UNIVERSITI TEKNOLOGI MALAYSIA

SMJM 1213 – "WASTE-TO-WEALTH ENERGY"

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INTRODUCTION

Around the world, waste generation rates are rising. In 2012, the worlds' cities generated 1.3 billion tonnes of solid waste per year, amounting to a footprint of 1.2 kilograms per person per day. With rapid population growth and urbanization, municipal waste generation is expected to rise to 2.2 billion tonnes by 2025.

Waste is defined as any unavoidable material resulting from domestic activity or industrial operation for which there is no economic demand and which must be disposed of. There are a variety of wastes, liquid or solid, emanating from human activities (domestic), agricultural or industrial activities (neither domestic nor hazardous), and hazardous or special. Faeces, indeed is also included in solid wastes. Among the liquid wastes, sludge, sewage, livestock and industrial wastes are known among communities.

It is very important to understand the wastes, their nature, problems associated with them, and how to dispose them off hygienically. Let take a look in Nigeria today, there are no sewers or underground drainage system and as a result all liquid wastes find their way into water courses. There are no urinals or toilet facilities in many public areas. Schools are devoid of functional toilets. Solid wastes are found everywhere and anywhere. In Nigeria, waste is generated at the rate of 0.43 kg/head per day and 60 to 80 per cent of it is organic in nature. A cow brought for slaughtering produces about 328.4 kg of wastes in the form of dung, bone, blood, horn and hoof. Sheep and rams produce about 0.9 kg waste per head per day (based on observation). The markets generate a variety of wastes, for example, corn cobs, vegetable wastes, packaging materials, etc. The household wastes also contain other materials such as paper, glass, metal, plastic, and other non-biodegradable materials and some of them are excellent raw materials for various industries in the country.

People litter the roads with no civic concern. All these wastes contain a lot of valuable resources in the form of nitrogen, phosphorus, potassium and other chemicals which are useful. Microorganisms play an important role in biogeochemical cycles and convert these valuable resources into harmless and useful products. However, there are certain wastes arising from industries or healthcare facilities which may be hazardous, infectious and need to be treated as special wastes.

As much as possible, one should aim at waste minimization or reduction, reuse, and recycling before dumping the wastes into a dust bin. Recycling the non-biodegradables will help the individual and also the local industry. In recent years, many industries are starved of raw materials. For recycling to be successful, separation should start at household level. If paper, plastic, aluminium, iron and glass can be separated and kept in separate bins or baskets, it is normal that our waste will be reduced for the clearing agent and we will pay less for his services? Besides saving some money from the agent one makes some extra money from the sale of these recyclables.

LITERATURE REVIEW

PROBLEM

The demands for goods and power are increasingly grow due to growth of population over time. Same goes to municipal waste, increasing over time due to the consumption of goods. By the year of 2025, the generation rate of municipal waste increase to 2.2 billion tonnes over a year (Diego Moya et al., 2017). Most of municipal waste management use landfills as the solution. Naturally, the waste will decompose releasing Carbon Dioxide gas, CO_2 and Methane gas, CH_4 to the atmosphere. This gas also known as Landfills Gas (LFG) (Uisung Lee et al., 2017). The gas has the potential to produce greenhouse effects which causes the atmosphere temperature to rise. As the waste use landfills as the solution, the waste will cause uncomfortable situation and environment towards nearby resident as the waste produce bad odour in the atmosphere.

SOLUTION

The waste can produce decent amount of energy as the gas has the ability to cause greenhouse effect in the atmosphere and releasing Methane gas which is significantly use to produce heat energy. The municipal waste has the heating value as much as 10 MJ/kg (J. Malinauskaite et al., 2017). Thus, the solution can be proposed based on the problem is Power Generation Plant which uses municipal waste as fuel for the plant. The solution will solve the upcoming Landfills gas emission. This solution eventually reducing the current amount of methane gas released on the atmosphere. This solution also will reduce the amount of landfills being used currently. There are five possible technologies that have been implemented widely. The technologies are incineration with energy recovery, pyrolysis or gasification, plasma arc gasification, refused derived fuel (RDF) and biomethanation (Omar K.M. Ouda et al., 2017). As the solution proposed for this problem use Power Generation Plant, this report decides to use the technology of incineration with energy recovery for the Power Generation Plant.

