Studying fossil fuels use in singapore environmental sciences essay

Environment, Ecology

Singapore is a little state with no natural resources, it is important to diversify the state 's energy beginnings so as to guarantee that this will non restrict Singapore 's economic fight and growing. Currently, the gas-fired power works generates 80 % of the state 's electricity and the staying 20 % coming from the oil-fired power works [1] .

The Energy Market Authority (EMA) has predicted that there would be an increasing gas ingestion demand in the electricity sector [2] . Therefore, there is an increasing demand to look for other energy beginnings such as coal and liquefied natural gas (LNG) , and besides atomic energy in distant hereafter [1] .

In add-on to happening the alternate energy beginnings, safeguarding theenvironmentis besides an of import undertaking for the state. It is reported that electricity coevals histories for about half of the C dioxide (CO-2) emanation in Singapore [3] . Therefore, there is a demand to look for cleaner fuels in order to cut down C dioxide emanations so as to minimise its part to planetary heating.

This paper will give an overview of the hazards, impacts, advantages, every bit good as the disadvantages of utilizing coal and LNG as alternate energy beginnings in Singapore.

Coal

Coal is a non-crystalline solid fuel which consists of chiefly C formed from the remains of organic affair under the Earth 's surface for 1000000s of old ages. It besides contains trace sums of sulfur, quicksilver and radioactive stuffs.

Hazard and Impacts of Coal

One of the hazards associated with the usage of coal as energy fuel is that coal degrades in reserves upon subjugation to weathering and atmospheric oxidization. This implies that the belongingss and constructions of stored coal can be altered and therefore, doing them less valuable for intended usage.

Therefore, in order to keep the belongingss of the majority coal, big coal atoms with smaller surface-to-volume ratio are preferred since a smaller overall effectual surface country slows down the rate of debasement. However, larger coal atom size would ensue in more null infinite, taking up valuable storage infinite, bring forthing less energy per unit volume which leads to higher transit costs [4] .

In the event that smaller coal atoms are employed alternatively, oxidation and debasement of coal would take topographic point at a faster rate due to increased effectual surface country. This may bespeak that coal is non suited for usage under Singapore 's clime of high humidness degrees which aggravate the coal debasement job.

Coal has high oxidization affinity which could ensue in self-generated burning during storage [4] . Heat coevals can happen from the exothermal oxidization reaction, and wetting (heat of wetting) . While the rate of heat dissipation is slower than the rate of heat coevals, heat build-up occurs. This frequently leads to self-generated burning that may be hard to command one time a reserve gimmicks fire [4] .

The issue affecting coal debasement is that dust atoms would be released when the coal is exposed to environment [4] . The production of all right atoms would degrade air quality and can trip societal wellness concerns, particularly when inter-building distance is smaller in Singapore. It would decline the wellness conditions of people who are enduring from lungs- and eye-related wellness jobs.

Having assessed the hazards affecting the usage of coal, the impacts associated are besides analyzed. If stored in unfastened reserves, the coal is non merely subjected to weave eroding which will increase particulate pollutants in the air, but besides rains that are frequent in Singapore 's clime that will do coal pile overflow. The H2O oozing through the hemorrhoids would fade out or leach heavy metals and toxic organic substances within, and finally travel into the belowground H2O, which may do its manner to reservoirs and H2O catchments. Contaminated H2O can do farther societal wellness jobs and would be damaging to marine aquatic life.

Besides the issue related to char storage, combustion of coal can take to serious environmental jobs. 20 % of the planetary nursery gas emanations emitted are the consequence of coal firing [5] . In United States entirely, 51. 6 metric tons of quicksilver were released into the air yearly from coal power Stationss [6] . It will be expected that more quicksilver is released if Singapore increases her use of coal. Mercury is toxic and poses a menace to both human species and marine beings. Accretion of quicksilver in the organic structure can do harm to encephalon and kidneys.

Singapore has ratified the Kyoto Protocol in 2006, which has ordinances on emanations and in consequence, punishments have to be paid for emanations [5] . This would be a great impact when Singapore adopts coal power because it has significantly more emanations compared to oil and gas. Punishments for CO2 emanation are expected to increase over clip due to more rigorous controls in topographic point, and would likely do coal power less attractive as an alternate fuel for energy variegation.

Advantages of Coal

Due to the high handiness of coal, the cost of coal is low compared to natural gas or crude oil. Based on research carried out by Massachusetts Institute ofTechnology(MIT) , the cost of coal is ~ $ 1-2 per million BTU, compared to $ 6-12 per million BTU for natural gas or crude oil [7] . Therefore, the usage of coal enables a lower capital investing in the natural stuff. Greater nest eggs from procurance of low-priced natural stuff enables better flexibleness in investing forpollutioncontrol in cut downing CO2 emanation. Coal militias could last much longer than gas and oil. In order to enable Singapore to prolong long-run energy demands, a dependable supply of fuel is a cardinal consideration. Harmonizing to probes carried out, the ratio of the militias to production rate (based on the current ingestion tendencies) has revealed that coal could last for another 155 old ages, which is much longer than in the instance of oil and gas (40 and 65 old ages severally) [6] . Singapore can see coal as one of its option in energy beginnings variegation since the low cost and durable supply of coal render it attractive, and therefore makes Singapore economically more competitory [8] .

