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Pollution, Degradation & Contamination

Clean Fuel Initiatives – How Does Malaysia Fare?

Come this September, all oil companies in Malaysia will be required to upgrade their fuel quality to comply with the EURO 2 standard for both diesel and petrol. This new standard means a reduction in the sulphur content from 3,000 parts per million (ppm) to 500 ppm for diesel, and from 1,500 ppm to 500 ppm for petrol.

The proposed reduction in sulphur level appears significant. But before we applaud the government for this clean fuel initiative, let us make some comparisons with the fuel quality standards adopted by countries near our shores.

Thailand adopted the EURO 2 standard way back in 2002, India in 2001, and Indonesia in 2007. Hong Kong has been using the EURO 3 standard since 2001 while Singapore, Taiwan and South Korea have migrated to the Euro 4 standard which has an ultra-low sulphur content of 50 ppm, that is, ten times lower than what we will have in our petrol this September!

The European Union (EU) started using the EURO 2 standard way back in 1996. Since 2005 EU has moved up to the EURO 4 standard and is now putting in place the processes to "graduate" to the EURO 5 standard. Malaysia therefore has not been really up to mark where clean fuel initiatives are concerned!

Fuel Standards and Our Health

How does the sulphur content in fuel relate to the man on the street? Through the air that we breathe!

We all know that vehicle emissions are a major contributor to urban air pollution. Key emissions include carbon monoxide (CO), unburnt hydrocarbons (HCs), nitrogen oxides (NO_x) and particulate matter (PM). PM may be solid or liquid particles found in the air, and are emitted directly or formed in the atmosphere from precursors such as sulphur oxides (SO_x) and NO_x. Likewise, NO_x and unburnt HCs react in the presence of heat and sunlight to form ozone (O_3) at ground level.

Pollutants which have the greatest impact on our health are PM, O_3, CO and SO_x. Ambient PM which can be inhaled deep into the lungs can cause premature death and aggravation of respiratory and cardio-vascular diseases. Diesel PM is of special concern because diesel exhaust has been associated with an increased risk of lung cancer. O_3 can irritate the respiratory system, reduce lung function, and inflame and damage the lining of the lungs. SO_x when present as particulate sulphates contributes to asthma.

Cleaner Fuels for Cleaner Air

Air pollution control programmes in developed countries have shown that the adoption of cleaner fuels and the introduction of improved technology and after-treatment devices are an effective approach to cleaner air through lower vehicle emissions.

Continued on page 3

Contents

A publication of the Department of Environment, Malaysia - FREE copy.

From the desk of the Director General

Pollution, Degradation & Contamination

This issue of IMPAK offers a set of diverse and interesting articles ranging from the use of nuclear energy for power generation to the preservation of the oceans and the coral environment. However, an even more interesting sub-text will emerge when these articles are read together and understood in the same way. It is the realisation that the true costs of acting and doing something cannot be ascertained or computed easily when green issues are involved. And the cost of not acting or doing something is even harder to ascertain and establish. And often by the time we are able to establish the true costs, it is environmentally speaking, too late!

As a first example, let us consider the transition to agriculture that is underpinned by green and sustainable principles. There will be a need for a change from the conventional view of agriculture to one where an ecosystem is adapted to optimise crop performance and reduce environmental degradation. The resulting benefits are that much harder to estimate right now. Hence the cost of transiting to 'green cultivation' will be difficult to work out.

Let us take the case of nuclear power as presented in an article here. At first hand it appears to be the answer to our concerns over the depletion of fossil fuel, which is currently the main source of electricity generation in Malaysia. A nuclear plant can supply a stable flow of electricity at low prices (as compared to coal and gas) and it does not emit carbon dioxide into the atmosphere. The country's first nuclear power plant plans to begin operations by 2025. All looks rosy but what if we cost 'the cost of not doing it' at all? For example, we must consider whether we really have the economies of scale to justify developing the multifarious range of a nuclear energy industry skills and abilities. Are there any hidden costs involved? Some say we have not properly taken into account the costs of decommissioning, storage of spent fuel and handling of radioactive leakages, as well as the environmental costs in the rare event of disaster. We must appreciate all this makes costing and accounting for environmental issues extremely difficult, requiring a new kind of expertise and a new mind set.

Other examples abound. The various articles presented here are a clear indication that the transition to a green economy requires an expert understanding of costs involved for doing or not doing anything and everything. Many would be surprised to know that for every barrel of oil extracted from oil and gas fields, another three barrels of wastewater or 'produced water' is produced. This works out to 250 million barrels of wastewater a day. And it is permitted to be discharged into the environment! Salts in this wastewater are a major source of toxicity. Hydrogen sulfide and hydrocarbon levels are also elevated. Even by combining various physiochemical and biological treatments, all these hazardous pollutants cannot be removed. Biological treatment offers the last hope but the question to ask is : 'When we buy a litre of petrol at RM 2.00, how much goes towards managing, in a responsible way, the wastewater generated in oil and gas fields?'

This brings us to clean fuel initiatives and how well or badly we are faring. In September 2009, we adopted EURO 2 standard for petrol and diesel. India adopted it in 2001, Thailand in 2002, Indonesia in 2007. Singapore, Taiwan and South Korea are on the ultra-low sulphur content EURO 4 standard. Meanwhile the EU is working on EURO 5 standard. We admittedly have lagged. And what truly is the cost of falling behind? To the man on the street, it is the air we breathe and its health hazards. To industry, it is lost man-days, to the environment it could well spell enhanced urban air pollution. The cost of not going to EURO 2 earlier is indeed difficult to compute! A similar picture and similar issues exist with regard to treating and disposing of clinical waste, managing contaminated land (at least now criteria and standards are being developed to provide guidance to management of contaminated sites) and to safeguarding our corals and ocean habitats for preservation and conservation of marine life. We cannot overlook the important fact that it is the continued existence of marine resources that guarantees a livelihood for the coastal communities.

There is hence a crying need to understand that the cost of delay in resolving environmental issues is more costly than we can imagine simply because we do not have a costing model to take all factors into account. A more holistic approach is required - one that involves harnessing the ideas and imagination of a range of professionals - engineers, accountants, doctors, planners and administrators. The true costs of a product, activity or an initiative must be made known. Only then will we be able to act in a manner that is more environmental friendly and kinder to Mother Earth.

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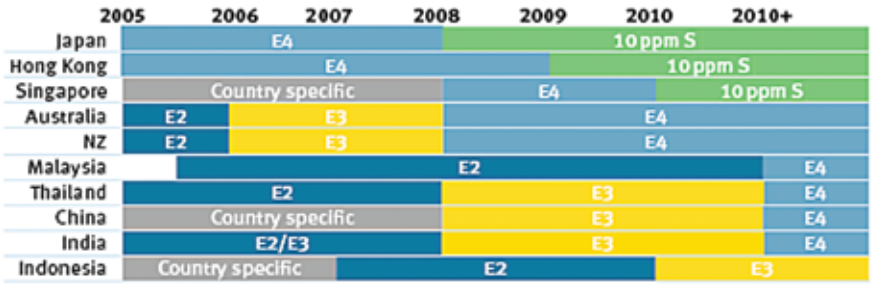
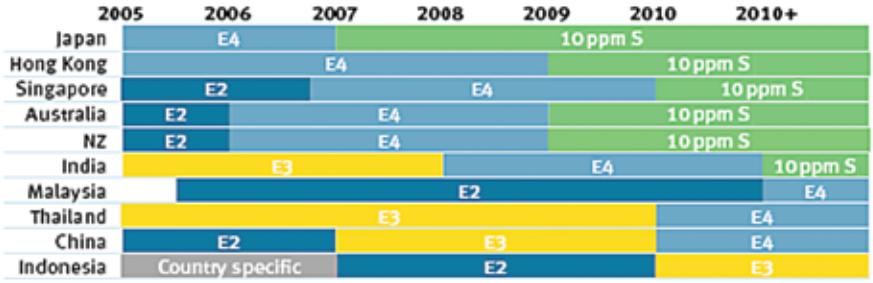


For sulphur in petrol: E2 sets the limit at 500 ppm, E3 at 150 ppm and E4 at 50 ppm

Figure 1: Petrol regulatory outlook for the Asia-Pacific region.



For sulphur in diesel: E2 sets the limit at 500 ppm, E3 at 350 ppm and E4 at 50 ppm

Figure 2: Diesel regulatory outlook for the Asia-Pacific region.

Reducing sulphur level in fuels is particularly vital for lowering particulate matter and can reduce emissions in two ways:

1. It reduces direct emission of both sulphur dioxide and sulphate particulates from all vehicles. Sulphur dioxide emissions from diesel and petrol vehicles, and particulate matter from diesel vehicles tend to increase in direct proportion to the amount of sulphur in the fuel.

2. Sulphur reduces the effectiveness of vehicle emission-control technologies for petrol and diesel vehicles resulting in increased vehicle emissions of CO, HC, NO_x, and PM. It also reduces effectiveness of new types of emission control devices such as advanced catalytic convertors and diesel particulate traps.

