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ENVIRONMENTAL MANAGEMENT REGARDING RESOURCE RECOVERY IN MALAYSIA

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ABSTRACT

Waste disposal is a global problem contributing to the ongoing climate change due to large emissions of greenhouse gases. So, by using a waste material as a resource instead of land filling, the greenhouse gas emissions from landfills will be reduced. Also, Waste material can be used for waste incineration with energy recovery, thus decreasing the greenhouse gas emission from energy utilization by changing from fossil fuels to a partly renewable fuel. The production of Refuse Derived Fuels (RDF) involves the mechanical processing of household waste using screens, shredders and separators to recover recyclable materials and to produce a combustible product Regarding Resource Recovery Center/Waste to Energy (RRC/WtE) Facility in Malaysia that located in Semenyih. This System involves the removal of inert and compostable materials followed by pulverization to produce a feedstock which be incinerated in power stations. The purpose of this study is to evaluate and forecasting of the number of these facilities that Kuala Lumpur will need regarding to potential of Municipal Solid Waste (MSW) generation and Refuse Derive Fuel that will be produce from that in the future. This plant can produce average 7.5 MWh electricity from 700 tons MSW or 200 ton RDF per day that approximately is used 1.8 MWh per day inside the pant, and it can sell around 5.7 MWh daily. Kuala Lumpur will generate around 7713 tons MSW per day, and it is able to produce 2466 ton RDF per day. Regarding to potential of MSW and RDF generation by 2020 in Kuala Lumpur it will need around 11 plants to treatment of MSW that this number of plant are able to produce around 62.7 MWh electricity per day.

Keywords: *Refuse Derived Fuel, Municipal Solid Waste, Resource Recovery Center, Waste to Energy plant*

INTRODUCTION

The root cause of world energy problems is growing world population and energy consumption per capita. World population is presently slightly over 6 billion and expected to grow to at least 8-9 billion, and possibly to 12 billion, by the end of the 21st century. It would reach 12 billion by the middle of the 21st century if the present 1.5% per annum growth rate was to continue. World economic growth and global demand for energy, the essential engine of economic growth, are expected to grow even faster during the next few decades by 3.3 percent a year, corresponding to a doubling time of 21 years. How many people can the earth support? Most experts estimate the limit for long-term sustainability to be between 4 and 16 billion. The climate change is one of the most difficult issues the world is facing today. The global warming is now evident to observations and is according to the International Panel on Climate Change (IPPC) very likely due to the increase of human induced greenhouse gases (GHG). Since the industrial time began, more GHGs have been released than what is sustainable. According to the Fourth Assessment Report of IPCC, the world will face a temperature increase between 1.1 and 6.4°C during the 21st century. Furthermore, sea levels will probably rise by 18 to 59 cm, and there is likely to be more frequent warm spells, heat waves, heavy rainfall, droughts, tropical cyclones and extreme high tides. The European Union (EU) has taken action by admitting the proposal “20-20-20” which emphasizes that by 2020, 20 percent of EU’s energy will be supplied by renewable energy sources and the energy efficiency will be increased by 20 percent. This shows that EU aim to alter its use of fuel and reduce the consumption of fossil fuels. In a global perspective, waste material is an almost unused source as a fuel for satisfying the demand of energy. Instead it is a huge problem in several parts of the world, with lacking space for disposal, GHG emissions and leakage. In some countries, however, waste material is now considered more as a resource than as a problem. Sweden is one of these countries, using energy recovery from waste incineration and partly energy recovery from sewage sludge. This change from fossil fuels to a partly renewable fuel constitutes one part of Sweden’s ambition to reduce GHG emissions. Energy is thus one of the indispensable factors for continuous development and economic growth (Rogner and Popescu 2001). However, at the same time, energy production can contribute to local environment degradation, such as air pollution and global environmental problems, principally climate change. Lately, the demand for energy is expected to increase worldwide over the next 24 years (International Energy Outlook 2004). The nature of non-renewable energy makes it deplete to a depletable resource and secondly, the combustion of non-renewable energy like oil, coal and natural gas contributes to significantly to the emission of greenhouse gasses that raise the issue of climate change. On the other hand, it was reported that developing nations are largely expected to account for the increment in the world energy consumption. In particular, energy demand in developing Asia is projected to double over the next quarter century due to the emerging economic growth (International Energy Outlook, 2004). Considering the fact that energy demand in Malaysia is estimated to be growing at a rate of about 5–6% annually (UK Trade &Investment, 2003).

