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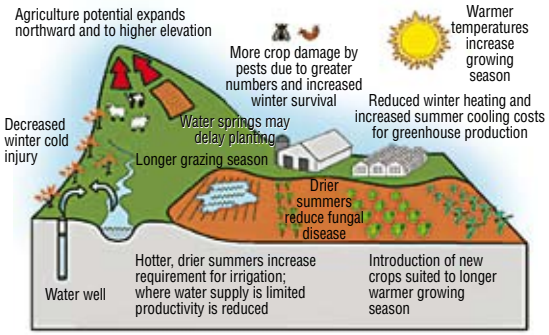
Role of Research, Innovation and Technology in Environment

Transforming towards Greener Agriculture: Are we there?

Agricultural production impacts climate change and in turn, is impacted by it. Current estimates indicate that the agricultural sector worldwide accounts for about 14% of the annual global Greenhouse Gas (GHG) emissions. With dramatic increases in global food demand, this figure could increase by up to 40% in 2030 (IPCC, 2007).



Impacts of climate change on agriculture

On one hand, developing countries contribute nearly half of the total GHG emissions. A business-as-usual approach towards agriculture will push these emissions further up because demand for more food, fuel and timber will force developing countries to convert forests to crop land, thus releasing more carbon dioxide and methane into the atmosphere.

On the other hand, climate change is steadily depressing crop yields, pushing food prices up and endangering food security. A study by the International Food Policy Research Institute (IFPRI) concludes that prices of agricultural commodities such as wheat, rice, maize and soybean will rise between 121 and 194% by 2050 due to limitations imposed by climate change. The rise in price, coupled with declining productivity of these crops (a 30% drop in wheat yield and 15% in rice), will threaten the food security of some 1.6 billion people in South Asia, the region likely to be hit the most, and render some 25 million more children malnourished, world-wide. It is estimated that an additional annual investment of USD 1.5 billion in agriculture and rural development will be needed to offset such an impact in South Asia and USD 7 billion on a global scale (IFPRI, 2009).

Changing the Game Plan

Numerous policy and scientific reports indicate that if better technologies and management practices are evolved and put into use, the agricultural sector can offer a huge potential to reduce GHG load in a cost-effective manner (World Bank, 2008; Parry *et al.*, 2004). As such, there is no controversy in developing agriculture to obtain higher yields and profitability for the farmer without affecting the environment. This approach in fact, is sustainable agriculture.

Sustainability has been given due consideration because in Asian countries intensive land use is accompanied by problems such as unplanned exploitation of natural soil and water resources. The skyrocketing costs of energy and agricultural inputs have reduced profitability, while severely damaging the environment. Data shows that agricultural acreage is being increased by 13% in the last 30 years at the expense of lowland forests and their rich biodiversity. With virtually no reserves of land with crop-production potential, the Asian Development Bank's estimate shows that land use per person will fall from 0.17 hectares in 1990 to 0.12 hectares in 2010.

This necessitates proper assessment of the constraints and potentials of natural resources by examining the policies of respective governments, and appropriateness of agricultural production technologies. The ideal technology should be efficient, practical, cost effective and pollution-free. Importantly, the sustainability factor should override all facets of technology development and implementation.

Green Technologies for Agriculture

The need for new agricultural production strategies that are built around the concept of green technologies has never been more critical. Failure to put such strategies in place will cause developing countries to suffer increased food insecurity. For the 1.5 billion people in the developing world whose livelihoods are dependent on agriculture, even a small loss in agricultural productivity could disastrously mushroom into a significant loss of income.

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From the desk of the Director General

Role of Research, Innovation and Technology in Environment

The environmental challenges facing us may tempt many to contemplate withdrawing from this technologically-inspired way of life and return to living a simple existence amidst pristine nature. The sad truth is that we cannot. Much of the pristine nature has been used up and too little of it is left for us to realise that dream. Besides it is indicative of running away from the problems we have created for ourselves. Rather, we must come to terms with this paradoxical conclusion: the driving forces of science, technology and innovation have got us into this environmental fix and it is these very same driving forces that must be harnessed to get us out of it. We must succeed in putting together Science and Technology, the Environment and Social Responsibility in new and innovative ways. And this will allow us to develop products and a lifestyle that leads to sustainable development whilst safeguarding the environment for future generations.