In short, reducing sulphur to very low levels (50 ppm and less) not only reduces PM emissions but also allows the introduction of emission control technologies in vehicles that provide even greater emission reductions. Lower emissions translate into better air quality. This in turn means less hospital admissions and emergency room visits, school absences, work loss days and restricted activity days – and higher productivity and a better quality of life.

Higher Standards Mean Higher Prices?

Why then is the government hesitating to tackle air pollution knowing well that the number of vehicles on our roads and highways will escalate in the future? There is speculation that the adoption of the EURO 2 standard may raise the price of fuel as some oil companies have indicated that they will not bear the increase in costs. On the other hand, the government is unwilling to pass on the extra processing cost to the consumer as there is fear that raising the price of both diesel and petrol will lead to another round of inflation.

In the Ninth Malaysia Plan, there is only a brief statement on the government's intention to introduce the EURO 3 standard for petrol vehicles without any details or target date provided. On the ground, some oil companies are gearing themselves for the new fuel standards but others are playing the wait-and-see game.

Tests done on fuels from various retailers reveal that the sulphur content varies greatly, with some levels as high as 2800 ppm and others as low as 300 ppm. Currently the sulphur content in the petrol or diesel we purchase is not disclosed; so motorists do not know which oil companies sell the cleaner fuel.

Public Awareness Campaigns

As a ramp up to the adoption of the EURO 2 standard, the government should encourage oil companies to state the sulphur level in their fuels, as certified by SIRIM or some other reputable and qualified laboratory. There should also be public awareness campaigns by the government on the overall health and environmental benefits of using cleaner fuels.

The government must not ever think of delaying the adoption of the EURO 2 standard beyond September 2009, particularly as the price of crude oil has fallen sharply and stabilised somewhat. It should not give in to – as it happens very often – pressure by the wait-and-see oil companies who claim they need more time to make the changes. On the contrary, it must now set a target date for the migration to the EURO 3 standard to show that it is committed to reducing vehicle emissions as part of an overall strategy to tackle the negative health and environmental effects of air pollution created by the transport sector.

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Is Precision Agriculture the Solution to a Degrading Environment?

Today, agronomic practices are being increasingly directed towards the sustainable agriculture paradigm, where an agro-ecosystem is adapted to optimise crop performance within specific environmental protection standards to ensure preservation of natural resources, including soil and water.

It is in this context that Precision Agriculture is changing the way people farm as it offers a myriad of potential benefits in profitability, productivity, sustainability, crop quality, environmental protection, on-farm quality of life, food safety and rural economic development. Precision Agriculture has been hailed as one of the most scientific and modern approaches to production agriculture in the 21st century, as it epitomises a better balance between reliance on traditional knowledge and information and management-intensive technologies.

Using a Global Positioning System (GPS) to record location data in a tropical peat land cultivated with pineapple.

Precision Agriculture embodies a holistic farm management strategy where farm operators can adjust input use and cultivation methods, including seed, fertiliser, pesticide and water application, variety selection, planting, tillage and harvesting, to match varying crop, soil and other field attributes.

Precision Agriculture has three fundamental requirements for operational success:

1. Ability to identify each field location
2. Ability to capture, interpret and analyse agronomic data at an appropriate scale and frequency
3. Ability to adjust input use and farming practices to maximise benefits from each field location.

Cutting-edge technologies such as Global Positioning System (GPS), Geographical Information System (GIS), Remote Sensing (RS), Variable Rate Technology (VRT), on-the-go sensors, grid sampling, and yield monitors are used to fulfill these requirements.

Various configurations of these technologies are suitable for different Precision Agriculture operations. Communication tools like the Internet are valuable for efficient delivery of Precision Agriculture services and products.

Protocols for Precision Agriculture implementation can be narrowed down to three general steps: (i) gathering information about variability, (ii) processing and analysing information to assess the significance of variability, and (iii) implementing change in the management of inputs.

Precision Agriculture is a cyclic process that typically gets smarter every year a farm operator uses it. Taken together, this implies that the three general steps may each require a timeframe ranging from months to years so as to generate a stable and workable structure. But this structure may be refined further to suit a changing environment.

Precision Agriculture and the Farmer

From the farmers' perspective, the most likely objective for adopting Precision Agriculture is to increase economic returns from their land and environment. Farmers' decisions on agronomic practice take into account the associated costs, benefits and risks. Agronomic practices are linked to a wide range of factors such as climate, infrastructure, soil, topography and yield distribution, nutrient requirement, insects, diseases and weeds. These factors typically exhibit spatial and/or temporal variability, and hence necessitate site-specific treatment rather than conventional uniform treatment.

The sources of variation in crop yield have been widely documented, and most of these sources are related to soil variability. Concerns about soil variability can be traced back to the ancient practice of cultivating crops based on soil colour. Soil properties vary substantially as a function of soil type, landscape orientation and previous management history in both intensively managed and undisturbed ecosystems.

However, prevailing technologies in the past prevented the identification and management of soil spatial variability. As such, soil spatial variability was often ignored, justifying uniform treatment of fields with regard to fertiliser and

pesticide inputs. This practice led to over-or under-application of fertilisers, pesticides, seeds and water. It was this oversight that resulted in sub-optimal yields, increased field management cost, energy wastage and above all, environmental pollution.

Environmental hazards imposed by agriculture are largely attributed to the overuse of chemical fertilisers and pesticides. In most crop production systems, fertiliser and pesticide use account for at least 60-70% of the farm operating cost. The inefficiency of crops to harness the benefits from these inputs further complicates the problem. Inputs that have not been utilised by crops may end up as pollutants in the atmosphere and waterways. In most cases, environmental hazards imposed by agriculture are manifested in soil and water quality measurements.

Conventionally, agronomic practices and treatments are usually applied in uniform fashion. For example, a plow is designed to operate at uniform depth and produce uniform results over a wide range of crop and soil conditions. Similarly, a sprayer will apply the same amount of solution containing either fertiliser or pesticide.

Reduction in Soil Degradation and Contamination

A study conducted in two adjacent fields, one employing a uniform treatment rate of nitrogen fertiliser and the other with variable rate treatment, demonstrated that the latter significantly reduced groundwater contamination (Bongiovanni, 2004). In a recent study in China, Guo-Wei *et al.* (2008) showed how site-specific nutrient management increased the adsorption and efficiency of nitrogen, phosphorus and potassium in rice plants. In a related study, Pampolino *et al.* (2007) showed that site-specific nutrient management reduced nitrogen fertiliser use in Vietnam and the Philippines by 14% and 10%, respectively. It also reduced total nitrogen losses from the soil by 25-27%.

The inability to respond to spatial variability in nitrogen uptake and utilisation in uniformly managed field units accounts for a significant proportion of nitrogenous pollutants, such as ammonia (NH_3), nitrous oxide (N_2O) and nitrate (NO_3^-), generated by agriculture and released to the environment (Baily *et al.*, 2001). Elsewhere, Khakural *et al.* (1998) demonstrated that variable rates of herbicide application reduced total herbicide use, and preserved surface and groundwater quality. Chemical inputs, particularly fertiliser and pesticide, when applied using the Precision Agriculture approach could reduce load accumulation and disposition. As a result soil and water contamination is minimised.

Precision Agriculture – the Answer to Preserving Natural Resources?

Stafford (2000) demonstrated that Precision Agriculture provides the means for precise and targeted application of inputs, fine-scale recording of field treatments, tracking of operation to operation and efficient transfer of recorded information with the harvested products. These capabilities could assist with enforcement and legislation of environmental protection. Precision Agriculture has also been shown to generate positive impacts (Kirchmann & Thorvaldsson, 2000) with regard to the following:

1. Soil erosion and salinisation
2. Soil fertility
3. Compaction of subsoils
4. Soil pollution

Essentially, Precision Agriculture gives farm operators the ability to manage variability of crop and soil parameters within a field and in between fields. This ability allows for fertiliser and pesticide application rates to be regulated. By doing so, the undesirable effects of excess chemical loading to the environment or productivity loss due to insufficient input application can be avoided.

Precision Agriculture enables intensive crop production to feed a growing world population within restrictive environmental protection standards. It is this capability of synergising agricultural productivity and environmental protection that makes Precision Agriculture a frontier production technology.

Remotely-sensed view of a crop field, laid out for strip-trial, showing clear spatial variability in crop vigour.

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Source

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Management of Contaminated Land – an Overview

A contaminated site is defined as an area of land in which the soil or underlying groundwater or sediment contains a hazardous waste or substance in an amount or concentration that exceeds accepted environmental quality standards. A site is considered contaminated if it is unsuitable for specific uses of land, water and sediment. The various contaminants present in the soil are therefore the result of pollution from previous land usage. However, some areas may become affected by the movement of groundwater (Figure 1) from neighbouring properties.