ENERGY PRODUCTION AND CONSUMPTION IN MALAYSIAE

Both in the industrial countries and particularly in the developing countries like Malaysia where rapid economic growth is expected. The energy demand for Malaysia in the year 1999,2002 and estimated values for 2005, 2010 (Thaddeus 2003). It can be seen that the energy demand in Malaysia`s increases rapidly as the energy demand increase almost 20% within the last 3 years (from 1999 to 2002). The energy demand is further expected to increase to 18, 000MW by the year 2010. In order to meet the increasing demand of energy in Malaysia, a major challenge facing the power industry will be having an effective and sustainable energy policy. An effective and sustainable energy policy has two main considerations. The first consideration is to increase access to affordable, modern energy services in countries that is lacking and secondly, to find the mix of energy resources and technologies (efficiencies) that will reduce the adverse environmental impacts of providing necessary energy services (Spalding-Fecher et al. 2005). Since all the urban areas and 93% of the rural areas in Malaysia have access to electricity (World Employment Report 2001), the crucial challenge facing the power sector in Malaysia currently is the issue of sustainability that is to ensure the security and reliability of energy supply and the diversification of the various energy resources. The question of security and reliability of supply is critical, to ensure smooth implementation of development projects to spur economic growth in Malaysia while diversification of energy resources is critical to ensure that the country is not dependent only on a single source of energy (Leo-Moggie 1996). The National Energy Policy has three primary objectives; supply, utilization and environmental. The first primary objective is to ensure the provision of adequate, secure and cost-effective energy supply by developing indigenous energy resources (both nonrenewable and renewable) using least cost options and to diversify supply sources (both from within and outside the country). The second objective is to promote the efficient utilization of energy and discourage wasteful and non-productive patterns of energy consumption within the socio-cultural and economic parameters. The final objective is to ensure that factors pertain to environmental protection are not neglected in the pursuit of the supply and utilization objectives. Environmental challenges facing the energy sector cover climatic change, air and water pollution as well as solid waste, which is mainly caused by the increasing use of fossil fuels (Hitam, 1999). On the other hand, the National Depletion Policy is aimed to conserve the country's energy resources, particularly oil and gas, as these resources are finite and non-renewable. In this respect, the production of crude oil was limited to an average of 630,000 barrels per day (bpd) while the consumption of gas in Peninsular Malaysia is limited to about 32,000 million standard cubic feet per day (Mariyappan 2000). The Fuel Diversification Policy in Malaysia was continuously reviewed to ensure that the country is not too dependent on a single source of energy. Table 1 shows the energy mix in Malaysia for the year 1980, 1990, 2000 and 2003 (Abdul-Rahman and BioGen 2003). Since 1980, the Malaysian government has implemented the four-fuel diversification strategy in the energy mix. This strategy was implemented after the occurrence of two international oil crisis and quantum leaps in prices in the year 1973 and 1979, in which during that time, the Malaysian energy sector had been highly dependent on a single source of energy, oil. Faced with the possibility of prolonged energy crisis, the government called for the diversification of energy resources away from oil. Other options of energy resources available at that time were hydropower, natural gas and coal as there were large untapped indigenous hydropower and natural gas reserves, while coal was considered an abundant worldwide resource with a very low and stable price (Thaddeus 2002). Table (1) illustrates the Energy mix in Malaysia (Abdul-Rahman and BioGen 2003).

Source	1980 (%)	1990 (%)	2000 (%)	2003 (%)
Oil	89.9	71.4	53.1	6.0
Natural gas	7.5	15.7	37.1	71.0
Hydro	4.1	5.3	5.3	10
Coal	0.5	7.6	7.6	11.9
Biomass	-	-	-	1.1

Table 1. Energy mix in Malaysia

Incineration of municipal solid waste (MSW) is another alternative method of producing energy from waste. MSW is made up of a wide variety of organic (combustible) and non-organic (non-combustible) products ranging in size and composition from dust particles to old furniture and appliances. The average composition of MSW in Malaysia is shown in Table 3 (WIIAD 1996). The actual composition of MSW in Malaysia varies from one place to the other. Among some of the factors that might influence the composition of MSW produced in a specific location is the extent of reduction, reuse and recycling (3R's) programs and also the duration of the year. The percentage of combustible material in MSW usually averages about 75%, but varies with the time of the year. Similarly, the moisture content of MSW is also a factor of season and weather conditions. The energy content of typical raw MSW is about 10,000kJ/kg. Malaysia has started considering incineration technology and its impact on the environment, mainly to reduce the volume of MSW produced in the country. Secondary aim is to produce energy from the incineration process. However, incineration of MSW is a very sensitive issue, particularly on environmental concern about the harmful emission of air pollutants such as acid gases, toxic heavy metals, dioxins and furans. Fluidized bed gasification technology and ash melting system are currently being tested in a location at Broga, Selangor, Malaysia.