In this issue of IMPAK, there is a focus on innovations and developments around the world that will help us green our technology and our lives. Perhaps even create green-collared jobs! A central green theme that emerges from the articles is featured here.

Firstly, it is an imperative and only proper to evaluate and agree what humankind collectively wishes the world to be. The last two decades have seen much debate on this journey of environmental realisation. Copenhagen, just ahead, is another milestone on this arduous consensus-seeking journey. Next, we must consider how much of the existing social and technological fabric of modern living is to be retained and how much to be discarded. Then finally, we are obliged to look for the most effective and equitable means of accomplishing the necessary transformation. Of course, we are not advocating that humankind return to the time when we led 'short and brutish' lives subject to the vagaries of nature. Science and Technology must still take centre stage in 'greening' our world.

For instance, in consumer electronics, energy and transportation sectors, there is a fierce push to eco-innovate. Environmental-friendly products and eco-label programmes are helping consumers make lifestyle choices that can help us reduce our ecological footprint. Mobile phones, cars and motor fuels are more visible choices slowly coming on stream. Twenty years ago, we would be hard pressed to imagine a biofuel derived from algae powering our cars. Or that electricity would substantially be generated from wind power. Or that the plastic shopping bag if not biodegradable, is socially not the 'in' thing. And innovations in waste management are now turning household waste into clean energy. The duration of composting has been shortened and revolutionalised agricultural waste composting procedures. In Port Talbot, UK, the world's largest anaerobic digestion plant is being built to turn wood waste into biogas and eventually produce 350 MW of electricity. This amount of electricity is sufficient to supply 500,000 households. Governments, including ours, are funding R & D on innovative waste management technologies including the treatment of ballast water used in ships which is deemed the second greatest threat to marine biodiversity. There is also a need to efficiently manage water use through innovative technologies as it is now deemed to be a precious resource. It will no doubt shock many of us to know that water lost in the water supply production industry (called Non-Revenue Water NRW) is as high as 37% in our country. Given these levels of water loss, application of technology and innovation to the water industry should surely help reduce water losses.

In the agricultural sector, the application of green technologies are our last hope to manage the complex interaction of nations, people, policies, politics and nature. The twin challenges of climate change and food security carry the seeds of future conflict and strife. On the bright side numerous policies and scientific reports indicate that if better technologies and management practices are put to use, the agricultural sector can substantially reduce GHG loads in a cost effective manner. Both yield and profitability can be improved, irregardless of climate change, if such technologies are adopted. These range from Plant Gene Technology (PGT), ICT Pest Control, Rainfall Management, Crop Technology, Biomass Technology and Precision Farming Technology. In short technology and innovation can make agriculture sustainable for both the small and the large scale commercial farms.

Necessity has been the mother of invention and innovation through the ages. At this critical juncture, environmentally speaking, the need for such innovation is pressing indeed. We cannot postpone the use and application of these technologies here in Malaysia and throughout the world any longer. To put it dramatically, it has to be now!

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Green agricultural technology revolves (ADB, 2009; Dar, 2009; Rosenzweig and Parry, 1994) around the following:

1 Plant Gene Technology (PGT) - Although controversial, a well designed application can increase crop production in an environmentally-benign manner. The scope of PGT encompasses gene isolation strategies, *in vitro* culture systems, improvement of biotic and abiotic stress tolerance of crop plants, development of safe transgenic plants, and plant-based biotechnologies to support human health.

2 Information and Communication Technology (ICT) - ICT-based market information systems have been shown to improve rural agricultural productivity in middle income developing countries. These systems are, however, generally limited in scale and have not been effectively replicated beyond the local level. Relatively few schemes exist in smaller countries that lack the economies of scale. Furthermore, while internet-based market information systems work well in more developed, literate markets, media such as mobile phones or community radio could be appropriate alternatives in least developed countries.

3 Pest Control Technology - Climate change could exert positive, negative or no impact on each pest. Pests are usually controlled by cultural practices, natural enemies, host plant resistance, biopesticides and synthetic pesticides. More often than not, these control tactics are highly sensitive to the environment and climate change may render them less effective. Climate change may also alter the interactions between pests and their host plants, directly affecting resistance to pest control. For example, there are indications that stem rot (*Sclerotium rolfsii*) resistance in groundnut is temperature dependent, while in Kenya resistance to sorghum midge (*Stenodiplosis sorghicola*) breaks down under high humidity and moderate temperatures.

