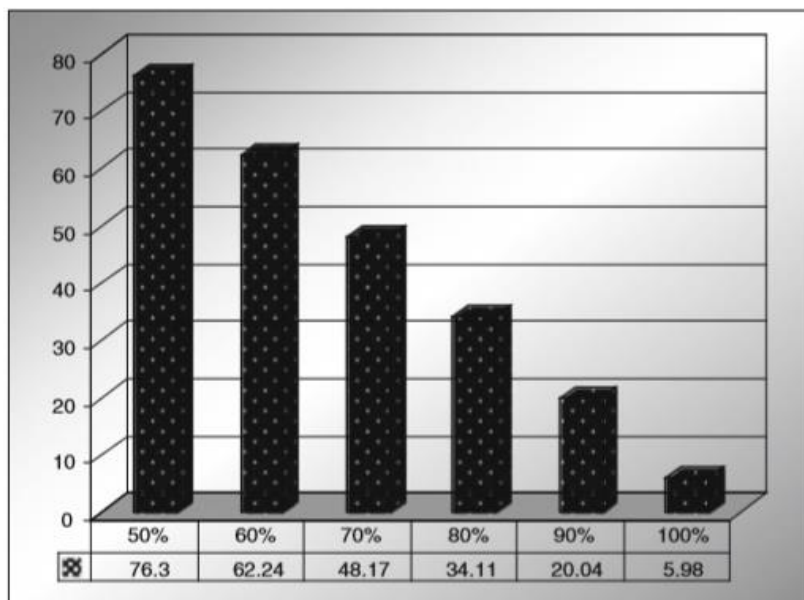


Figure 2. The percentage of recycle aluminium against acid gaseous emission in material processing stage (Zhu 2013)

The main acid-gas emission release from tail pipe gaseous of passenger car is SO<sub>2</sub> during using stage on domestic usage. The other gaseous includes NO<sub>2</sub> and NO<sub>x</sub>. Figure 1 shows the higher during material producing. The acid gaseous resulting the acid rain when this release to the atmosphere. By using the recycle material could be reduced the emission of acid gaseous as depicted in Figure 2. The acid gaseous emission will reduced toward zero when 100% recycle of aluminium in material processing compared to primary aluminium source. Therefore, the solution for design consideration of new car should be lightweight and sustainable using recycle material of aluminium and steel that reducing material processing in primary source (Zhu 2013).

## 2.2. Waste Water from Automobile Work

It was found from case study in Germany where the paint shop as a part of automobile work produced the effluent (Bajaj and Winter 2013). This effluent from decanters (DECA) waste water created by floating grease, metal sheet, parts and carousels that treat chemically, centrifugation and decantation processes. The DECA effluent sampling is keep in plastic container in canister at 4°C for 30 days before ready for process in anaerobic digestion in methane production. This DECA need to analyse its characteristics before the mixture of DECA with a co-substrates and inoculum. Table 2 depicted the characteristics of DECA effluent after decantation process as mentioned. The DECA has contained COD, fatty acids, solids, removal of heavy metals almost except the Fe about 0.9.

Table 2. Characteristics of DECA (Bajaj and Winter 2013)

Parameters	Values
Color	Gray
Odor	Pungent
Electrical conductivity (mS/cm)	5.18
pH	7.60
Solids (g/kg)	
Total solids	9.50
Volatile suspended solids	5.42
COD (g/L)	
Total COD	10.17
Dissolved COD	7.43
Fatty acids (mmol/L)	
Acetic acid	0
Propionic acid	0
Butyric acid	0
Valeric acid	0
Heavy metals (mg/L)	
Cr	0
Cu	0.02
Mn	0
Fe	0.90
Co	0.02
Ni	0.02
Cd	0
Pb	0
Zn	0

These methane products could be used as fuel in combustor boiler for electric generation. The release the methane to the atmosphere will reduced greenhouses gas (GHG) and CO<sub>2</sub> producing. Figure 3 shows the Methane product from mixture of DECA effluent, glucose as co-substrates with different amount using gas chromatography (GC).