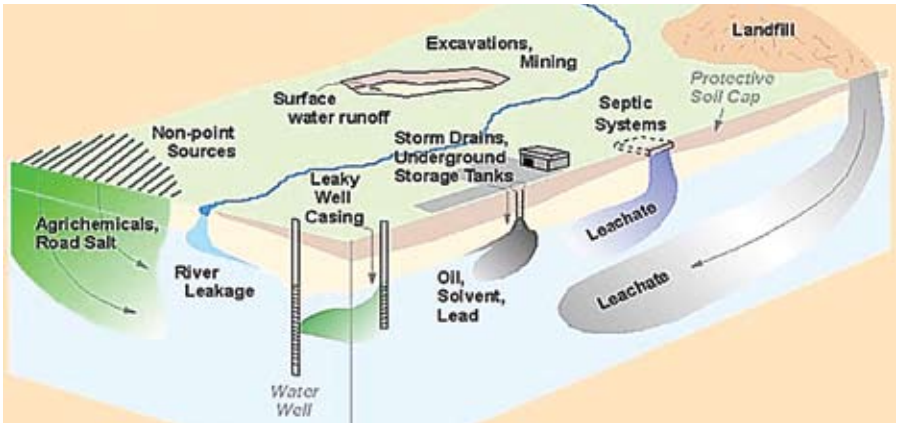

Figure 1: Common sources of contaminants and their movement through soil and groundwater.

Contaminants pose a threat to human health, the environment, and safety. Their potential effects on humans, for example, range from minor physical symptoms to life-threatening diseases such as cancer. Children are often most at risk from exposure to contaminated soil, air, water and food. And even if a site does not pose a threat to people, it can still be an environmental hazard. Soil, water and sediment at a site may contain substances that can injure fish or mammals; impair the reproduction of birds; and accumulate in the food web. These effects can be severe enough to impair, or cause imbalance in, ecological functions or systems.

The common thread that underlies contaminated land is that many sites become contaminated during past industrial or commercial use. Such activities often result in chemicals and other toxic materials being spilled or deposited on land. Some of the common substances found at sites that are considered contaminated are heavy metals such as lead, arsenic, cadmium and mercury as well as organic chemicals, including benzene and toluene in gasoline. These occur at about two-thirds of the sites that have been contaminated.

History of Contaminated Land Management

The management of contaminated land effectively began with the enactment of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on 11 December 1980 as federal law in the United States of America. CERCLA was established to tax chemical and petroleum industries in order to create a fund to remediate future sites of uncontrolled hazardous wastes and is organised through a National Priorities List (NPL) which catalogues contaminated sites across the United States that are in need of further investigation or clean-up.

The enactment of CERCLA was in part due to the Love Canal disaster that is considered one of the most infamous environmental disasters to occur in the United States. In the 1890s, William T. Love began excavating a canal on a 70-acre site. His plan was to develop a canal and harness energy with a hydroelectric power plant. He hoped that the project would encourage development of the area. However, his vision was never fulfilled and Love ended up selling his land to Hooker Chemicals and Plastics. In 1942, Hooker Chemicals and Plastics began using the excavated area as a landfill for chemical wastes. Over a period of 10 years, over 21,000 tonnes of toxic wastes were disposed off at the site. This stockpile of toxins including halogenated organics, pesticides, chlorobenzenes and dioxin covering nearly 16 acres was eventually capped and sold to the Niagara Falls Board of Education (NFBE) in 1953.

The NFBE began development of the Love Canal shortly after the transfer of ownership and approximately 200 houses and an elementary school were built in the area directly adjacent to the chemical landfill. In the 1960s, residents began complaining of strange odours in their neighbourhoods. These complaints escalated in the 1970s when the toxins from the chemical landfill began leaching into the surface and groundwater thereby bringing these toxic substances into basements and backyards in direct contact with the residents of the Love Canal. A number of the leached chemicals were suspected carcinogens. It was later determined that the toxic wastes had contaminated much of the area surrounding the landfill and had also runoff into the sewerage system and ultimately to surrounding creeks and the Niagara River, a source of drinking water for nearly 77,000 people in the vicinity of the area.

The immediate effects of the toxic contamination were obvious with residents suffering from lesions and burns as well as chronic effects such as leukemia and birth defects. After the situation at Love Canal was publicised, action was taken at both the local and national level, including the appropriation of emergency funds to aid the Love Canal residents. The mounting disaster and the need for a concerted and well-coordinated clean-up effort exposed the need for a better way to manage environmental accidents.

On 30 September 2004, over two decades since the identification of the site as an Emergency Declaration Area and the forced evacuation of over 1,000 families, Love Canal was removed from CERCLA's NPL. Although the site was declared safe for human habitation and has since been redeveloped, Love Canal will continue to be monitored on an annual basis.

Assessment Methods for Contaminated Land

A key means of gathering information to determine if a site is contaminated is through what is commonly termed a 'site investigation'. The findings from these site investigations are compared with internationally accepted environmental quality standards as a "measuring stick" against which the presence of contamination by substances in soil, surface water, groundwater, vapour and sediment is determined. An overview of the key processes will determine if a site is contaminated, following which site investigations are conducted to determine the level of contamination and remediation that will be necessary.

A preliminary site investigation involves searching existing records for information about a site, interviewing people who are or have been involved with the site, and determining the general location and degree of any contamination. If more information is needed, then a detailed

site investigation is undertaken. In this case, investigators conduct more detailed work to determine the location, extent, and impact of contamination. The information gathered is usually sufficient to develop a remediation plan, or a human health or environmental risk assessment.

Contaminated Land: The Malaysian Perspective

The treatment and disposal of hazardous waste in Malaysia is currently being handled by Kualiti Alam which started its operations only in 1998. This begs the question on how hazardous waste was managed in Malaysia prior to this and where have all this waste been disposed off previously. While awareness of this issue among the general public remains low, there have been a number of reported cases of illegal dumping of hazardous waste that have been reported in the local media recently. However, for every case that is reported, there is an even larger number that have gone unreported or unnoticed.

This issue is of paramount importance to Malaysia due to the fact that groundwater remains an important source of water supply for domestic use, potable water supply and irrigation. The contamination of the land could result in contamination of the underlying groundwater thereby rendering it unfit for consumption and use which will in turn create long term environmental and health impacts that might not be detected until it is too late.

Currently, hazardous waste is disposed off at a secured landfill managed by Kualiti Alam. The landfill site is approximately 80 acres in size to accommodate 8 secured landfill cells with a total volume of 2.5 million cubic metres. The waste that is accepted at this landfill will have to fulfill strict conditions required under the Landfill Acceptance Criteria imposed by the Department of Environment (DOE) Secured Landfill Licensing Conditions. Currently, only inorganic solid waste that meets all the parameters stated in the Landfill Acceptance Criteria is eligible for direct landfill disposal. Otherwise, the waste will have to be disposed off at either the solidification or incineration plant operated by Kualiti Alam.

Importance of Having Malaysia Specific Regulations

There is no established comprehensive legislative framework for the management of contaminated land in Malaysia. There is also no statutory requirement to report the existence or ownership of contaminated sites and there are also no clean up standards in Malaysia.

Currently, pollution of the soil is addressed to some extent in the Environmental Quality Act (EQA) 1974. Section 21 of the EQA empowers the Minister to specify acceptable conditions for emission, discharge or deposit of environmentally hazardous substances, pollutants or wastes into any area, segment or element of the environment while Section 24 contains provisions for restrictions on pollution of the soil and penalties for contravention of these conditions.

In terms of groundwater contamination, there are several Acts that serve to protect water sources. The most important being the Water Supply Enactment (1955) and the EQA 1974 and its subsidiary regulations.

The Water Supply Enactment (1955) empowers the state water supply authorities to supply water to domestic and commercial consumers. Where supply services have been privatised or incorporated, the Act serves to set up a regulatory body to oversee operations of the supply company and ensure compliance with current drinking water quality standards. However, there is no legal power to enforce compliance or to initiate corrective actions.

The EQA 1974 and its subsidiary regulations empower DOE to take action to control pollution of water sources and the regulations specify limits for the discharge of sewage or other industrial effluents into watercourses. In addition to this legislation, there are other measures to control contamination of water sources which include guidelines and codes of practice for specific industries and environmentally relevant activities.

Having said this, multinational companies operating in Malaysia were known to have performed site assessments and remediation primarily driven by their corporate social responsibility policy. In the absence of Malaysia-specific regulatory requirements and guidelines, all the assessments and remediation are inconsistently being performed in accordance with various international specifications of choice or based on companies' corporate standards.

Given this situation, criteria and standards are being developed to provide guidance for contaminated site management in order to ensure that public health and environmental concerns are ultimately addressed.

Table 1: A summary of the different levels of investigation typically undertaken for the management of contaminated land.

Type of Site Investigation	Level of Detail
Phase I Environmental Site Assessment (ESA)	A phase I ESA is used to gather sufficient information to develop an independent professional opinion about the environmental condition of the property and to identify actual or potential environmental contamination which may impact the property value or effect claim to an "innocent land owner" exemption following acquisition.
Phase II Environmental Site Assessment	A typical phase II ESA involves the collection of original samples of soil, groundwater or building materials to analyse for quantitative values of various contaminants. The most frequent substances tested are petroleum, hydrocarbons, heavy metals, pesticides, solvents, asbestos and mold.
Phase III Environmental Site Assessment	A phase III ESA investigation involves the remediation of a site. Phase III investigations aim to delineate the physical extent of contamination based on recommendations made in Phase II assessments. These investigations may involve intensive testing, sampling, and monitoring, "fate and transport" studies and other modeling, and the design of feasibility studies for remediation and remedial plans. It normally involves assessment of alternative clean up methods, costs and logistics. The associated reportage details the steps taken to perform site clean up and follow-up monitoring for residual contaminants.