4 Rainwater Harvesting and Storage Technology - While rainfall predictions remain uncertain, it is generally accepted that climate change will reduce water availability and storage, and warmer temperatures will increase the demand for water by crops. Improving crop production in many regions largely depends on better capture and storage of rainwater. As almost 95% of water in developing countries is used to irrigate farmlands, policies to improve irrigation efficiency are also critical. Research is needed on water flows and water quality, and infrastructure needs to be improved.

5 Land and Crop Management Technology - Economically viable technologies that can reduce crop failure risks, improve soil fertility and increase productivity under variable climatic conditions are highly desirable. These include methods to reduce agricultural inputs, such as fertiliser micro-dosing and smarter application of pesticides, as well as technologies for minimising soil disturbance such as reduced tillage, conservation agriculture and crop rotation. Revising planting dates, plant densities and crop sequences can help cope with delayed rainy seasons, longer dry spells and earlier plant maturity that are already being observed across parts of Africa.

6 Crop Technology - Changes in growing seasons in the tropics can be mitigated by using crop varieties that are adaptable to a wide range of climatic conditions. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has developed pearl millet hybrids that can cope with temperatures of 40°C and deliver normal yields with limited water. They have also developed short duration varieties of chickpea and pigeon pea, which mature in 65–75 days and so can escape terminal drought. There is a need to better understand the physiological mechanisms in crops that control heat tolerance in order to develop 'climate-proof' crops.

7 Biomass Technology - Effective and cost-effective conversion of biomass into energy and material of high quality is desirable. Comparatively, biomass burning is cleaner (less emissions) than that of fossil fuels. In addition, biomass is a renewable resource and can be produced domestically. The other benefits of biomass include waste reduction, reduced use of landfills, improved watershed quality, and creation (and retention) of jobs in a rural economy.

8 Precision Farming Technology - The use of computers and cutting-edge technologies such as Global Positioning Satellites (GPS), Geographical Information System (GIS), Remote Sensing (RS), Variable Rate Application (VRA) and Artificial Intelligence (AI) to strategically adjust farm input application is fast gaining credence. Such adjustment is based on information about spatial and/or temporal variability occurring with regard to crop, soil or environmental quality. Such an approach has the potential to significantly reduce the use of fertilisers, pesticides and other amendments that can cause chemical pollution.

The Malaysian Scenario

In Malaysia, several agricultural practices to mitigate climate change are already in place. Oil palm, Malaysia major industrial crop, which occupies about 4 million hectares of land, can effectively sequester large amounts of carbon dioxide (a GHG) from the environment. In oil palm cultivation, it is standard operating procedure to establish leguminous cover crops (also known as green manure) at the start of the cropping cycle. These cover crops effectively control soil erosion, which is very rampant due to high rainfall. Additionally, zero burning which is a widely accepted means of land clearing in oil palm significantly reduces carbon dioxide emission.

There is also an increasing commitment to venture into crops that can be processed into biomass energy. One such crop is *Jatropha curcas*, a perennial shrub which can be grown under marginal soil conditions. *Jatropha curcas* is an advantageous energy crop because its oil is non-edible. Nevertheless, much effort is required to improve its agronomic operations (e.g. mechanised harvesting instead of manual harvesting), and increased oil extraction efficiency.

Conclusion

Climate change will have dramatic consequences for agriculture. However, substantial uncertainty remains about where the effects will be greatest. The impact on low-input agriculture is likely to be minimal as other factors will continue to be the overriding constraints on crop growth and yield. Adopting green agricultural technologies will substantially increase agricultural productivity, regardless of climate change. But adopting better 'temperature-adapted' crop varieties could completely mitigate the climate change effects that result from global warming.

Agricultural outcomes are determined by complex interactions among people, policies and nature. In order to meet the twin challenges of food security and climate change, the world must find ways to grow more food and do so by using greener agricultural technologies.

References

ADB. 2009. The Economics of Climate Change in Southeast Asia: A Regional Review. Mandaluyong City, Philippines: Asian Development Bank.

Dar, W.D. 2009. Agriculture can adapt to climate change. *Science and Development Network.* http://www.scidev.net/. Accessed on Nov 29, 2009.