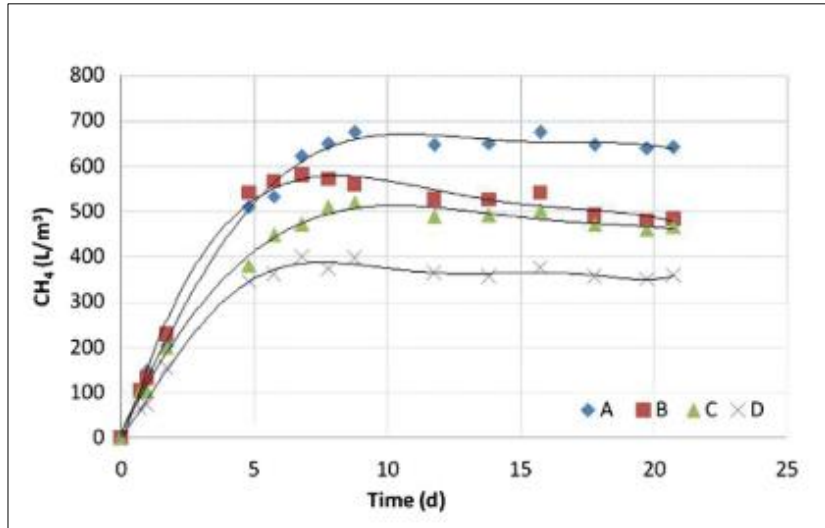


Figure 3. Methane product from mixture of decanter (DECA) effluent, glucose as co-substrates with different amount  
(Bajaj and Winter 2013)

Sample A, B, C and D are DECA effluent with contain of 2 g/L, 1g/L, 0.5g/L and 0g/L respectively. It was confirmed that the methane production is better without the glucose as co-substrates when the lowest methane producing based on sample D (0g/L) (Bajaj and Winter 2013). Therefore, the proper solution in handling the effluent in paint section in automobile Industry Were Significantly That Require The Lab Test And Comply To Local Standard And Regulation.

### 2.3. Eco-Efficient In SME Automotive Company

Small and micro company of automotive as we call SME's are synonym that support the automotive industry manufacturer to provide the vehicle maintenance, periodic vehicle services according to the manufacturer after sales service provider in region and near to the town area. The efficient in handling the cleaner activity in SME Company as important as the good practice to provide proper management the waste from recycle part, automotive scrap and so on. The eco-efficiency directly relate to the three aspects; economic, environmental and social (Alves and Dumke De Medeiros 2015). The case study in Brazil for 5 SME company, the residue are reused about 230 tons per year that reduced the R\$18 million in term of energy and water usage.

### 2.4. Energy Management System

Beyond 2020, EU countries aims to reduce the emission of greenhouse gases (GHG), these effort involved in automotive manufacturing industry includes. The transparent of all resources and energy usage in control production, infrastructure became very significant to use the energy management system as environmental programmes

implemented by Volkswagen (Think Blue Factory), Audi (Ultra) and BMW (Efficient Dynamics) (Franz et al. 2017). The focus areas are paint workshop and body shop that use the highly intensive production and car production plants where the indicator of energy consumption per vehicle production, the renewable energy for sharing strategy reduced the electrical consumption such as compressed air compression network and electric generation. This indicators as point of review in car manufacturing production plan as a apart of industry 4.0 motion that use Linked Factory as IT solutions to collect transparently all energy use and monitored all resource of water usage, electric generation, emission control and so on. Therefore, the measurable and transparent indicator of manufacturing plant are needed for reduce the emission and as well as organizational structure (e.g: press shop, body shop, paint shop, assembly area, and infrastructure section in manufacturing plant).

## 2.5. Life Certification

According COP-21 in 2015 that concerning the need for automotive industry to reduce the CO<sub>2</sub> in GHG emissions, the diagnostic for environmental management system were implemented in Brazilian auto parts industry (Reale et al. 2016) based on Life Certification methodology under Life Institute that legally operated since 2009 in Brazil. The environmental impact assessment by Life Certification to aim the negative impact on biodiversity such river, air quality and so on as main indicator from automotive manufacturing industry. This tool could be used as mechanism to obtain impact from production process to obtain the value estimated of impact on biodiversity (VEIB) using the specific calculation such as water consumption, electric use, solid waste generation, and GHG emissions. The questionnaires are used to collect the data as shown in Table 3 according to (Reale et al. 2016) based on eight equations relate to environment aspects. Therefore Life Certification could be used as a tool incorporating with biodiversity and increased the efficiency of process.