RESOURCE RECOVERY CENTER (RRC) IN KAJANG

The Resource Recovery Center plant is located on a piece of land (28 acres) at Lot 3041 and 3042, Mukim UluSemenyih, District of Hulu Langat and Selangor Darul Ehsan. The built up area for the RRC/WTE plant will cover about 5 acres of the said land. This includes of the RDF plant, power plant, treatment plants and other covered buildings. The proposed site is a former tin-mining land where the mining license has expired for several years now. The surrounding land area is under agricultural status. The proposed site has been earmarked by the Kajang Municipality as a Kajang Municipal landfill area. Due to public protest recently, the said lots have not been used for the landfill area as yet. The Kajang Municipal Council has given permission to Recycle Energy Sendirian Berhad to use the said land for the proposed Resource Recovery Centre. The proposed project plant with an appropriate orientation would be able to meet the DOE requirements where the nearest human settlements are located about 900 meters west of the project site.

ENERGY PRODUCTION IN WASTE TO ENERGY (WTE) PLANT

The plant can process about 700 tons of raw municipal solid wastes per day. The RRC will operate 16 hours a day and produce enough fuel to operate the WTE Power Plant 24 hours a day. While RRC/WTE will run on a three shift basis to process MSW and export power. The RRC itself will have two sections, a Receiving section and a Processing section. Receiving section will operate for only 10 hours in the day time dawn to dusk, whereas the processing section will be designed to operate for 16 hours in two shifts. The WTE Complex will run on a three shift basis to process MSW and to export power. The wastes are received from the bunkers by downstream processing in four separate streams (two bunkers per stream). Each stream will be able to process approximately 18 tons per hour. Together, about 70 tons per hour is processed here totaling 700 tons per day of 10-hours operations. There is 60 tones capacity in the receiving. Intermediate MSW storage area before the next processing is carried out. The RDF plant having 700 TPD (Ton per day)to MSW processing capacity, has been divided into four lines. Each line has been further divided into two major sections. Receiving operates for 10 hours. Processing operates for 16 hours from an intermediate storage facility. The critical equipment such as MSW receiving hoppers, bag splitters and, shredders are divided into two parallel operating equipment sets of 50 to 60% capacity. Failure of anyone will still leave the line to operate at 50 to 60% capacity. Control logic of PLC has been designed in such a way that the equipment can be repaired and put to service without affecting the running line processing. The critical equipment will have onsite maintenance facility and spare stocking.

GENERATION OF SOLID WASTE AND RDF AND PRODUCTION OF ELECTRICITY IN MALAYSIA

The official estimated KL's population in 2007 is 1.604 million according to statistic department 2007. The quantity of waste generation in KL alone is projected to increase from 2620 tons in 1995 up to 3070 tons in 2000 (Mansor 1999). Table (2) illustrates the solid waste composition from 1975 to 2000 (Murad and Siwar 2006). Table (3) shows a detail of rate of increasing of population, MSW and percent of recyclable materials (Nasir 2004)

Composition of waste	1975	1980	1990	1995	2000
Organic	63.7	78.05	40.8	61.76	68.67
Paper	11.7	11.48	30.0	12.16	6.43
Plastic	7.0	0.57	9.8	5.27	11.45
Glass	2.5	0.57	3.0	5.27	1.41
Metals	6.4	3.16	4.6	6.89	2.71
Textile	1.3	3.16	2.5	2.84	1.50
Wood	6.5	2.58	3.2	0.00	0.70
Others	0.9	0.43	6.1	5.81	7.13

Table 2. Composition of municipal solid waste in several years in Kuala Lumpur

Parameter	Assumption
Rate of population increase	4% per year
MSWG per person	1.50 kg per day
Rate of increase of SWG per person	2% per year
Total waste per house with 3.5 person per house	5.25 (1.5 * 3.5) kg per house per day
Volume of waste per house per day with bulk density = 100 kg/m3	100.00 m3
Population of Kuala Lumpur in 2004	2 million (including foreigners)

Table 3. Miscellaneous assumptions

The predicted results of total solid waste generated (per day and per year) are shown in Table (4) For instance; the Municipal Solid Waste Generation (MSWG) in column 4 for a population of 2.34 millions in 2008 is 3798.9 tons/day (Nasir 2004).