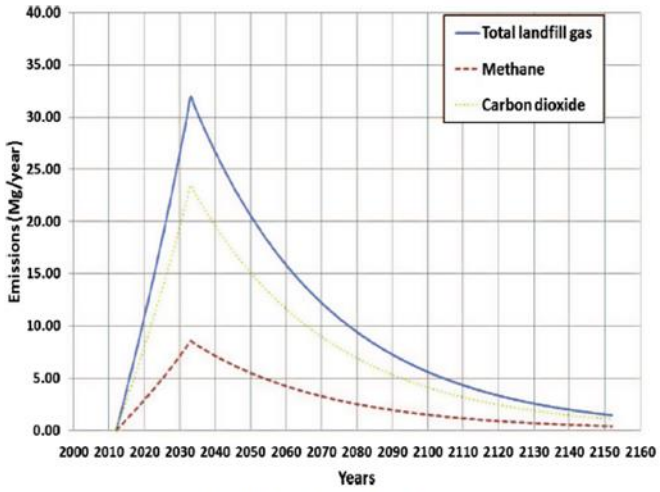
RESEARCH PAPER OVERVIEW

"Waste-to-energy potential in the Western Province of Saudi Arabia"

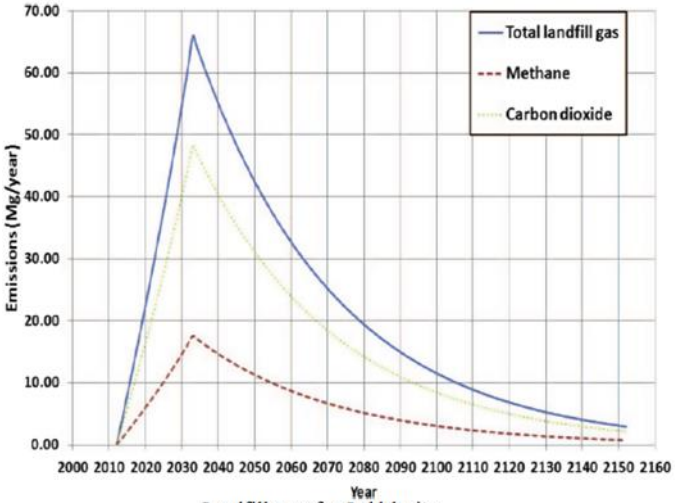
By Omar K.M. Ouda et al. (2017)

This overview views the research paper that has been done by expert researchers as prove to the problem and solution pointed out by this report. Briefly, the research paper has general problem where the municipal waste generation increasing from time to time throughout years emitting decent amount of Landfill gas(LFG) mainly made up from Carbon Dioxide gas and Methane Gas and use landfills widely to manage municipal waste which is the same general problem and solution in worldwide. The research paper focused the problem and the solution in three main city of Western Province of Saudi Arabia where the cities are Makkah, Madina and Jeddah. The solutions proposed by the research paper are incineration with energy recovery which is the same solution with this report, refused derived fuel (RDF) and biomethanation. The research paper has presentable data for both pointed general problem and solution by this report.