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Clinical Waste Management in Malaysia

Clinical waste (CW) or medical waste includes materials that are produced in the course of health protection, medical treatment and scientific research. It forms a separate category, that is, medical or health care waste. The major sources of this type of waste are hospitals, clinics, health centres, diagnostic and research laboratories, autopsy centres, transfusion and haemodialysis centres, nursing homes and mortuaries. It has been well acknowledged that wastes generated in hospitals and health care establishments may be hazardous or offensive and pose a health risk to patients, personnel and the general public and pose a threat to the environment too if not handled and disposed off in a satisfactory manner. Under the requirements of the Environmental Quality (Scheduled Waste) Regulations 2005, it is mandatory to ensure the safe handling, storage, transportation and disposal of pathogenic and clinical waste and quarantined materials generated in the health care system, which are defined as scheduled waste.

Legislation and Policies of Clinical Waste Management

The storage, collection, packaging, labeling, transporting, treatment and disposal of scheduled or hazardous waste including clinical waste is regulated by the Environmental Quality (Scheduled Wastes) Regulations 2005. The DOE in Malaysia is empowered to enforce the Regulations. Provisions of the Regulations include the following:

1 Rendering innocuous the scheduled wastes prior to disposal
2 Reduction in generation of scheduled wastes by best practical means
3 Maintenance of up-to-date inventory of generation, treatment and disposal of scheduled wastes by the generator
4 Storage, treatment and disposal to be confined to prescribed premises licensed by DOE
5 Monitor the transport of scheduled wastes from generator's premises till it reaches approved destination, fulfilling necessary license and consignment note requirements
6 Preparation and submission to DOE an Environmental Impact Assessment (EIA) report for usage of any premises for scheduled waste storage, treatment and disposal activities.

Also, import and export of hazardous wastes are prohibited unless given approval from DOE. Penalty clauses which included heavy fines and imprisonment for offences have been specified in EQA 1974.

The Environmental Quality (Scheduled Wastes) Regulations 2005

In this Regulations, wastes categorisation relating to Clinical Waste are listed in the First Schedule as:

- SW 403; Discarded drugs containing psychotropic substances or containing substances that are toxic, harmful, carcinogenic, mutagenic or teratogenic.
- SW 404; Pathogenic wastes, clinical wastes or quarantined materials.
- SW 405; Waste arising from the preparation and production of pharmaceutical products.
- SW 406; Clinker, slag, and ashes from scheduled waste incinerators.

Classification of Clinical Waste

Clinical waste has been divided into five categories, namely Groups A – E (MOH, 1993). Typical examples of wastes classified under each category are given below:

Group A Waste

1 Soiled surgical dressings, cotton wool, gloves, swabs and all other contaminated waste from treatment areas; plasters and bandaging which have come into contact with blood or wounds; cloth and wiping materials used to clear up body fluids and spills of blood.
2 Material, other than reusable linen, from cases of infectious disease (e.g. human biopsy materials, blood, urine, stools).
3 Pathological waste, including all human tissues (whether infected or not), organs, limbs, body parts, placenta and human foetuses; animal carcases and tissues from laboratories and all related swabs and dressings.

Group B Waste

"Sharps" such as discarded syringes, needles, cartridges, broken glasses, scalpel blades, saws and any other sharp instruments that could cause a cut or puncture.

Group C Waste

Clinical waste arising from laboratories (e.g. pathology, haematology and blood transfusion, microbiology, histology) and post mortem room waste, other than waste included in Group A. For some waste arising from highly infectious or potentially infectious biological material from laboratories and post mortem rooms, disinfection (by autoclaving or equivalent treatment) prior to final disposal is required.

Group D Waste

Pharmaceutical wastes such as expired drugs, vaccines and sera, including expired drugs that have been returned from wards, drugs that have been spilled or contaminated, or are to be discarded because they are no longer required.

Group E Waste

Items used to dispose off urine, faeces and other bodily excretions assessed as not falling into Group A. This includes used disposal bed pans, incontinence pads, stoma bags and urine containers.

It is widely accepted that lower income countries generate less CW than high income countries (WHO estimates 0.5kg/person/year to 12/kg/person/year). The estimate for the UK is 3.5kg/person/year, 2kg/person/year in Greece and Belgium and 6kg/person/year in Spain. The rate of generation of total hospital wastes varies between 1.4 and 2.4 kg per occupied bed per day. Between 65% and 80% of the hospital wastes are general wastes having similar characteristics as municipal wastes. In Malaysia, the rate of generation of clinical wastes is between 0.3 and 0.8 kg per occupied bed per day (Pillay, 2002). The data provided in Table 1 reflect the average amount of clinical waste generated per week from different hospitals according to their waste percentage of individual components over a week.

Table 1: Average clinical waste generated per week.

Components	Composition-Average Weight (%)	Range (%)
Rigid plastic	30	16 - 38
Film plastic	8	4 - 10
Total plastic	38	
Mixed paper	10	2 - 13
Surgery dressing	3	1 - 5
Diapers	18	13 - 21
Absorbents	18	13 - 24
Gloves	13	9 - 17

Source: Detailed EIA for Proposed Upgrading of Clinical Waste Incinerator, Kamunting, Perak, 2007

Clinical Waste Management Services in Malaysia

For more effective and better management of clinical waste and to ensure that activities carried out meet DOE regulations, the clinical waste services of the Ministry of Health (MOH) hospitals and health care facilities throughout Malaysia have been privatised to three concession companies in 1997. Three separate contracts were signed between the Government of Malaysia and the concession companies to provide five support services to about 130 hospitals and institutions throughout Malaysia (Hamidon, 2001) with effect from 1 January 1997. The provision of Clinical Wastes Management Services (CWMS) is one of the five support services, which requires the concession companies to provide collection,

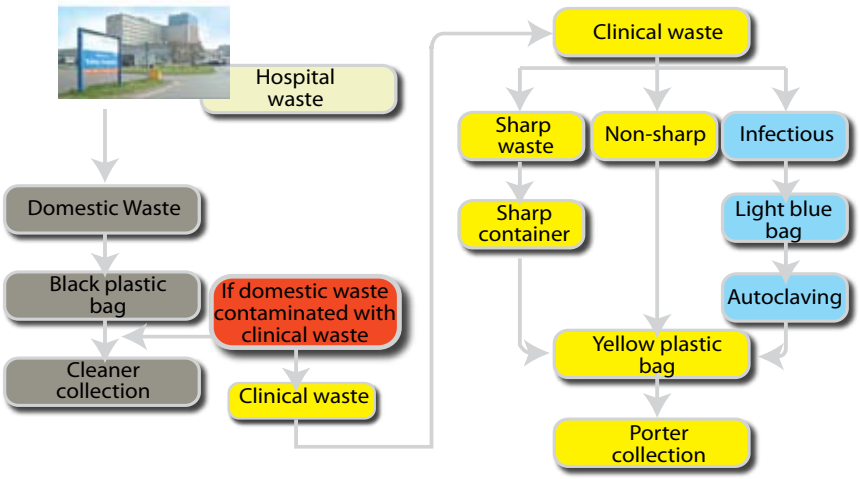

Figure1: Segregation of clinical waste.

storage, transportation, treatment and disposal of clinical wastes (CW) to all contract hospitals and other health care facilities over the concession period. These include healthcare establishments in Malaysia, including government and private hospitals, polyclinics, health centres, medical and health research institutions, diagnostic and research laboratories, blood transfusion services, private practitioners and dental surgeries.

The Contractual Requirements

In performing the CWMS and other contractual obligations, the concession companies are required to adopt as close as possible the agreed procedures, terms of reference and performance indicators in the scope of work. Except for the segregation of waste (Figure 1), which is the responsibility of the hospital staff, all other components of the CWM would be carried out by the concession companies.

Supply of Bags and Containers

The concession companies are required to supply in adequate numbers, various sizes of bags and containers including sharp containers, receptacles and containers for on-site storage to all establishments at the source of generation or locations as specified by the Director of each contract hospital. They are also required to provide suitable containers at a central storage facility in each contract hospital. These containers are to be used to transport CW from the establishment to the designated incinerator.

Collection of CW

CW in yellow bags are to be collected by the concession companies daily or more frequently as directed by the Director of each contract hospital for sources with high generation rate, from the on-site storage to central store. No bags or sharp containers are to be collected unless properly identified and secured to prevent spillage. Collection of CW is to be carried out following an agreed time schedule and via designated routes and using suitable collection devices for such purposes.

Storage and Transportation of CW

The central storage for CW in each contract hospital is to be at a secured facility. If the collected waste is to be stored for more than 24 hours, refrigerated storage at 4˚C to 6˚C shall be provided. It means the central storage facilities together with all related equipment have to be provided. For cases where a regional incinerator is used, the concession companies are responsible for the transportation of CW from each facility to the dedicated CW incinerator.

Treatment and Disposal of CW

The concession companies are required to supply, install, commission, operate and maintain CW incinerators for the treatment and disposal of CW with the capacity to meet the needs of the MOH for the entire contract period and also the related legislations.