Year	Population of KL city millions	MSWG Kg/Cap./day	MSWG tons/day	MSWG tons/year
2008	2.34	1.62	3798.88	1383642.0
2010	2.53	1.69	4274.86	1560323.9
2012	2.74	1.76	4810.49	1755828.9
2014	2.96	1.83	5413.23	1975828.9
2016	3.20	1.90	6091.49	2223393.9
2018	3.46	1.98	6854.73	2501976.5
2020	3.75	2.06	7713.61	2815467.7

Table 4. Prediction of total MSWG of Kuala Lumpur

This facility can convert 700 tons MSW to 224 tons RDF per day and related to volume of MSW by 2020 that will be around 7713.61ton per day, the amount of RDF will be around 2468 tons per day. This plant can produce average 7.5 MWh electricity from 700 tons MSW or 200 ton RDF per day that approximately is used 1.8 MWh inside the plant and it can sell around 5.7 MWh daily. Kuala Lumpur will generate around 7713 tons MSW per day, and it can produce 2466 tons RDF per day. Regarding to potential of MSW and RDF generation by 2020 in Kuala Lumpur the number of WTE like RRC can be calculate following:

N= MSW f / MSW u
N= number of facility like RRC
MSW f= amount of MSW by 2020
MSW u= amount of MSW for each facility
N= 7713 / 700 = 11
And amount of electricity production by 2020 can be calculated following:
E=N * EU
E= total electricity production
N= number of facilities
Eu= amount of electricity production per each facility
E= 5.7 * 11 = 62.7 MWh
it will need around 11 plants to treatment of MSW that this number of plants are able to produce around 62.7 MWh electricity per day.

CONCLOSION

The Malaysian energy sector is still heavily dependent on non-renewable fuel such as fossil fuels and natural gasses a source of energy. These non-renewable fuels are limited and also contribute to the emission of greenhouse gas. While it is recognized that the world, including Malaysia is not ready to displace non-renewable energy with renewable fuels, the implementation of various policies and programs by the government of Malaysia has increased the awareness of the importance of the role of renewable energy in a sustainable energy system. There for, using municipal solid waste as fuel to produce of electricity is a suitable approach in point of view of producing energy and reducing of environmental impacts. One of the best methods to produce energy from municipal solid waste is using refuse derived fuel in the power plant like RRC/WTE in Semeniyh. RRC/WTE plant consists of 2 processing units. The RRC plant comprises of solid waste receiving area, waste recovery and shredding, drying and separation units for the RDF production. The second system produces electricity. This plant is able to produce average 7.5 MWh electricity from 700 tons MSW or 200 tons RDF per day that approximately is used 1.8 MWh inside the plant and it can sell around 5.7 MWh daily. Kuala Lumpur will generate around 7713 tons MSW per day, and it can produce 2466 tons RDF per day. Regarding to potential of MSW and RDF generation by 2020 in Kuala Lumpur it will need around 11 plants to treatment of MSW. Thus, this number of plants is able to produce around 62.7 MWh electricity per day.

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REFRENCE

BioGen. 2003, Biogen awareness and information session: renewable energy in Malaysia—potential and ‘‘the way forward’’,

Hitam.S. 1999. Sustainable energy policy and strategies: a prerequisite for the concerted development and promotion of the renewable energy in Malaysia.

Mariyappan. K. 2000. Country report from Malaysia: status of renewable energy and energy efficiency in Malaysia.

Mohamed.A.R. and Lee, K.T.2005. Energy for sustainable development in Malaysia: Energy policy and alternative energy.

Mohd.M.N. Mujeebu,M.A. 2009. Assessment of municipal solid waste generation and recyclable materials, potential in Kuala Lumpur, MalaysiaMohamed Osman Saeed.

Nternational Energy Outlook. 2004World energy and economic outlook.

PTM.2004. (Malaysia Energy Centre. Biomass power generation & cogeneration project (BioGen).

Rogner. H.H. and Popescu, A. 2001 .World energy assessmen.

Spalding-Fecher, R. and Winkler, H.S. 2005. Energy and the world summit on sustainable development. Energy Policy.

Thaddeus .J. 2002. Complementary roles of natural gas and coal in Malaysia. Eighth APEC coal flow seminar/nineth APEC Clean fossil energy technical seminar/fourth APEC coal trade, investment, liberalization and facilitation workshop, Kuala Lumpur, Malaysia.

Tsai.W.T. and Chou, Y.H. 2004. An overview of renewable energy utilization from municipal solid waste (MSW) incineration in Taiwan. Renewable & Sustainable Energy Reviews in press, available online.

UK Trade & Investment, 2003. Power market in Malaysia. Available at: http://search1.tradepartners.gov.uk/text/energy/malaysia/profile/overview.shtml .

WIIAD . 1996. Winrock International Institute for Agricultural Development, Mining the urban waste stream for energy: options, technological limitations and lessons from the field.

World Employment Report. 2001.National report on the ICT sector in Malaysia.

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