Table 3. Data collection from questionnaire LIFE (Reale et al. 2016).

Environmental aspect	Data collected in industry	National reference value (2011)
Waste generation (Ton/year)	53192.39	150,422,568
GHG (CO <sub>2</sub> )	3214.45	2,192,601,000
Water consumption (m <sup>3</sup> /year)	404,785	38,221,632,000
Energy consumption (tep/year)	4,097,115.89	246,636,000

## 2.6. End of Live Vehicle

Association of Southeast Asian Nations also concern in various issue relating to increase number of car production, disposal of scrap and part that illegally dumped in landfill. According to Economic Research Institute for ASEAN and East Asia 2016 (Kojima 2018) were discussed and reported the concerning about the environmental impact in Car Manufacturing and its product ELV. Therefore the benchmark as current status implementation in Myanmar, Vietnam, Thailand, Malaysia, Indonesia, Philippines, India, and Japan as listed in Table 4.

Table 4. Current status of ELV in ASEAN and East Asia in 2016.

Issue	Current status
The design for recycling (DfR) and regulations, end of life vehicle	Article 3 in ELV Japanese Law requires manufacturing companies to implement in measures to promote DfR. 3R (Reduce, Reuse and Recycle) became the responsibilities in business entities.
End of live vehicle (ELV), Inspecting of old cars, registration or deregistration.	<p>In Malaysia old car sell in the rural areas to be utilised it. Car that could not be repaired will be sell to recycling companies.</p> <p>In Indonesia tha small –scale repair shop called 'bengkel' that repairing the car as well as by using used parts.</p> <p>In Yangon, Myanmar the owner of used car (older than 20 years) will send to ELV facilities to get approval to import a new car and increased the ELV in Myanmar.</p>
ELV dismantling facilities (dismantling, shredding and pollution control)	<p>In Indonesia, dismantle car parts are manually using gas burner. The nonferrous material will be sent to aluminium manufacturer..</p> <p>In Vietnam, ELV operated in Hanoi by informal sector and no registered ELV facility in the country.</p> <p>In Thailand the dismantling of domestic and imported car are conducted by dismantling companies where the steel scrap are sold to recycler.</p> <p>In India 410,700 tons of scrap (metal, aluminium and plastic) were sent to scrap dealer while 7,800 tons of rubber and plastics are dumped in open dumping sites.</p> <p>Malaysia (authorized facilities such as ASR Incinerator and Amsteel Mills), Myanmar (2 facilities under Myanmar Economic Committer) and Japan in 2013 provides 1,083 shredding operation and 1,364 shredding sites.</p>
Reuse of vehicle parts to sale or reused parts (regulation due to import and export)	<p>Malaysia Automotive Recycler Association (MAARA) remanufacture transmission, in Philippines, ITO MFG Philippines Corporation remanufacture the chassis, body, or engine. In India, no organized industry for remanufacturing used car parts but only informal companies to remanufacture motors, starters and alternators.</p> <p>In Indonesia, the remanufacturer's product need to register year of the product while in India under ELV listed the component parts as non-reusable.</p>
Downstream recycling and treatment facility (waste treatment, regulation on	<p>In Malaysia, under Environmental Quality (Schedule Wastes) Regulation 1989 where hazardous waste (batteries, catalysts and waste oils). Used battery as SW102 waste of lead-acid batteries are properly stored, collected and sold to recycling manufacturer. Waste oil as SW312- from automotive workshop are properly stored and sold to waste oil collector to deliver to recovery facilities to treat or disposed.</p>

licensing and waste treatment)	Nowadays, only one shredder company in Malaysia, Amsteel (Mega Steel) that has blast furnace and buy the scrap for recycling. Regarding to Aluminium, Press Metal Berhad and Daiki Aluminium Industry (M) Sdn. Bhd are among the largest integrated aluminium in Southeast Asia with smelting about 440,000 tons and 190,000 tons per year.
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Therefore in Malaysia the issue on imported car and auto part were increased the number of scrap due to imported about 5000 container per month that emerged the factor of illegal dumping area and increased the solid waste in landfill if lack of management by authorized company to handle the ELV at the downstream recycling in properly until send to shredder company to dismantling and smelting as depicted in Figure 4.