Clinical Waste Generation Trend Rate

During the course of operations, the CW received at the incineration plant for disposal is generally from two major sources namely, from public/ government hospitals and clinics and from private/ non-government hospitals and clinics. The public and private hospitals and clinics are basically located in the central region (covering Federal Territory and Selangor) and East Coast (covering Kelantan, Terengganu and Pahang). According to the survey of medical waste management in Malaysia, conducted by the Ministry of Health Malaysia, the clinical waste generated for the whole of Malaysia was 3,030 tonnes in the year 1997 and this increased to 4,320 tonnes in the year 2000, based on which a 12.6% annual growth rate (exponential growth) can be calculated.

It is expected that there will be an increase in clinical waste received due to an increase in such health establishments and the increase in numbers of those who are likely to seek medical treatment. The clinical waste generated for the central and eastern region of Peninsular Malaysia was 1,220 tonnes in the year 1997 and this increased to 3,057 tonnes in the year 2006 (Figure 2). This can be translated into an average growth rate of 10.8% per annum. From a projection for the years 2007 to 2015 based on a 10% per annum growth rate, it is estimated that by year 2010, the total CW load will reach 4,475 tonnes, and eventually increase to 7,208 tonnes in year 2015 (Figure 3).

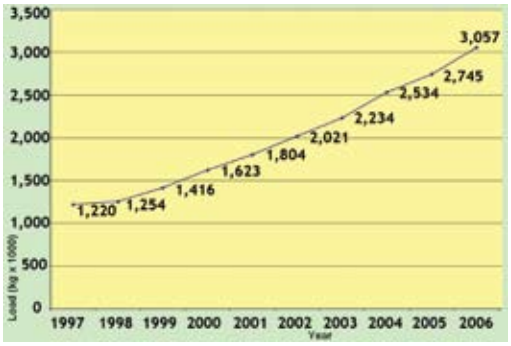

Figure 2: Generation rate for clinical waste.

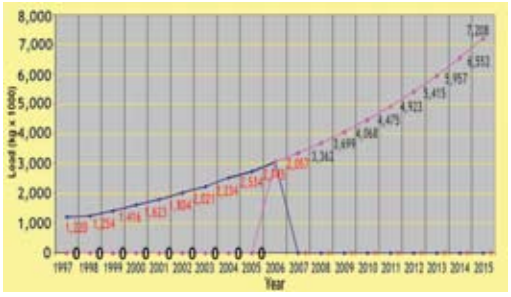

Figure 3: Projected generation rate for clinical waste load.

Conclusion

In conclusion, with the current clinical waste growth rate, an expansion of existing plants or an additional plant is necessary and urgently required to meet the projected demand of wastes in the concession area of the central and eastern region perhaps at least for the next 10 years. If this critical issue is not addressed, it could result in serious environmental and health implications and also contradict the government's efforts to ensure a safe, healthy and sustainable environment.

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Produced Water from Oil and Gas Fields:
Environmental Impacts and Treatment Technologies

The significance of oil and natural gas in modern civilisation is well known. Oil and gas production processes generate a large volume of wastewater. Oil and gas field wastewater or produced water is the largest waste stream generated in oil and gas industries. It is a mixture of different organic and inorganic compounds. Due to increasing volume of the waste, the effect of produced water has recently emerged as a significant environmental concern.

Origin of Produced Water

Naturally occurring rocks, in subsurface formation are generally permeated with different underground fluids such as oil, gas and saline water. There are three sources of saline water:

- Flow from above or below the hydrocarbon zone.
- Flow from within the hydrocarbon zone.
- Flow from injected fluids and additives resulting from production activities.

This water is called 'connote water' or 'formation water' and becomes produced water when a hydrocarbon mixture of saline water comes to the surface (Veil *et al.*, 2004).

Global Onshore and Offshore Produced Water

Produced water production globally is estimated at around 250 million barrels per day compared with around 80 million barrels per day of oil. As a result, the water to oil ratio is around 3:1. Produced water is driven up by the maturing of old fields but driven down by better management methods and introduction of new oil fields (Dal Ferro & Smith, 2007). About 95% of the water can be reinjected after pretreatment for enhanced oil recovery. On the other hand, in gas fields water injection is not applied. Figure 1 gives an estimate of onshore and offshore produced water production since 1990, forecasted to 2015.

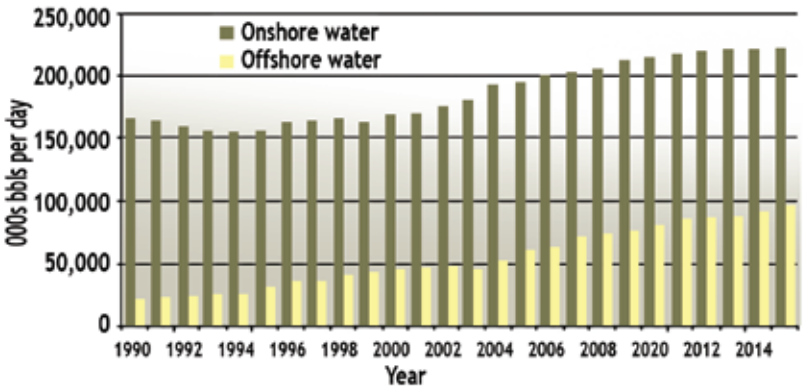

Figure 1: Global onshore and offshore water production (adapted from Dal Ferro & Smith, 2007).

Characteristics of Produced Water

Produced water is a mixture of different hydrocarbons and inorganic salts. Factors such as geological location of field, the geological formation, life time of reservoir and type of hydrocarbon product being produced affect physical and chemical properties of the produced water. The major compounds of produced water include dissolved and dispersed oil compounds, dissolved formation minerals, chemical compounds, production solids (including formation solids, corrosion and scale products, bacteria, waxes and asphaltenes) and dissolved gases (Hansen & Davies, 1994).

The volume of produced water from gas fields is less than from oilfields. A wide range of gas treatment chemicals are used in gas fields including methanol, ethylene glycol and triethylene glycol. About one-third of these chemicals are discharged in produced water (Neff, 2002). Volatile component concentrations in produced water from gas fields are higher than produced water from oilfields (Utvik, 2003). In gas fields, water injection is not applied; therefore the produced waters are mixture of formation water and condensed water.

Impact of Produced Water Discharge

Produced water from oil and gas industries is often permitted to be discharged into the environment. Impact of discharging produced water into the sea is generally characterised by the water's toxicity and organic loading (Hansen & Davies, 1994). Environmental effects of produced water components include:

1. Produced water salts are a major contributor of toxicity (Neff, 2002).
2. Non-polar organics are consistently toxic in different sources of produced water. At low-salinity concentration of produced water, hydrogen sulphide and hydrocarbons are major toxic compounds to freshwater animals (Neff, 2002).
3. Some production chemicals can increase partitioning of oil compounds into aqueous phase at high concentrations. Treatment chemicals can precipitate and accumulate in marine sediments.
4. The concentration of heavy metals in produced water is often higher than in sea water (Stephenson, 1992).

Produced Water Management

Produced water is considered an oilfield waste. Whether waste or commodity, produced water management has cost. For managing produced water, a three-tiered pollution prevention hierarchy is followed (Veil *et al.*, 2007):

1. Employing technologies to minimise produced water production
2. Reuse and recycling
3. If neither of those tiers are practical, disposal is the final option.

Physical Treatment

Usual physical methods for treating produced water are (i) cyclone, (ii) oil /water separator, (iii) adsorption, and (iv) evaporation. De-oiling hydrocyclone systems are used widely for removing suspended oil droplets from produced water. But this method does not meet the required overboard discharge water quality specifications. Suspended particles in raw produced water plug media and decrease removal efficiency. On the other hand, in some sites, produced water is evaporated to reduce its volume and the vapour is used to increase oil recovery. This system eliminates physical-chemical treatment but running cost is high.

Chemical Treatment

Coagulation and flocculation, chemical oxidation and demulsification are used to treat produced water. Lime softening, inorganic mixed metal (Fe, Mg, Al) polynuclear polymer and ferric ions are used as chemicals to remove suspended solids from produced water. Chemicals can be used to remove suspended and colloidal particles, but are not effective for removing dissolved constituents. Disadvantages of the chemical process are generation of sludge and increasing concentration of metals in the effluent. Chemical oxidation is the usual method for decomposing refractory chemicals in wastewater using a strong oxidant, catalyst and irradiation (except for ozone treatment). In addition to low removal efficiency of chemical oxidation, high running cost is a disadvantage of this method. Demulsifiers are surface-active agents that are effective in disrupting the effect of natural emulsifiers present

in the oil. In most crude oil, solids such as iron sulphides, silts, clay, drilling mud, paraffin, etc. complicate the demulsification process.

Biological Treatment

In biological treatment, microorganisms digest suspended and dissolved pollutants. This method is cost effective and environmental friendly. In aerobic treatment, activated sludge, trickling filter, Sequencing Batch Reactor (SBR), Chemostate reactor, Biological Aerated Filter (BAF) and lagoon systems are used. Because of high salt concentration of produced water, the usual microorganisms in activated sludge systems cannot survive. To improve biological treatment effluent, membranes can be coupled to it as a membrane bioreactor.