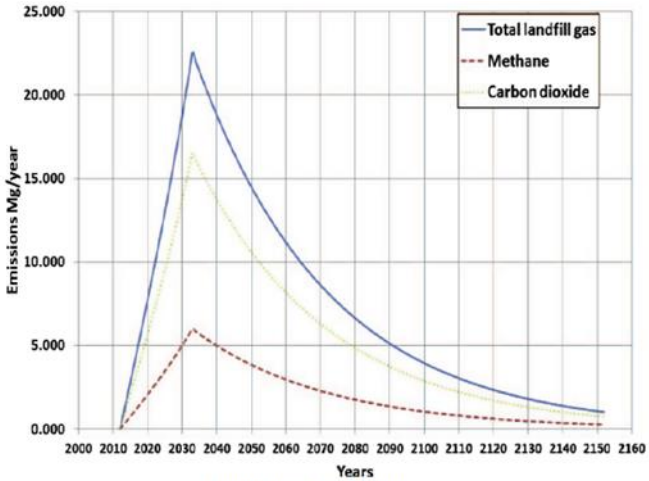
DATA IN RESEARCH PAPER FOR PROBLEM



Landfill gas for Makkah site

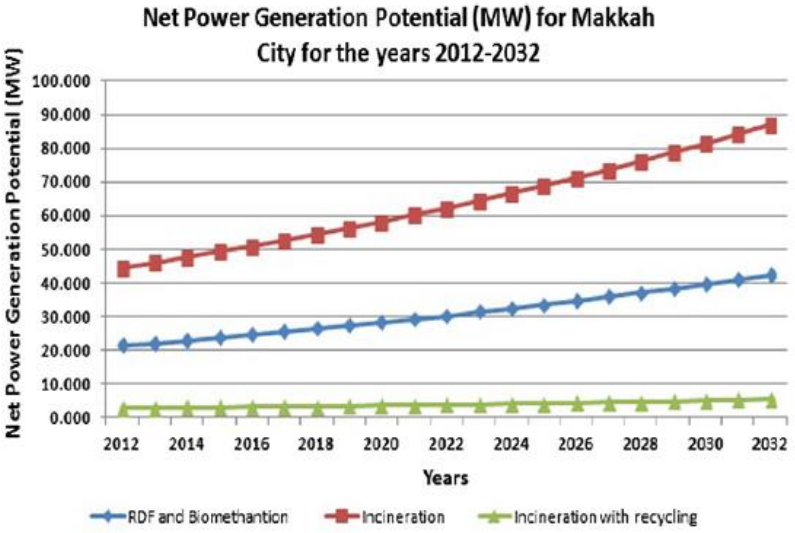


Landfills gas for Jeddah site

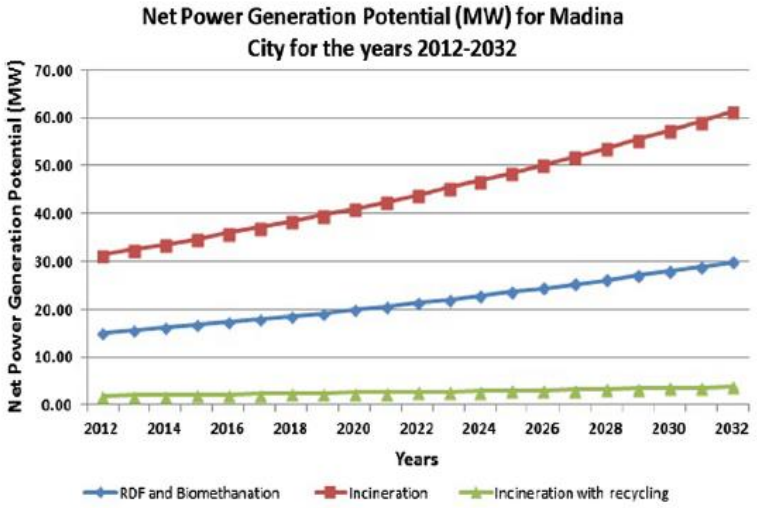


Landfills gas for Madina site

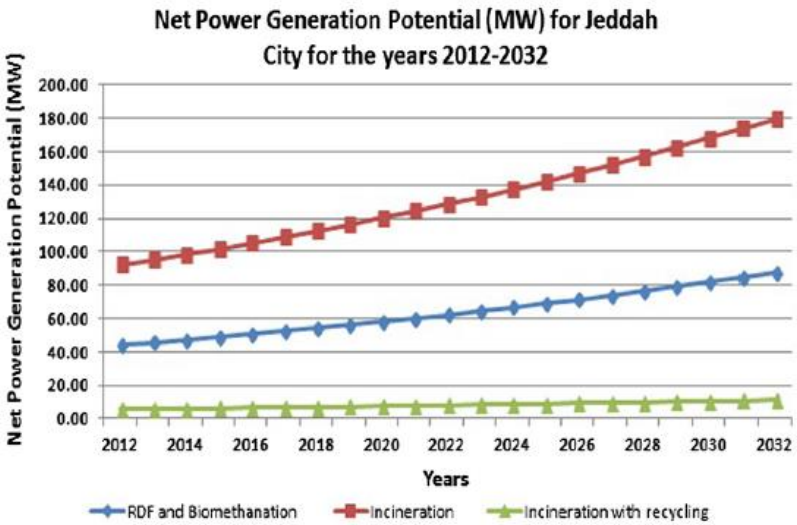
DATA RESEARH PAPER FOR SOLUTION PROPOSE



Net power generation potential (MW) for Makkah city for the years 2012–2032.



Net power generation potential (MW) for Madina city for the years 2012–2032.



Net power generation potential (MW) for Jeddah city for the years 2012–2032.

OBJECTIVE

- To ensure the protection of the environment through effective waste management measures.
- To protect the health and wellbeing of people by providing an affordable waste collection service.
- To promote alternative measures of solid waste management the usage of the alternatives power sources.