Coal is a major beginning of energy in many states like China, US, and India. As the supply will non run out in the close hereafter, researches are proactive to develop advanced clean coal engineerings, including gasification and liquefaction for C dioxide gaining control and storage [7] . Furthermore, the lifting costs of oil and gas as a consequence of depleting beginnings would force the development of such engineerings at a faster rate, doing coal power emanations comparable to oil and gas power.

China as the universe largest coal consumer would unlikely halt the use of coal. Alternatively of change overing to alternative cleaner fuels that may incur substructure costs while decelerating down its advancement, research on advanced methods for continual use of coal at a much lower emanation would be developed by them. With new methods being developed, coal power emanations would be of all time diminishing along the clip line [7] .

For case, CO2 Capture and Storage (CCS) which is presently in development is expected to do coal power a feasible power option with an expected 20-60 % addition in usage compared to today 's degree. With CCS, CO2 emanations from firing coal can be reduced to merely half to a 3rd of the sum of emanations today, which makes it comparable to CO2 emanations from burning of gas and oil at present times [7] .

Disadvantages of Coal

Despite the fact that coal is lower in cost, the comparative energy content per unit weight is low excessively [4] . Sing two indistinguishable trucks transporting the same volume of coal and crude oil, the truck transporting

crude oil gives higher energy output content. Consequently, higher cost is incurred in the transit of coal. Currently, H2O conveyance offers a lower cost alternate to railway, but there is an increasing ordinance on fuel for Marine conveyance, which will further increase cost of coal transit.

Stocking of coal requires stock heap direction, which would likely be much more strict than anyplace else as land is scarce in this state [5] . Coal storage is comparatively land area-intensive. Other considerations include the clime of Singapore, which rains are expected to happen often, unfastened hemorrhoids are improbable to be considered. Storage in enclosed silos or sand traps would, nevertheless, incur higher capital costs and can restrict enlargement capablenesss.

Gas fired power workss emit 70 % lesser CO2 per unit of electrical end product, and petroleum-based systems emit 50 % lesser CO2 than coal-burning power [7] .

LIQUEFIED NATURAL GAS (LNG)

Liquefied natural gas is natural gas that undergoes liquefaction and it consists chiefly of methane. During the procedure of liquefaction, drosss like H2O, N, C dioxide, H sulphide and other S compounds are removed.

The beginnings of gas are well-diversified. Soon, the type of natural gas used in Singapore is the Piped Natural Gas (PNG) obtained from Indonesia and Malaysia. Singapore considers LNG as an alternate energy beginning as it starts the building of the liquified natural gas terminus in Jurong Island, so as

to purchase gas from Qatar, every bit good as other possible LNG providers such as Australia and Oman [2] .

Hazards and Impacts of LNG

The hazards involved in LNG prevarication in its containment and handling. Under ambient temperature and force per unit area, natural gas in its liquid signifier occupies 1/600th times the volume of its tantamount gas signifier. If LNG were to get away into the ambiance, it will zap rapidly taking to the undermentioned jeopardies: (1) formation of a gas cloud with many times the volume of associated LNG which may attach to with hazards such as fire or detonation ; (2) terrible brickle break harm to reaching stuffs such as C and low metal steel constructions at cryogenic temperature ; (3) terrible hurt to personnel coming into contact with the cryogenic stuff [9] .

The release of LNG would non ensue in fire unless it is exposed to an ignition beginning when its volume in air is between 5 % and 15 % [10] . If this happens in or near to residential part, the abodes who face the fire would have thermic radiation harm.

In instance if LNG escape were to go on in the cloaca systems, it would bring forth flammable bluess that would detonate under parturiency and doing farther harm [9] . In add-on, vaporized LNG can do suffocation when released into a confined country as O concentration is reduced.

During the transit of LNG, oilers are comparatively vulnerable to transgress by hit with heavy supplanting ships even if at the most moderate velocities.

Such incidents are likely to happen within port where heavy supplanting ships and LNG oilers portion the same operating environment. In add-on, spillage can happen when LNG oiler travels through difficult point obstructors (for case, concrete hemorrhoids and stone pinnacles) . Upon impact, terrible harm to the bottom construction of the LNG oiler could ensue in interior hull incursion. Nevertheless, hazard of major spillage can be greatly reduced the two-base hit hulled design [9] .

Singapore 's displacement in accent to LNG has raised the concerns of general public with respects to the storage and transit of LNG, particularly after some efforts of onslaughts by terrorists. However, for the same ground stated under hazard of loss in containment of LNG, pure methane will non light in the presence of an explosive charge without premixing with the right proportions of air. In instance of terrorist onslaught, the likely consequence on LNG installations would be a big pool fire alternatively of an detonation. Hence, LNG armored combat vehicles and oilers are non attractive marks for terrorists who seek to execute monolithic devastation to population lives [11] .