Membrane Treatment

Physical, membrane-based separation has emerged as the promising technology for the 21st century. Membranes are thin films of synthetic organic or inorganic materials which separate a fluid and its components selectively. Membrane separation processes such as microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) can be used to remove different sized materials. MF is used for separation of suspended particles, UF for the separation of macromolecules, NF for separation of multivalent ions and RO can separate univalent ions (Madaeni, 1999). UF is one of the most effective methods for oil wastewater treatment especially for produced water in comparison with the traditional separation methods because of high oil removal efficiency, non use of chemical additives, low energy costs and small space occupancy.

Fouling is adsorption or accumulation of certain components of produced water on the membrane surface or in the membrane pore, eventually causing flux decline. Fouling is a fundamental limitation to economic viability of membrane treatment in produced water treatment.

Combined Systems

In combined systems, different physical, chemical and biological methods are used as pretreatment of membrane units. In a pilot study to reuse oilfield produced water for irrigation and potable water, a series of processes were proposed as shown in Figure 2. The warm softening process removed 95% hardness (with initial hardness of 1000 mg/l) and 95% of total dissolved solids (TDS) was removed by RO (Funston *et al.*, 2002).

The optimal treatment of highly saline wastewater should involve a biological treatment of wastewater with acclimated microorganisms a saline environment prior to membrane treatment especially reverse osmosis.

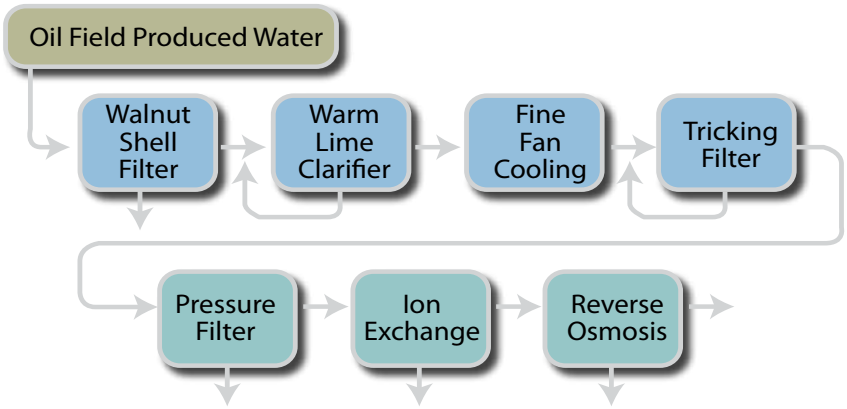

Figure 2: Pilot plant schematic (Adapted from Funston *et al.*, 2002).

Produced Water Treatment Costs

Jackson & Myer (2003) provided cost estimates for produced water disposal methods. Disposal costs are dependent on the volume and chemistry of produced water and also size and location of the operation. Table 1 shows produced water disposal methods and costs.

Future Developments

Produced water is the most significant waste stream for oil and gas producer countries. Today, using cost effective and efficient treatment technology for treating produced water to reduce contaminants for discharge and/or reuse is a major challenge for oil and gas companies. For treating produced water, a suitable strategy depends on source of produced water and concentration of pollutants and the final requirements for discharge; recycle or reuse. Even by combining physico-chemical and biological treatments, all hazardous pollutants cannot be removed. Newly developed technologies such as membranes can help to polish final effluents to meet most of the requirements. In offshore facilities cost effective and highly efficient demulsifiers, effective physical oil/water separators and highly efficient adsorbers with effective regeneration process are favourable techniques. In onshore production sites, where enough space is provided, using highly efficient halophile oil degrading microorganisms in biological treatment is a cheap, effective and environmental friendly method. Also, using cheap and efficient immobilisation materials in biological treatment for increasing biological treatment efficiency is recommended for future research.

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Table 1: Produced water disposal methods and costs (adapted from Jackson& Myer, 2003).

Method	Estimated Cost ($/bbl)	Limitation	Benefits
Surface Discharge	0.01-0.08	Energy costs	Livestock, wildlife, irrigation
Secondary Recovery	0.05-1.25	Infrastructure	Increases production
Shallow Reinjection	0.10-1.33	Energy and maintenance	Recharges aquifer
Evaporation Pits	0.01-0.80	Sequestering from wildlife	Livestock impoundment
Commercial Water Hauling	0.01-5.50	Distance	-
Disposal Wells	0.05-2.65	-	-
Freeze-Thaw Evaporation	2.65-5.00	Regional Climate	Water/salt separation
Evaporation Pits	1.00-1.75	-	-
Constructed Wetland	0.001-2.00	Land Area	Livestock, wildlife habitat, communities, education
Induced Air Flotation for De-oiling	0.05	CAPEX	
Anoxic/Aerobic Granular Activated Carbon	0.083	CAPEX	

CAPEX: Capital expenses

Source
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Nuclear Power – Are We Ready?

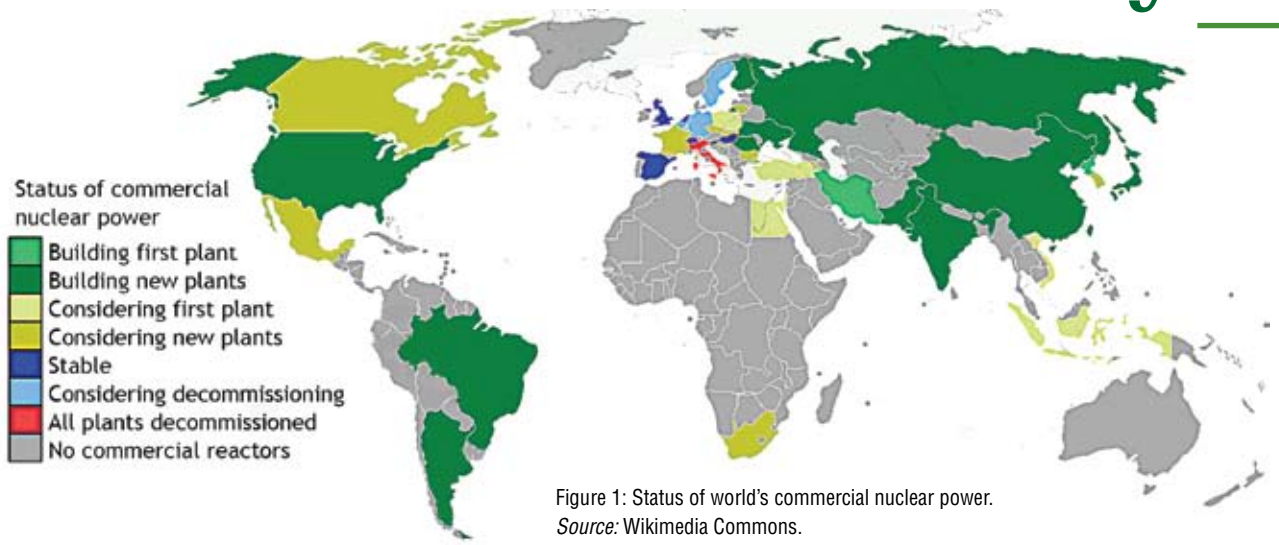

Figure 1: Status of world's commercial nuclear power.
Source: Wikimedia Commons.

MOST of us will remember how nuclear power has always been associated with bandits in our favourite cartoon series. So powerful is that technology that they tend to use it as a threat to conquer the whole world.

In real life, the devastating effects of nuclear technology have been recorded in history when Japanese cities Hiroshima and Nagasaki were atom-bombed during World War II.

As dangerous as it is, however, this powerful technology has been the most sought-after solution for energy security in many countries, particularly those in Europe.

According to the International Atomic Energy Agency, the top 10 countries with the highest nuclear share of total electricity generation are all located in the European region. France, for instance, generates 76% of its electricity from nuclear.

The idea of having a nuclear power plant in Malaysia sounds great, isn't it? The advantages of nuclear-generated electricity have been much touted.

The nuclear plant can generate a stable flow of electricity to users at low prices (rates are presumably cheaper than power generated from other sources such as coal and gas) and it does not emit carbon dioxide into the atmosphere.

It also seems to be the answer to our concerns over the depletion of fossil fuel, which is currently the main source of electricity generation in Malaysia, and the volatile prices of raw materials such as coal and crude oil.

Presently, the major components of Malaysia's electricity generation mix are natural gas (60%), coal (24%), hydro (8%) and biomass (4.2%).

Malaysia's nuclear ambition became apparent when Tenaga Nasional Bhd (TNB) announced that it would sign an agreement with Korea Electric Power Corp next month to engage the latter's assistance in conducting a preliminary study for developing a nuclear power plant in Malaysia.

TNB's view is that nuclear-generated electricity is the most viable long-term option to address the growing demand for power in the country. Hence, its plan for the country's first nuclear power plant to begin operations in 2025.

The head of TNB's nuclear unit Mohd Zamzam Jaafar was quoted as saying that the state-owned utility company is currently scouting for suitable sites for the nuclear plant.

The question is ... do we really need to pursue nuclear energy?

There are many implications of having a nuclear power plant in the country. Of utmost concern is the safety issue, and whether we have the technological capability to deal with any unforeseen incidences that could arise from nuclear energy development.