Issues on Waste to Wealth Energy

Industrial Waste

Industrial waste is the waste produced by industrial activity which includes any material that is rendered useless during a manufacturing process such as that of factories, industries, mills, and mining operations. The types of industrial waste generated include cafeteria garbage, dirt and gravel, masonry and concrete, scrap metals, trash, oil, solvents, chemicals, weed grass and trees, wood and scrap lumber, and similar wastes. Smoke and greenhouse gases are being released by industries into the air which causes increase in global warming. Industrial wastes will also cause water, air, soil pollution which will harm the environment.

Agricultural Waste

Agricultural waste is waste produced as a result of various agricultural operations. It includes manure and other wastes from farms, poultry houses and slaughter houses; harvest waste; fertilizer run-off from fields; pesticides that enter into water, air or soils; and salt and silt drained from fields. Agricultural wastes bring an effect on soil pollution, water pollution and also health related issues.

Hazardous Waste

Hazardous waste is a waste with properties that make it potentially dangerous or harmful to human health or the environment. The most common hazardous waste that can be found in home are paints, batteries, solvents, cleaning agents and pesticides. Hazardous waste carries environmental risks and also health risks for humans and wildlife. Hazardous waste releases some pollutant such as mercury that will lead to respiratory diseases, heart diseases and also cancer.

Radioactive Waste

Radioactive waste is waste that contains radioactive material. Radioactive waste is usually a by-product of nuclear power generation and other applications of nuclear fission or nuclear technology, such as research and medicine. There are 3 types radioactive wastes which are low-level waste, intermediate-level waste, and also high-level waste. Radiation exposure can cause cancer, birth defects, and other abnormalities, depending on the time of exposure, amount of radiation, and the decay mechanism. High-level radioactive waste from nuclear reactors can be hazardous for thousands of years.

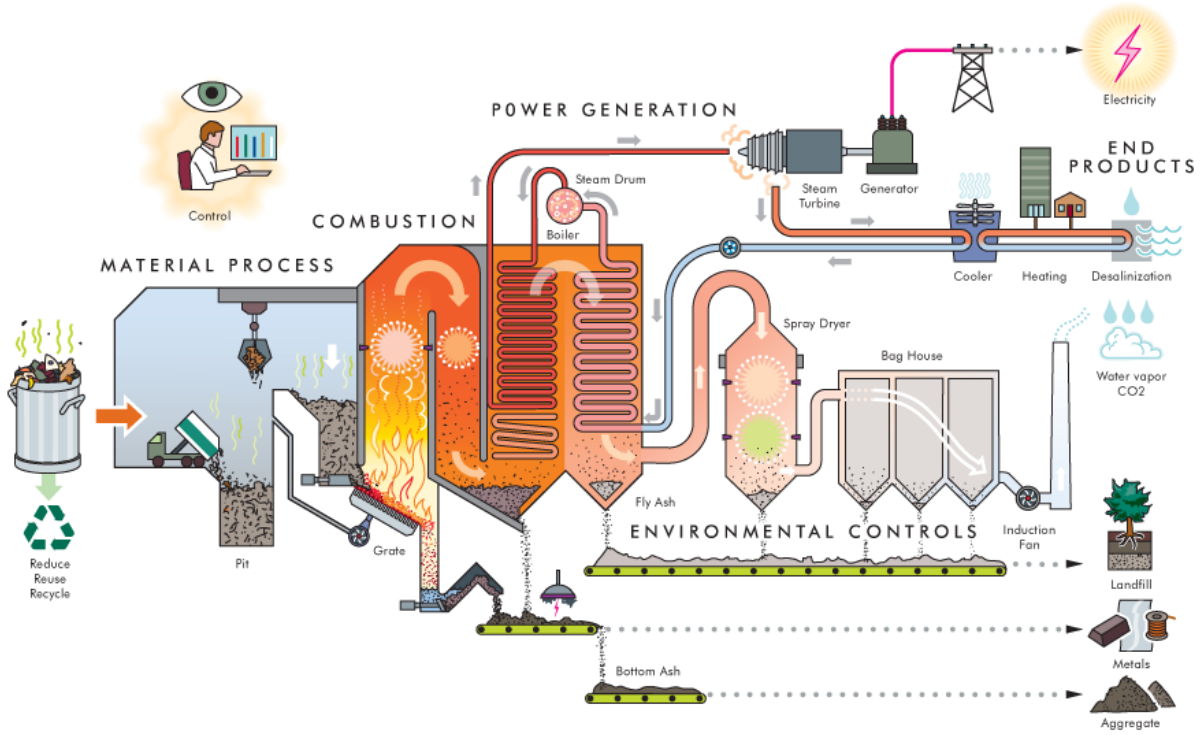
Medical Waste

Medical waste is defined by the Environmental Protection Agency as anything that contains bodily fluids or wastes, such as surgical gloves, needles, swabs, body organ cultures and even bloody bandages. Medical waste is a subset of wastes generated at health care facilities, such as hospitals, physicians' offices, dental practices, blood banks, and veterinary clinics, as well as medical research facilities and laboratories. The effects of dumping medical wastes are gastroenteritis infections, respiratory infections, herpesvirus, and also genital infections.