IFPRI. 2009. Climate Change: Impact on Agriculture and Costs of Adaptation. Policy Report. Washington D.C.: International Food Policy Research Institute.

IPCC. 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press.

Parry, M. L., C. Rosenzweig, A. Iglesias, M. Livermore& G. Fischer. 2004. Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Global Environmental Change* 14(1): 53–67.

Rosenzweig, C. & M. L. Parry. 1994. Potential impact of climate change on world food supply. *Nature* 367: 133- 138.

World Bank. 2008. Agriculture for Development. World Development Report 2008. Washington, D.C.: The World Bank.

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The Electrical Car: Solution to Energy Shortage and Air Pollution?

Internal combustion engine vehicles are responsible for the vast majority of pollutants that plague urban areas today. Studies on the sources of air pollution have shown that transportation accounts for the bulk of nitrogen oxide (54%) and carbon monoxide (89%) emissions in the United States (Gateway Japan, 1994). Furthermore, internal combustion engines are also believed to be one of the largest single sources of carbon dioxide (28%) emissions (Gateway Japan, 1994) that lead to a greenhouse effect in the atmosphere. Internal combustion engine vehicles also generate other types of pollution, including sulfur oxides and hydrocarbons but in small amounts. The introduction of clean vehicles, like electrically-driven vehicles, would be an interesting move in the direction of a significant reduction in harmful exhaust gases, with a view to a sustainable transport policy (Van Mierlo & Maggetto, 2003).

Pollution from Power Plants

Replacing automobiles having internal combustion engines with vehicles having electric motors is seen by some as one solution to urban smog and tropospheric ozone. Electric vehicles produce little or no pollution directly. The amount of pollution created by electric vehicles depends mostly on the source of the electricity used to charge them. A good example of this scenario is in California, which derives only about 20% of its electricity from so-called dirty sources like coal and oil (California Energy Commission, 1995). The primary sources of electricity in California are natural gas-burning power plants and hydroelectric generators; both are clean sources of energy. A study by the Natural Resources Defense Council and Environmental Defense Fund indicates that the replacement of all internal combustion engine vehicles with electric vehicles in the Los Angeles Basin (LA Basin) may cause reductions of between 37% and 99% in all categories of transportation-related pollutants except for sulfur oxides (Chapman *et al.*, 1994). The study also noted that most of the pollutants caused by the electric vehicles came from the small component of electricity generated by coal-fired power plants. These observations highlight the potential cleanliness of electric vehicles when charged with a clean power source.

A comparison of the pollutants emitted by internal combustion engine vehicles and electric vehicles charged by various energy sources

is presented in Table 1. Notice that carbon monoxide and hydrocarbon emissions are negligible when using electric vehicles, but the emission of sulfur oxides increases. Also note the increasing emissions of carbon dioxide, nitrogen oxides, and sulfur oxides that occur when using greater proportions of coal and oil-derived electricity.

While studies of the pollution-reducing ability of electric vehicles in California are quite favourable, they cannot be applied to the rest of the world as a whole. The truth is that when using electricity generated from dirty sources such as coal and oil, electric vehicles may actually create more pollutants than comparable internal combustion engine vehicles. A report by the US General Accounting Office (GAO) cited a German study that estimated the environmental impact of electric vehicles with two distinct energy mixes: one comprising only 49% coal-fired electricity, and one comprising only coal-fired electricity (Gateway Japan, 1994). The estimates provided by the study are given in Table 1. Assuming that 49% of an electric vehicle's charging energy is derived from coal, the study found that electric vehicles would cause comparable levels of nitrogen oxides and carbon dioxide to be emitted, and that sulfur oxide emissions would increase by a factor of 10. Furthermore, when assuming that an electric vehicle is charged with 100% coal-fired electricity, the study estimated that the electric vehicles would emit 150% more carbon dioxide, 250% more nitrogen oxides, and 2400% more sulfur oxides than a comparable internal combustion engine vehicle (Gateway Japan, 1994).

While these coal-fired electric vehicles will emit more pollutants, they still will emit less carbon monoxide and hydrocarbons than a comparable internal combustion engine vehicle. The GAO report noted that mandatory pollution controls at power plants ensure that electric vehicles will always produce less carbon monoxide and hydrocarbons than internal combustion engine vehicles, regardless of the source of the electricity. The German study offers some insights into how electric vehicles would perform in the United States. Their value of 49% represents the portion of German electricity generation that is based on coal, and is close to that of the United States, which, as a whole, derives 55% of its electricity from coal and oil (US Energy Information Administration, 2008).