Former Prime Minister Tun Dr Mahathir Mohamad, in his blog, raised his concerns about the danger of pursuing nuclear energy and urged the authorities to give this option a second thought, citing we do not know enough about nuclear energy to be able to manage it well.

Risky pursuit

Like any other technology, nuclear power has its own risks and rewards, says Ravi Krishnaswamy, director of energy and power systems practice at Frost & Sullivan Asia-Pacific in Singapore.

In his e-mail to *StarBizWeek*, Ravi says he believes that the safety features of nuclear power plants have increased multi-fold over the last several decades, especially after some major nuclear power plants accidents such as the Three Miles Island in the US in the late 1970s and Chernobyl in Ukraine in 1986.

Photo 1: The Watts Bar Nuclear Plant in Spring City, Tennessee, United States.
Source: Associated Press.

Photo 2: Where will all the waste from a nuclear power plant go?
Source: Greenpeace, Netherlands.

He cites the examples of countries in high seismic zones such as Japan and Taiwan that have successfully operated nuclear power plants for several years without major incidents.

To date, the nuclear share of total electricity generation in Japan and Taiwan is 25% and 20%, respectively.

However, Ravi points out some of the shortcomings that Malaysia faces in the pursuit of nuclear energy option.

These include the lack of trained human resources and capability in handling the technology, the risk of mishandling and theft of radioactive nuclear material, the problems associated with radioactive waste disposal and the health hazards that could arise from exposure to radioactive nuclear material such as cancer and birth defects.

When it comes to nuclear energy, it takes just one accident to leave an adverse effect that could last for multiple generations, says an officer at the Centre for Environment, Technology and Development Malaysia (Cetdem).

Citing the case of the Chernobyl disaster, he says there are still ongoing health effects from the incident to this day.

He also points out that the severe release of radioactivity not only affected people living in Ukraine, but also those living in other countries in Europe as the radioactive dust clouds were blown to the region.

Radioactive particles can be easily carried by water and wind. So, even if the nuclear power plant is located offshore, the radioactive effects can still reach people living on the mainland, and neighbouring countries, the officer at Cetdem says.

At what cost?

According to Frost & Sullivan's Ravi, the viability of nuclear power cannot be seen only in the context of capital expenditure or potential dangers.

He explains that the viability of the initiative is normally evaluated in relation to the country's energy mix, domestic resources availability, electricity demand growth, fluctuations in supply and cost of other fuels, and whether the country's economic and industrial growth can justify the creation of an elaborate nuclear power infrastructure.

Meanwhile, the officer at Cetdem says there are huge hidden costs involved in the development of nuclear power plants. These include costs of decommissioning, storage of spent fuel and handling of radioactive leakages, as well as the environmental cost.

"Vast amounts of resources will have to be diverted towards the maintenance of nuclear power plants, and such costs could be expensive," he says.

In terms of human resources, he believes there is a need to train a generation of nuclear scientists who know enough about dealing with nuclear waste and accidents.

Photo 3: Yongwang Nuclear Power Complex, South Korea.
Source: The Schiller Institute

However, while most of the factors seem to support the development of a nuclear power plant in Malaysia in the long term, the Government still has to consider whether a nuclear initiative is justified in terms of the economies of scale, Ravi says.

> "Countries like India and China have huge populations and limited domestic energy resources, hence could easily justify the development of an expensive and elaborate infrastructure for nuclear power ... and not just nuclear power generation plants, but also fuel and spent fuel processing, fuel mining and heavy water plants, among others," he explains.

These countries, he adds, could potentially obtain at least a quarter of their electricity generation from nuclear and still have sufficient demand to build and replace nuclear reactors every 10 years. Not so for Malaysia. So, in terms of economies of scale, Ravi thinks having a nuclear power plant does not work in favour of the country. The nuclear share of total electricity generation in India and China at present is 3% and 2%, respectively.

He argues that nuclear is not a sustainable energy, as the sector requires the mining of uranium, which is a very polluting industry.

He adds that if there is a rush by countries to build nuclear energy, it could result in a sudden increase in demand for uranium, and hence the spike in the price of the commodity.

The debate on whether Malaysia should pursue its nuclear ambition is likely going to continue. But pundits say there are other renewable energy sources such as solar PV, biomass, wind and hydro systems that Malaysia could harness. And these, instead of attracting criticisms, will draw much support from many quarters.

Photo 4: The commemoration of Chernobyl disaster.
Source: www.foeeurope.org

Source
Reproduced with permission from *The Star,* 30 May 2009

Combating Climate Change:

The World Ocean Conference 2009 & Coral Triangle Initiative Summit

Oceans play major roles in determining the world's climate system. Unfortunately, the climate change phenomenon facing the earth has threatened marine lives and the livelihood of the people. Recently, the Inter-Governmental Panel on Climate Change (IPCC) has also raised the alarm by warning governments around the world to be prepared for the impacts and threats of the increase in temperature and rising sea levels. To make the situation worse, there are also detrimental impacts from human activities on the marine and coastal environments around the world. For instance, overfishing and in a manner that causes destruction to the ecosystems, pollution both from land-based and sea-based sources, as well as coastal degradation have seriously impacted the balance of the marine ecosystems.

In addition to this, the legal framework that constitutes and governs the use of the sea, the Convention on the Law of the Sea (UNCLOS) 1982, which is now 27 years old, also does not address the ways in which governments manage maritime affairs related to the impacts of global climate change on the oceans, or the role of the oceans in the phenomena of global climate change. Obviously, the climate system and the pressure on the world's oceans have dramatically changed since then. All these definitely warrant countries to respond to the effects of climate change and to reduce the stresses on the oceans and their natural resources.

Taking all these into account, Indonesia hosted the World Ocean Conference (WOC) 2009 along with the Coral Triangle Summit (CTI) in Manado, North Sulawesi from 11-15 May 2009. Overall, the conference encompassed three significant events, which included:

1. Ministerial/High Level Meeting on Climate Change and Marine Resources;
2. Coral Triangle Initiative Meeting and Summit; and
3. The International Symposium on Ocean Science, Technology and Policy.

Ocean experts, ministers, high-level government officials, as well as the head of multilateral and non-governmental organisations attended the various programmes during the WOC 2009. Overall goals of the conference were to:

1. Increase the understanding of participants regarding:
   - climate change and its implications on the social and economic welfare of coastal communities and on the ecology of marine and coastal zones;
   - the role of the oceans in the behaviour of global climate change phenomena; and
   - the need for measures to mitigate against, or adapt to, the impacts of climate changes.
2. To forge a strong commitment from the global community to improve marine and coastal resource management as a key component of the response to climate change.

Issues Highlighted and Discussed

Throughout the WOC 2009, the clarion 'Through Ocean, We Save the Earth' was seen on billboards, buntings, and also advertised on buses moving all over the city of Manado. The plea very much reflected the Indonesian government's serious efforts towards safe-guarding the oceans and the natural resources.

Social and Economic Livelihoods of Coastal People

To further elaborate, the impacts of climate change on the social and economic livelihoods of coastal people were much discussed at the conference. Some of the more notable impacts, as highlighted by renowned speakers included changes in the migration routes of fish, coral bleaching which would further affect the productivity of valuable fisheries resources, risks to human health, increasing risk to sea-going vessels and interruptions of marine transportation; to name a few. On the other hand, some of the major impacts of climate change on the condition of marine and coastal ecosystems would include the threat from sea level rise on coastal areas/habitats, ocean acidification, ocean warming, increase in frequency and severity of tropical storms and extreme sea conditions, as well as changes in rainfall patterns.

Role of Oceans in Regulating Climate Change

The oceans also play a definite role in regulating climate change. For instance, mangrove ecosystems are one of the main coastal habitats important for shoreline protection, besides also reducing the threat of coastal erosion, and contributing towards the absorption of carbon dioxide emissions. In addition, marine phytoplanktons and seagrasses further assist in absorbing greenhouse gases through carbon sequestration and carbon sink. It is also important to acknowledge that the immense volume of seawater is also a link in the hydrological cycle which regulates the availability of freshwater as a basis of all human life.