Advantages of LNG

Singapore depends on natural gas and crude oil as its chief beginnings of energy supply, which makes these options vulnerable to monetary value fluctuation and supply break. Therefore, LNG offers the chance of significant variegation off from current fuel supplies, enabling Singapore to keep its

security of supply while maintaining electricity costs every bit low as possible to maintain concern and consumer costs down.

The providers of LNG are good diversified as identified earlier. Hence, LNG may easy be available in copiousness. Even though LNG is a non-renewable resource, its supply worldwide is sufficient to run into the demands of Singapore for the following two decennaries, harmonizing to EMA [12] .

Compared to other fossil fuels, LNG is considered as an environmentally-friendlier and cleaner fuel. LNG contains about wholly methane and no other drosss such as metals, sulfur and N since the liquefaction procedure has removed such drosss from natural gas to forestall solids formation as the gas is refrigerated. As such, LNG burning will surely ensue in lessair pollutionand lower C dioxide and azotic oxide emanation every bit good as atom emanations. In add-on, the emanations of sulfur dioxide are besides negligible compared to char and oil. Hence, the usage of LNG will assist to cut down jobs of acerb rain and nursery consequence.

Due to the high volatility of LNG, it will non blend with H2O or dirt in instance of spillage on H2O or land. Alternatively, it will vaporize and disperse rapidly into the air without any residues. Water and land pollutions are therefore avoided.

In footings of flammability, LNG has higher flammability bound (5 %) compared to other fuels like Liquefied Petroleum Gas (LPG) (2. 1 %) or gasolene (1. 3 %) . This implies that for a given volume, more LNG bluess are required to light. Besides, LNG vapour has the highest autoignition

temperature (1004 oF) compared to other liquid fuels like LPG (850-950oF) , gasolene (495 oF) and diesel fuel (about 600oF) .

Since LNG occupies 600 times less infinite than natural gas at ambient conditions, less storage infinite is required. It is besides easier to transport LNG though grapevines than natural gas.

In footings of energy coevals, LNG has high net energy output. Hence, the usage of LNG will give higher efficiency compared to oil in power works.

Disadvantages of LNG

Although LNG is considered as a cleansing agent fuel, it besides contributes to planetary heating to a little extent. Methane, which is the chief component in LNG, is besides a nursery gas which will increase the methane degree in the ambiance if released.

In tropical part like Singapore, one definite challenge is to maintain LNG as liquid. This could imply a important sum of energy ingestion to take down the temperatures of the LNG armored combat vehicles [13] . In order to keep LNG as liquid without excessively much chilling, expensive substructure is required for LNG storage and transit [11] .

Economically, the operations of LNG are capital intensive due to big sum of disbursals needed for the building of liquefaction installations, transit grapevines and purchase of specially designed oilers and LNG ship. High transit cost of LNG from other states to Singapore constitutes portion of the cost excessively. Furthermore, being the lone receiving and regasification

terminus in Singapore, the LNG terminus may monopolise LNG supply. In other words, the users may hold to bear higher monetary values.

Even though LNG oilers and installations are less likely marks for terrorists, any successful onslaught could ensue in loss of substructures that are highly valuable. Therefore, seashore guards are needed to guarantee the safety and security of the LNG oilers. By beef uping security along coastlines and port installations, Acts of the Apostless of terrorist act and incidents can be prevented.

However, while guaranting larboard security is indispensable, transportation paths are every bit vulnerable. If any incidents or onslaughts were to happen in the center of a sound, LNG supplies and all other flows of trade via the same transition would be disrupted.

Decision

Coal is the cheaper signifier of energy that is besides extremely abundant. It could, nevertheless, degrade when exposed to oxygen, ensuing in it being a hapless quality fuel. Due to take down energy content per unit volume, coal would take up big storage infinites in land-scarce Singapore. Environmental pollution could originate from the release of coal dust which is a menace to public 's wellness. Heavy metals and other drosss found in coal are harmful pollutants that are likely to be released upon debasement. However, development of new clean-coal engineerings can be expected from big coal consumers such as China, US and India.

Like coal, Liquefied Natural Gas (LNG) will help Singapore in get bying with the demand in electricity as a cleansing agent and abundant signifier of fuel. The monopolization of LNG terminus in Singapore could, nevertheless, unfavorably consequence in consumers paying higher monetary value for LNG fuel. The storage infinite for LNG is much smaller than natural gas, which fits good for Singapore whereby land is scarce. When assorted in 5 % to 15 % with air, LNG will light upon exposure to an ignition beginning. Most of all, LNG is a much cleansing agent and efficient signifier of energy compared to other fuels and burn with minimum atom residues and environmental pollution.

The hazards associated with the handling of coal and LNG can be minimized by following with industrial criterions and ordinances.

While the clime of Singapore disfavours the storage of both coal and LNG, the scheme for energy variegation utilizing these two options shall render our energy system resilient for the following 20 old ages.