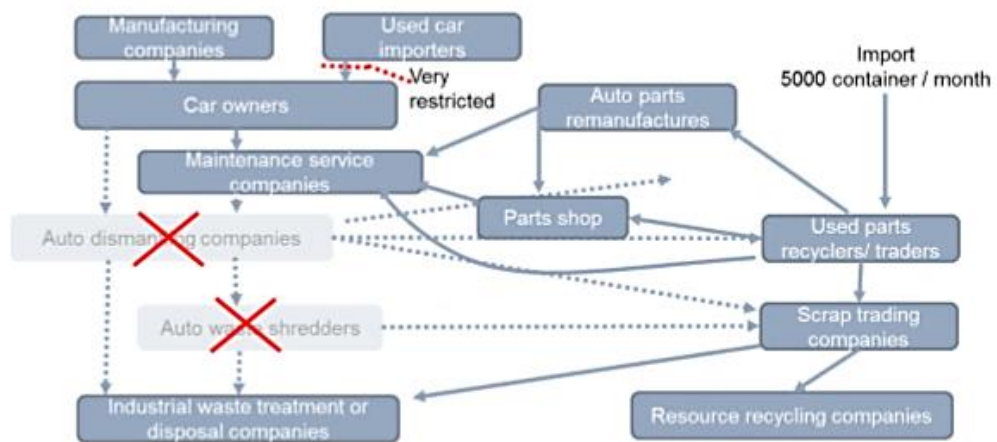


Figure 4. Recycling flow from Car Manufacturing Companies and Used Car/Parts

### 3. Discussions

#### 3.1. Environmental Impact Assessment in Malaysia

The Environmental Quality (Amendment) Act 1985, amended the Environmental Quality Act, 1974. Amendments include the insertion of section 34A which requires any person intending to carry out any prescribed activity to submit report on the impact on the environment to the Director of Environmental Quality for examination (Department of Environment Ministry of natural resources and Environment Malaysia 2007). Environmental Impact Assessment (EIA) under Department of Environmental (DOE) under Ministry of Energy, Science, Technology, Environment & Climate Change enforce to all new project or the expansion of existing ones classified as 'prescribed activities' require to submit to the Director of Environmental Quality before the project is approved by related authorities.

The key factor of previous studies on environmental impact in car manufacturing industry are listed in Table 4 to be considered to compare to the existing regulation of Malaysia side. The related agencies as the stakeholder in handling the respective issue regarding to car manufacturing resources, operation and its product that produce the hazardous material and emissions.



Table 4. The key factor to overcome by solutions in various countries in section 2.0 were compared to agencies related in Malaysia.

Ref.	Key factor of issues	Solutions	Countries	Agencies Related Malaysia.
(Zhu 2013)	Material processing of steel and aluminium caused	Recycle of aluminium in material processes stage.	China	Department of Environment (DOE) Malaysia Investment Development Authority (MIDA) Jabatan Mineral dan Geosains (JMG) Local Authorities
	Acid-rain from exhaust gaseos contained SO <sub>2</sub> , NO <sub>2</sub> and NO <sub>x</sub> .	Lightweight vehicle manufacturing		Ministry of International Trade and Industry (MITI)
(Bajaj and Winter 2013)	Effluent GHG emissions	The solution in handling the effluent in paint section These methane product could be used as fuel in combustor boiler for electric generation.	Germany	Department of Environment (DOE) Department of Environment (DOE)
(Alves and Dumke De Medeiros 2015)	Sewage water treatment for reuse of waste water product in SME Reused and recycle	The residue are reused about 230 tons per year that reduced the R\$18 million in term of energy and water usage Reused and recycle from part and scrap	Brazil	Department of Environment (DOE) Malaysia Investment Development Authority (MIDA)
(Franz et al. 2017)	Energy management system	The measurable and transparent indicator of manufacturing plant are needed for reduce the emission and as well as organizational structure based on Linked Factory as IR. 4.0 motion.	EU Countries	Department of Environment (DOE) Malaysia Investment Development Authority (MIDA)
(Reale et al. 2016)	Water consumption, electric use, solid waste generation, and GHG emissions.	Life Certification could be used as a tool incorporating with biodiversity and increased the efficiency of automotive manufacturing process	Brazil	Department of Environment (DOE) Malaysia Investment Development Authority (MIDA)

### **3.2. Malaysia Investment Development Authority (MIDA)**

Malaysia Investment Development Authority (MIDA) as authorized government agency that driving the National Policy on the Environment with the aim to develop economic, social, and culture with better quality life. Regarding to Environmental Quality Act 1974, the need for environmental in monitoring all project, self-enforcement in industry activities includes integrated waste management operations such as collection, sorting, recycling, treatment and disposal waste. MIDA has approved three integrated Waste projects under Kualiti Alam, Cypark Resources and Shan Poornam.