Not all pollutants related to electric vehicles arise from the generation of electricity. Any discussion of the environmental impact of electric vehicles must also take into consideration the problems associated with the manufacturing and disposal of their battery packs. The typical electric vehicle contains no less than half a tonne of batteries (often of the lead-acid variety) that need to be replaced every 20-25 thousand miles (Gateway Japan, 1994).

The prevailing opinion is that the batteries will not pose much of an environmental problem because of their large weight and high cost. The rationale is that since electric vehicle battery packs weigh several hundred pounds and cost several thousand dollars,

Table1: Estimates of the pollution emitted by electric vehicles relative to modern internal combustion engine vehicles.

Region Studied	LA Basin	Germany	Ideal	Internal Combustion
Amount of Electricity from Coal or Oil	21%	49%	100%	(for comparison)
Carbon Monoxide	0.007	0	0	1
Carbon Dioxide	0.34	1	2.5	1
Hydrocarbons	0.01	0	0	1
Nitrogen Oxides	0.27	1	3.3	1
Sulfur Oxides	1.72	10	25.0	1

they will most likely be replaced by certified repair centres, which will return them to the manufacturer for recycling. Unlike regular car batteries, it will not be economical to simply throw away electric vehicle battery packs when they can no longer hold a charge. The batteries will most likely be refilled, and the original contents recycled, just as motor oil is today.

Enhanced Control of Pollution at the Sources

While electric vehicles may not always hold an outright advantage in terms of pollution reduction, they allow for more control over the pollution that is generated. Because electric vehicles emit little or no pollution directly, their use would shift the source of emissions from the individual vehicle to the electric power plants, allowing more precise measurements of the amount of pollutants emitted. Using this information, regulators could conceivably rotate the operation cycles of power plants to keep local emissions in line with air quality regulations. Since the electricity used to power electric vehicles could come from all over the region, pollutants could be redistributed away from crowded urban areas where they are potentially more dangerous.

The use of electric vehicles would further decrease auto emissions over time because only about 10,500 power plants will have to be monitored, maintained, and upgraded as opposed to the over 100 million private automobiles (US Energy Information Administration, 2008). Despite the vast amounts of money spent each year in the US to maintain the emissions systems of gas-powered automobiles, cars generally emit more pollution as they age. Deterioration of the catalytic converter and other critical emissions control components eventually lead to an increase in emissions from older cars. Electric vehicles would not suffer from this problem because electric power plants receive more maintenance at regular intervals than would be afforded to a private automobile. In fact, the US Government already maintains a strict testing schedule of once a month for electric power plants, making sure that they comply with emissions standards. Another advantage of this centralised approach is that any new pollution reduction technology can be universally applied to every electric vehicle by simply upgrading the power plants.

As can be seen, so many trade-offs in local versus global pollution are involved that it is impossible to say with certainty that electric vehicles provide the best short-term solution to transportation related pollution. Government officials in Germany have concluded that, for the time being, catalyst-equipped internal combustion engine vehicles would reduce pollution more than electric vehicles (Gateway Japan, 1994). They came to this conclusion because most of Germany's overflow electricity generation is coal-based, that is to say, as electricity demand increases, the percentage coming from coal-fired power plants will increase.

Electric vehicles are much simpler to explain. A rechargeable battery provides power to electric motors. When the charge is low, the battery must be recharged from an external source. This means that the carbon cost of driving this type of vehicle depends entirely on the local electricity generation sources, regardless of whether it is nuclear, fossil fuel, wind generation or hydro etc. Another consideration when choosing this type of transport is range. At present, these cars have a very limited capability, restricted by the capacity, size and weight of the cells available. While battery technology is advancing at a great pace, it is still not possible to mass-produce an affordable small car with much better than a 50 or 60 mile capability before it requires 6 to 8 hours charge.

Aptera 2e three-wheel electric car, has stated that they expect to sell 100,000 electric cars in five years.