SOLUTION TO WASTE TO ENERGY

Incineration is a waste treatment method that involves the combustion of organic substances contained in waste materials. Combustion and alternative high-temperature waste treatment systems are delineated as "thermal treatment" which means that waste treatment technology that involves high temperatures within the process of the waste feedstock.

Waste combustion is especially common in countries like Japan wherever land could be a scarce resource. Scandinavian nation and Sweden are leaders by mistreatment the energy generated from combustion for over a century, in localized combined heat and power facilities supporting district heating schemes. In 2005, waste combustion created 4.8% of the electricity consumption and 13.7% of the overall domestic heat consumption in Scandinavian nation. Varieties of alternative European countries trust heavily on incineration for handling municipal waste, above all Luxembourg, European nation, Germany, and France.



MECHANISM OF WASTE INCINERATORS

Step 1: Monitor and Control

- The air stream rising to the stack is continuously monitored to ensure compliance with air quality standards. The entire process can be controlled to optimize efficiency in the combustion, heat and steam generation, electrical energy, and environmental control processes.

Step 2: Material Process

- Waste material is received in an enclosed receiving space, wherever it is more completely mixed in preparation for combustion. Negative flow of air can carry dust and odor into the combustion chamber from the receiving space, in conjunction with the waste to eliminate its spread outside the facility.

Step 3: Efficient Combustion

- Mixed waste enters the combustion chamber on a timed moving grate, that turns it over repeatedly to keep it exposed and burning. The method turning over or jabbing a fireplace log brightens the fire. A measured injection of oxygen and fumes drawn from the receiving space makes for an additional complete burn.

Step 4: Fly Ash Capture

- The finest airborne particulates are removed within the filter baghouse, wherever an induction fan draws air through fabric bags toward the stack or chimney. This method removes 96 % of any remaining particulates. The bags are vibrated at intervals to shake loose particulates caked on their inner and outer surfaces. Captured ash is commonly returned to landfills.

Step 5: Acid Gas Treatment

- The acidic combustion gasses are neutralized with an injection of lime or sodium hydroxide. The chemical reaction produces gypsum. This process removes 94% of the hydrochloric acid.

Step 6: Bottom Ash Recycling

- The unburned remains of combustion "bottom ash" are passed by magnets and eddy current separators to get rid of each metal (steel and iron) and other metals such as copper, brass, nickel, and aluminum for recycling. The remaining ash may be used as mixture for roadbeds and rail embankments. Ash is generated at a ratio of regarding 10 % of the waste's original volume and 30 % of the waste's original weight.

Step 7: Steam Power Generation

- Highly efficient superheated steam powers the steam turbine generator. The cooling steam is cycled back into water through the condenser or diverted as a heat source for buildings or desalinization plants. Cooled stream is reheated in the economizer and super heater to complete the steam cycle.

Step 8: Heavy Metal Capture and NOX Treatment Dioxins/Furans Treatment

- Activated carbon is injected into the hot gases to absorb and remove heavy metals, such as mercury and cadmium. Nitrogen oxide in the rising burn gases is neutralized by the injection of ammonia or urea. Dioxins and furans are destroyed by exposing flue gases to a sustained temperature of 850°C for 2 seconds. This process removes more than 99% of dioxins and furans.

Step 9: Electric Power and Heat

- A 1,000 ton-per-day WTE plant produces enough electricity for 15,000 households. Every ton of waste will power a household for a month. If combined with a cogeneration plant design, WTE plants can, while manufacturing electricity, additionally provide heat for nearby businesses, desalination plants and alternative purposes.

PROS AND CONS OF WASTE TO ENERGY

Pros:

1. Better Waste Management: The approach actually makes waste management easier and more economical. Incineration will burn up to 90% of the whole waste generated in a much chosen space. At times, the waste incinerated is over 90%. Landfills solely facilitate organic decomposition that doesn't do a lot of and artificial or nonorganic waste keeps accumulating.
2. Produces Energy: Incineration plants generate energy from waste. This energy can be used to generate electricity or heat. It can be used to power the needs of people living nearby.
3. Uncontaminated Groundwater: Incineration doesn't add any cyanogenic components to the groundwater, as landfills do. Also, the chemicals that landfills leaks into the environment together with the soil get averted.