Cypark conduct the environmental solution in Peninsular Malaysia include 17 landfill sites, ground water assessment, monitoring on environmental and waste water treatment. Kualiti Alam lead the green technology as the first integrated waste management centre in Negeri Sembilan and conduct 76 categories and 77 scheduled waste listed under the Environment Quality (Scheduled Wastes) Regulation 2005 in collection, treatment, recycling, recovery and final disposal. Penang based-Shan Poornam is integrated company and specialises in managing hazardous waste regarding to intellectual property rights using green technologies to produce eco product that comply the Restriction of Hazardous Substances Directive (RoHS), such as secondary aluminium alloy ingots and precious metals such as platinum, palladium, gold and silver. Therefore in the in automotive engine and its accessories contain all the recycle product that could be recycle such as gold, silver, aluminium, and so on and through these authorized company prior the management from downstream in monitor, collecting all solid waste to recycle and disposed for unrecyclable material in proper way.

### **3.3. Recycle of ELV into Construction**

According to (Wong, Al-Obaidi, and Mahyuddin 2018) the monitoring the under the local authorities and Department of Environment (DOE) need to handle these issue properly to ensure solid waste due to scrap and plastic residues that could not be recycle are disposed by authorized company. Therefore the continuous management due to self-enforcement as authorized by MIDA need further that collaborate with existing association registered under DOE and Malaysia Automotive Recycler Association (MAARA) to link the solid waste in term of scrap, tire, and part with construction and recycle manufacturer directly to reduce the hazardous from car manufacturing and its product of ELV. The potential of construction products that could be manufacture using ELV recycle such as non-ferrous metals (roofing sheet, aluminium cladding, thermal insulation), plastics (acoustic insulation, filler material, carpet textiles, piping), rubber (road surface, asphalt, crash barriers), glass (concrete block, carpet glues, paving tiles, roof canopy, thermal insulation).

### **3.4. Environment Quality Concern in Car Manufacturer**

Proton as first national car manufacturer since 1980, currently promotes proton environmentally friendly with green equipment, machinery, robots and automation systems (Asia 2014). Using green technologies, less energy, less waste into the air. Waste water recycle treatment is used as incinerator coolant at rate of 25,000 litres per hour. The recycle water were used to water plants, clean the roads and drains the facilities. Toxic waste from water effluent discharged after treatment was below the limit as order under the Environmental Quality Act, 1974; COD –Chemical oxygen demand's standard is 100mg/l (proton-less than 50mg/l) and BOD-biological oxygen demand's standard is 50mg/l (proton- less than 10mg/l). Kualiti Alam is appointed to collect all schedule waste in form of dry sludge from Proton water treatment, the paint sludge due

to overspray dust are treated by an incineration process about 1000 Celsius. Under the MITI approval regarding to the manufacturing license (ML), Proton were joint manufacturing with OEM investor as strategic partnership to promote the high impact segment car and green technologies as new automotive policy in Malaysia (To 2009), ELV scheme with rebate RM5000 for exchange of 10 year old car as down payment for new proton car to ensure proton's car to not harm the environment and peoples (Asia 2014).

#### 4. Conclusions

The car manufacturing merged as the important sector in driving the economic in Malaysia. The green manufacturing process, waste treatment with proper monitoring and energy management system were became the best solution in Malaysia. The environment impact assessment being the compulsory for all new manufacturing plant approval, as a tool for compliant any waste water treatment, air quality, solid waste management, and reducing the green gas houses (GHG) emissions. The DOE, MIDA, MITI, Malaysia Automotive Recycler Association (MAARA), JMG and local authorities are among the significant agencies in approval all project for car manufacturing plant and any expansion existing ones. Under the MITI recognition and approval, Proton promotes the green technologies in manufacturing plant, car production, ELV scheme as eco-environmental friendly strategies in sustainable car manufacturing product (To 2009).

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