Conclusion

At present, for the vast majority of the countries, neither electric vehicles nor comparable gasoline-powered vehicles hold a solid advantage over the other in cleanliness. This balance will probably not be changed any time in the near future as the problem with electric vehicles is not inherent to them, but rather to the means by which we generate our electricity. Although electric vehicles offer some compelling advantages over internal combustion engine vehicles in terms of pollution management, the real advantage of electric vehicles lies in the future when more electricity is produced from cleaner sources.

References

California Energy Commission. 1995. California Historical Energy Statistics. *http://www.energy.ca.gov/* [Assessed on 1 March 2009]

Chapman, F. C. Calwell & D. Fisher. 1994. What's the Charge? Estimating the Emissions Benefits of Electric Vehicles in Southern California. Calstart Resources. *http://www.calstart.org/reference/papers/emission.html*

Gateway Japan. 1994. Electric Vehicles: Likely Consequences of U.S. and Other Nations' Programs and Policies. *http://www.gwjapan.org/ftp/pub/policy/gao/1994/95-7.txt*

US Energy Information Administration. 2008. Annual Energy Review 2007. US Energy Information Administration. *http://www.eia.doe.gov/emeu/aer/contents.html*

Van Mierlo, J. & G. Maggetto. 2003. Comparison of the environmental damage caused by vehicles with different alternative fuels and drive trains in a Brussels context. *Proceedings of the Institution of Mechanical Engineers, Part D, J. Automob. Eng., I MECH E, SAE and IEE 217* (D7)

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Moving Towards Eco-Innovative Approaches and Products

Increasing concerns about the detrimental effects of human activities on environmental health has led to the birth of the eco-innovation concept, which is indeed timely. Industry players have stepped up product R&D with ideas that embrace environmental-friendly technologies and socially-acceptable innovative paths towards sustainability. These range from product design and development to the use of resources during the production and manufacturing processes. In simple terms, it marries Science and Technology, Environment and Social Responsibility in a sense that products are developed and used with the aim of achieving sustainable development that accords greater protection to the environment.

Eco-Innovation Efforts

The European Union (EU) has been actively promoting and supporting this concept to its business community by creating an eco-innovation funding scheme with a fund size of nearly €200 million for the duration of 2008 to 2013. The scheme encourages industry players to come out with innovative products, services and technologies that can make better use of natural resources and reduce Europe's ecological footprint.

There are various eco-innovation projects and initiatives going on around the world, more noticeably in the United States, Europe and East Asia (Japan and South Korea) particularly in the consumer electronics, energy and transportation sectors. The "Eco Label" programme complements these initiatives by encouraging business players to market environmental-friendly products and help consumers to easily identify eco-friendly products in the market.

European Union Eco-Label

Eco-Friendly Mobile Phones

Mobile phones have been an essential part of our life since the mid-1990s. According to the International Telecommunications Union (ITU) and Gartner figures, mobile phone subscriptions have surpassed 4 billion, with an estimated 1.22 billion mobile phone units sold worldwide in 2008. Such an enormous figure clearly points to the need for innovative ideas to ensure mobile phones eventually give minimal environmental impact once their useful life is reached.

Some interesting product developments are already taking place such as the introduction of carbon-free phones, green and solar phones. The carbon-free phone by a US manufacturer and name *Renew,* features 100% recyclable casing made from recycled water bottles. This innovative product has been certified by *Carbonfund.org's CarbonFree®* Product Certification as the first carbon neutral phone in the world. This means, the manufacturer invests in renewable energy sources and reforestation elsewhere as an initiative to offset the carbon dioxide they could not reduce and the carbon footprint they could not neutralise, arising from manufacturing, distributing and operating the phone.

The *Renew* Model

Another eco-friendly phone, the *Blue Earth*, introduced by a Korean manufacturer also has casing made from recycled water bottles. The phone unit is manufactured free from harmful substances such as beryllium, phthalates or Brominated Flame Retardants. In terms of energy, it has a solar panel on its rear casing for charging and powering the phone, virtually eliminating the need for a charger.

The *Blue Earth* Model

The *Reclaim* Model

This manufacturer has also come up with another green phone named *Reclaim* built using corn-based bio-plastic which makes up 40% of the phone's casing. The bio-plastic material, a substitute made from fermented plant starch is known as Polylactic acid (PLA). This material itself is 100% biodegradable as it comes from renewable, carbon-absorbing plants. The fact that it is known to be 'carbon neutral', means that it is helping to reduce emissions of greenhouse gases. That in itself is a major incentive for owning it. Besides, PLA also does not emit toxic fumes when incinerated.