Cons:

1. Expansive expenditure: The costs of building the infrastructure are substantial. The price of running incineration plants is substantial too. One additionally desires trained workforce and dedicated employees to keep the incinerators running. All this adds to the cost.
2. Harmful emission: Although modern incinerators are very effective at filtering out harmful toxins and chemicals, they're not 100% effective. The really small particles that can emit with the hot flue exhaust gases have the potential to cause health problems for those who live downwind. These pollutants can result in heavy metals such as Cadmium being released into the atmosphere. Research is currently being undertaken to ascertain just how harmful these pollutants can be.

WASTE INCINERATOR IN MALAYSIA

The plans to make a waste incinerator to include into Kuala Lumpur Transfer Station, in Taman Beringin, Kuala Lumpur, was first mooted in 2014 however was met with criticism from the general public, who cited shut proximity as one of the most reasons for their objection. The project costing is between RM700mil and RM900mil is to be built on 1.62ha next to the existing transfer station. It is a partnership between the government and private firms wherever the later will hand over the capital expenditure for the project before handing it over to the government. The project was currently at the final stage of tender, that involved detail negotiation of contract document, with a local company as the developer, and international firms as technology supplier and operation support. The tender is anticipated to be all over at the end of 2017. National Solid Waste Management Department (JPSPN) director-general, Ismail Mokhtar, said that using the design-build-operate-and-transfer model, the appointed contractor will not only have to design and build the plant, they also need to operate it for 25 years before the government takes over. He also stated that the plant benefits the country as it will double the existing landfill's lifespan to about 140 years besides encouraging technology transfer to a Malaysian company. Ismail said that the plant benefits the country because it can double the present landfill's lifetime to about 140 years besides encouraging technology transfer to a Malaysian company. The plant is estimated to burn 1,000 tonnes of household waste and 200 tonnes of commercial waste per day and turn them into electric power and every 1,000 tonnes of waste burned, we can generate 25 to 30megawatts of electricity per hour which is sufficient to light up about 57,000 houses. It is said that everything is already in place and the contractor will be monitored properly to follow the guidelines so that the three main pollutions of noise, smell, and gas emissions can be addressed. The incinerator will burn the waste in 850 to 1000 degrees Celcius in the combustion chamber. The heat from the combustion will then be recovered using heat exchanger before it is converted into electricity and channeled to the people through TNB supply line. The mega project will go through the normal development procedures such as conducting Environment Impact Assessment, obtaining development order from Kuala Lumpur City Hall (DBKL) and public engagement.

CONCLUSION

Incineration might be the most effective waste management measure to decrease the amount of waste produced. It is able to convert a waste to another form of energy like heat energy and some useful gases that can be used in certain industry fields. Some of the unrenewable sources also can be preserved and replaced by the energy sources which are produced from incineration.

It is clear to see that the waste we produced daily are potential to be another form of raw materials in other fields if we try to deserve it. It is also make benefits to us as we are able to recycle the recyclable sources and conserve the renewable energy.

REFERENCES

https://www.thestar.com.my/metro/metro-news/2017/11/06/a-step-closer-to-new-era-of-waste-management-proposed-wastetoenergy-plant-aimed-at-saving-cost-cutti/

https://junkwize.com/blog/pros-and-cons-of-rubbish-incinerators/

http://www.deltawayenergy.com/wte-tools/wte-anatomy/

https://www.sciencedirect.com/science/article/pii/S0959652617317316

https://www.sciencedirect.com/science/article/pii/S187661021734763X

https://www.sciencedirect.com/science/article/pii/S1876610216313686

https://www.sciencedirect.com/science/article/pii/S1018363915000033

https://www.sciencedirect.com/science/article/pii/S0360544217319862

http://www.malsparo.com/types.htm

https://medwasteservice.com/2018/effects-medical-waste-human-health/

http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-wastes/radioactive-waste-management.aspx

https://www.conserve-energy-future.com/types-of-radioactive-waste.php

https://bizfluent.com/list-5978867-health-effects-hazardous-waste.html

https://www.conserve-energy-future.com/causes-and-effects-of-agricultural-pollution.php

https://www.conserve-energy-future.com/causes-effects-of-industrial-pollution.php