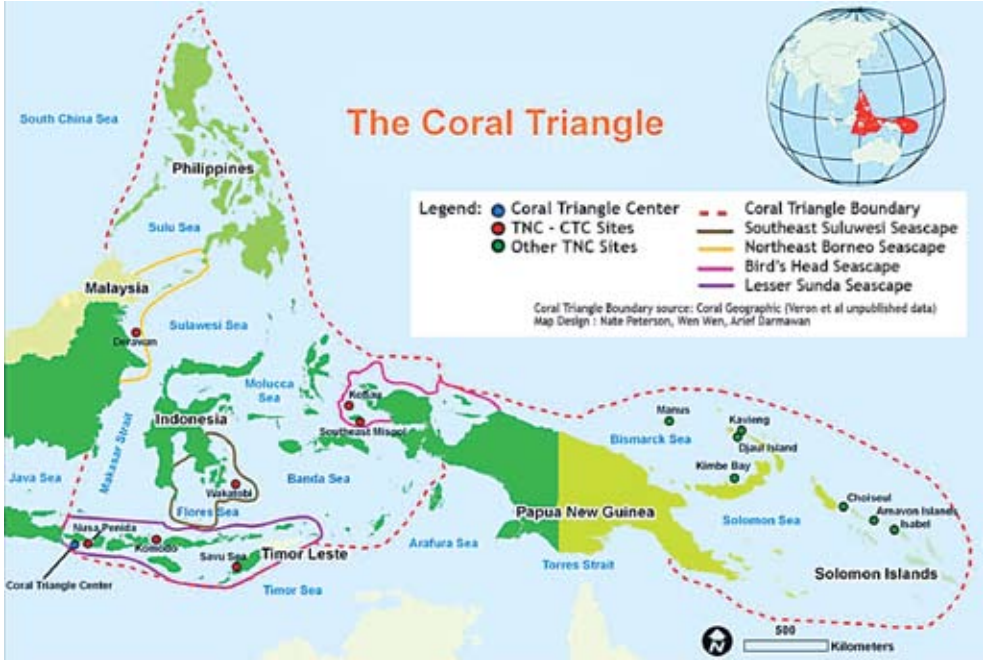

Figure 1: Map showing the Coral Triangle area.
Source: The Nature Conservancy. Retrieved 14 March 2009 from http://www.coraltrianglecenter.org/

Adaptation and Mitigation Measures

Discussing about adaptation and mitigation measures necessary to address the climate change phenomena, several speakers highlighted that an approach based on scientific knowledge and reliable data is essential, when deciding on measures to anticipate and plan. Detailed analyses and studies to understand climate change trends, and to predict the weather conditions are also essential. Mitigation efforts are crucial to reduce the number of victims and the extent of losses due to climate change. To some extent, the development of marine protected areas and the implementation of integrated coastal management could contribute towards reducing some of the harmful threats of human activities on the coastal and marine environment in order to built resilience of the ecosystems involved towards climate change. On the other hand, for adaptation measures, to be successful, communities need to be empowered to face the threats of climate change, and ensure food security. One good approach would be through the development of alternative livelihood sources for the coastal communities. For example, this could be done through the development of sustainable ecotourism activities, and good aquaculture practices by the coastal communities.

In order to form strategic alliances on regional and international cooperation to address the matter, the exchange of data and information, capacity building, technology transfer, research and sustainable funding are necessary. In line with this, strategies to meet the Millennium Development Goals (MDGs) are also a crucial element.

Coral Tringle Initiative Summit (CTI)

An area covering almost 5.7 million square kilometre (Figure 1), the Coral Triangle, is indeed the global centre of marine biodiversity with more than 600 coral species and 3,000 fish species. This area is also home to some 76 % of the world's coral species and 50% of the world's reef fish species. The livelihood of more than 120 million people directly depend on the riches of the sea in this region. Nevertheless, this is also the most critically threatened area, mainly from climate change, overfishing, illegal and harmful fishing activities, unsustainable coastal development and pollution.

Historically, the Coral Triangle Initiative (CTI) was first proposed at the Asia-Pacific Economic Cooperation meeting in Australia in 2007, before being endorsed at the UN Climate Change Conference in Bali in December 2007. Then on 15 May 2009, six countries participated in the CTI Meeting in Manado (Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands and East Timor) to confirm their commitment to the initiative (Photo 1). Following that, major progress made at this meeting included the adoption of a Leaders' Declaration and the CTI Action Plan especially focusing on coral reefs, fisheries, and food security aspects. This will ensure cooperation of the countries involved in implementing the strategy in sea conservation, sustainable marine resource management, protection of endangered species, as well as adapting to climate change phenomena in the next few years. As far as Malaysia is concerned, the Prime Minister had announced a contribution of USD 1 million to the CTI projects during the Summit; thus proving the country's serious conservation efforts in marine biodiversity in line with the Convention on Biological Diversity (CBD) that we are a party to.

Photo 1: Respective ministers representing the six countries at the CTI Summit in Manado.
Source: Coral Triangle Initiative Summit - Secretariat. Retrieved from http://www.cti-secretariat.net/

The Way Forward: Targets and Achievement

Essentially, the WOC 2009 was mainly targeted at increasing (i) cooperation between nations to manage marine resources in the context of climate change; (ii) understanding across the global community regarding the vital role of the oceans in regulating climate change; (iii) global attention to the need to save small islands and coastal areas as part of facing up to global climate change; (iv) commitment from international bodies and inter-governmental organisations to protect and conserve fisheries resources to ensure food security; (v) preparedness to mitigate disasters caused by climate change; and (vi) capacity for the coastal communities to adapt to the effects of climate change.

One of the major outcomes of the WOC 2009 is the formal adoption of the Manado Ocean Declaration (MOD). The MOD is a commitment made by nations to address the impacts of climate change on the coastal and marine environment. The recommendations mainly contain ways in which the declaration can be translated into action, in the form of opportunities for international cooperation in areas such as research, exchange of data, capacity building, transfer of knowledge and technology, substantial financial support and others. Further, the conference was also able to put oceans in the centre stage in world attention and raise awareness of the importance of oceans in climate change. Therefore, it is hoped that the WOC Declaration will strengthen the UN Framework Convention on Climate Change (UNFCCC), and will serve to elevate the importance of oceans at its 15th Conference of the Parties (COP15) in Copenhagen this December. The declaration should be further used to bring solutions to UNFCCC COP15 and more funding for countries to act, rather than just as a platform for articulating statements that merely identify the problems.

Conclusion

The seas and oceans are faced with threats both from natural sources and harmful human activities. Some of these impacts could cause irreversible damage to the ecosystems and resources, which would eventually impact the coastal communities and all of us. Currently, climate change is one of the more obvious scenarios that need to be addressed accordingly. However, it is unfortunate that knowledge about the oceans is still limited and most developing countries in the region depend on the potential to exploit sustainably the marine resources. As such, enhancing the knowledge of ecosystems, ocean dynamics, as well as coastal processes is essential for managing the seas in a more prudent way. In addition, results from scientific studies should be provided to policy makers to pursue options which will benefit the environment. In line with this, the message delivered at the WOC 2009 is daunting and clear – that we have to react together responsibly to save the seas before it is too late.

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Event Highlights

Department of Environment, Malaysia

June 2009

Launching of *Rakan Alam Sekitar* (RAS) and Prize Giving of *Sekolah Lestari*-Environmental Award 2007/2008

The launching of *Rakan Alam Sekitar* (RAS) and Prize Giving of *Sekolah Lestari* - Environmental Award 2007/2008 was held on 4 June 2009 at Dewan Jubli Intan Sultan Ibrahim, Muar, Johor. Both events were jointly held in conjunction with the World Environment Day 2009, which was themed, "Your Planet Needs You! UNite To Combat Climate Change."

RAS, a new programme by the Ministry of Natural Resources and Environment, was launched by YAB Tan Sri Muhyiddin Mohd Yassin, Deputy Prime Minister and Minister of Education. Local community leaders including Members of Parliament throughout Malaysia participated in this programme with the aim of getting involved in environment conservation and protection activities in their respective areas. During the ceremony, the logo and RAS membership card were also launched by the Deputy Prime Minister. About a 1,000 people from different sectors, including schoolchildren from around Muar district participated in this event.

A total of 72 secondary and primary schools participated in the Prize Giving of *Sekolah Lestari* - Environmental Award 2007/2008 which saw cash prizes, awards and certificates being presented by the Deputy Prime Minister. The winners of the *Sekolah Lestari* - Environmental Award 2007/2008 were SMK (P) Methodist Pulau Pinang, Pulau Pinang and SK Bakri Batu 5 from Muar, Johor for the secondary and primary school categories respectively. Both schools received a plaque, certificate of commendation and prize money of RM10,000.00. Also present at the event were YAB Dato' Haji Abdul Ghani Othman, Menteri Besar of Johor, YB Datuk Douglas Uggah Embas, Minister of Natural Resources and Environment and YB Tan Sri Joseph Kurup, Deputy Minister of Natural Resources and Environment.

July 2009

19th Inter-University Environmental Debate

Organised by the Department of Environment (DOE) in collaboration with the Malaysian Universities Debate Council (MADUM), Dewan Bahasa dan Pustaka (DBP) and Ministry of Higher Education, the 19th Inter-University Environmental Debate saw participation from 22 teams from 22 institutions of higher learning in Malaysia. Universiti Teknologi PETRONAS (UTP) in Tronoh, Perak hosted the event from 24-28 July 2009. The two teams that made it to the finals of the 2009 Debate held at Dewan Canselor of Universiti Teknologi PETRONAS were Universiti Putra Malaysia (UPM) and Multimedia University (MMU). UPM emerged the overall winner of the 2009 Debate, receiving the Minister of Natural Resources and Environment Challenge Trophy, a cash prize of RM 8,000.00 and a certificate of participation. Amirrudin Abdul Rahman of UPM emerged as the Best Debater and received the Director General of Environment Trophy, together with a cash prize of RM 1,500.00. YB Tan Sri Joseph Kurup, the Deputy Minister of the Ministry of Natural Resources and Environment gave away the prizes. It is the Department's hope that this yearly important event will see increased participation from universities and institutions.

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