Moving further with the eco-friendly tag, the phones are fitted into a smaller product box of which the packaging material is totally made of post-consumer recycled material and printed using soy-based ink.

Currently, not only phones but the chargers could end up becoming electronic waste, creating other problems for the environment. With so many different brands of phones, even a household of 4 persons could end up having 4~5 units of different types of chargers, as the phone manufacturers usually sell by bundling phones with a customised charger. In this sense, the EU has taken a significant step towards reducing waste by convincing mobile phone producers to harmonise chargers. This move was announced in June 2009 and will benefit consumers in terms of lower prices, as this reusability will mean customers can opt to remove a chunk of the unnecessary cost paid for a new phone package.

Environmental-friendly Biofuel and Biodiesel

Our dependence on fossil fuel in the form of petrol and diesel to power our vehicles began with the invention of the first car. With growing consumer concerns in relation to greenhouse gas emissions (CO_x and NO_x) on the environment arising from fuel combustion and the realisation that fossil fuel will be depleted in years to come, the search for alternative types of fuel such as biofuel and biodiesel is inevitable and increasingly important.

Biofuels are processed from living biological material or from metabolic by-products (organic or food waste products), and are commonly used to power vehicles, heat homes and for cooking in Europe and the United States. In order to be considered a biofuel, the fuel must contain over 80 percent renewable materials. Two common strategies of producing biofuels are to grow crops high in sugar or starch, and crops that contain high amounts of vegetable oil. This will have a two-pronged benefit, as these plants can either contribute to the production of biofuel or manufacturing of bio-plastic material.

Meanwhile, biodiesel, a renewable energy resource is made from vegetable oil or animal

fat, and it can be used to power vehicles without modifications of the engine. In Thailand's Nakorn Sawan area, biodiesel fuel manufactured from used or recycled cooking oil obtained from restaurants and households is widely used in the agriculture and transportation sector. Locally, plantation conglomerate Sime Darby Plantation, in 2005 embarked into producing and commercialising palm oil-based biodiesel to meet the demand for cleaner and environmental-friendly fuel. The biodiesel fuel is a blend of 5% processed palm oil and 95% petroleum diesel.

Oil palm seeds

A new generation of biofuel derived from algae is being researched and funded by big oil companies such as Exxon Mobil, Chevron and Royal Dutch Shell respectively. The research paper on algae biofuel has been presented at the 237th National Meeting of the American Chemical Society. Research collaboration between Exxon Mobil and Synthetic Genomics found that algae have the most potential in terms of economies of scale, both in produce yield and infrastructure utilisation. Algae appear to be a suitable candidate because they can produce more fuel per acre and have far superior yield than palm, sugar cane, corn or soybeans. They also have the advantage of easily fitting into the vast infrastructure of refineries and distribution channels that already exist for fossil fuel.

Algae can grow practically anywhere; in sea-water, salty water, adulterated water or even in sewage. They can feed on sewage and carbon dioxide, and grow in many places, including deserts, ponds and oceans. Algae produce oil as a byproduct of photosynthesis. One environmental benefit of algae over other biofuel sources such as palm oil, or sugar cane and corn is they do not have to be grown and cultivated in places that can otherwise be used for food production; moreover, they alleviate the need to clear-off forested areas that could endanger species habitat. In other words, the 'food vs. fuel' debate does not arise in the case of algae cultivation.

Algaeus, hybrid car powered by algae fuel

Algae fuel has been successfully tested on hybrid cars, and the first algae fuel-powered vehicle in the world was officially launched in San Francisco in 2009. The car, called *Algaeus* is a modified Toyota Prius, which derives power from eco-friendly crude oil that has a blend of 5% algae fuel. The car recorded 150 miles per gallon (equivalent to 60 km per litre) in its promotional cross-country tour and is claimed to be street-ready and environmentally friendly.

Another renewable fuel source that is rapidly gaining prominence is bioethanol; its usage lies mainly as an alternative fuel to fossil fuel. Bioethanol produces 70% less greenhouse gas emissions than fossil fuel during combustion with oxygen by forming carbon dioxide, water and aldehydes. It can be manufactured and processed from commonly known crops such as sugar cane, potato and corn, as well as many types of cellulose waste and harvest by-products.

Bioethanol is used in vehicles in the form of a fuel blend with fossil fuel in the range of 20–25% (E20–E25), or a pure form of 100% (E100). The fuel has been successfully implemented in Brazil, involving production from sugar cane and achieving a conversion to fuel usage of nearly 90%. No doubt with such distinction, Brazil is also considered to have the world's first sustainable biofuels economy.

Bioethanol pump station in Brazil

On the local front, UNIMAS has successfully researched and will soon commercialise sago palm-based bioethanol in 2010. The Science, Technology and Innovation Ministry will be pumping RM11.6 million of funding from its Techno Fund to the plant, and the next project in the pipeline is to produce biodiesel from sago wastewater. In another development, a joint venture among three Malaysian companies, will be venturing into bioethanol processing and production in Sabah with a target production capacity of 100,000 tonnes per year.

Greenhouse Gas Emission and Transportation

Electricity harnessed from wind mill or wind turbine is also seen as an attractive alternative to fossil fuel in power generation. Power from wind source is clean, plentiful, renewable, widely distributed and produces no greenhouse gas emissions when it converts wind energy into mechanical energy during the power generation process. When the electricity is utilised to drive the public transportation system, such as rapid transit or metro, trams and electric bus, the benefit is enormous as it reduces the number of individual cars on the road and contributes to a cleaner air quality.

Canadian city, Calgary is acknowledged as having a head start in environmental friendly transportation, having embarked on project collaboration with electricity companies to develop a programme that supports wind-generated electricity way back in 2001. The city's light rail transit system, CTrain was one of the pioneers to use electricity generated from 12 windmills located in Southern Alberta. The new system produces zero-emission as compared to the original system, whereby the power to run the trains was generated from coal and natural gas, thus contributing to greenhouse gases emission. The transition to use wind-generated power has recorded an estimated reduction of CO_2 emissions by 26,000 tonnes annually.

Windmills for electricity generation in Norway

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Role of Technology and Innovation in Waste Management

The Wadeville pyrolysis plant
Source: Engineering News (2008)

From the days of primitive society, humans have used the earth's resources for living and subsequently generating waste, very much like what we do today. In early times, disposal of wastes did not pose a significant problem because the population was small and the amount of land available for assimilation of wastes was large. Various methods have been used traditionally to dispose waste generated: burying, burning or even dumping into the river or sea. Increasing urbanisation and better lifestyles also saw increased expectations for proper waste management. This resulted in better approaches to waste management such as landfilling, controlled burning and degradation avoidance.

Increasing Complexity of Waste

Nevertheless, modernisation, technological developments and urbanisation have led to increasingly more complex waste generation. For example, new inventions of electronic and electrical appliances result in new categories of waste, previously unknown. For example, the evolution from dealing with floppy diskettes about a decade ago to dealing with compact disks (CD) today and probably having to deal with millions of thumb drives in the near future. This is a clear indication that the development in product complexity has also caused waste management technologies to evolve in parallel with peoples' requirements and expectations of a better lifestyle. As a result, more innovative and creative ways of waste management technologies were developed such as incinerators, sanitary landfills with gas extraction, anaerobic digestion for gas recovery etc.

Innovation in technology development for waste management plays an important role in ensuring effective management of waste, not only in terms of proper disposal, but also from the perspectives of waste handling, recovery of useful materials and protection of the overall environment and human health in long run.

Innovative Waste Management Strategies

1. Waste-to-Energy (WTE)

Waste contains high energy value if a proper method is applied to extract the energy for use, either directly as electricity, or indirectly by producing solid fuel such as carbon or refuse derived fuel (RDF). The WTE process is more common where waste is combusted in an incinerator to generate steam or electricity. This safe and environmentally-sound technology is very useful particularly in dealing with large volumes of waste. Modern incinerators are strictly designed to meet all regulatory environmental discharge standards. WTE through incineration of waste has played an important role in waste management all around the world not only by minimising the amount of waste being disposed off to the landfills but also providing energy.

The world's largest WTE plant, situated in Wadeville, South Africa, utilises a specialised autoclaving technology combined with pyrolysis. The waste is reduced to cellulous fibre and converted into clean gas. About 1MW of electrical energy can be generated from 1 million tonnes of waste by using the facility. On the other hand, the world's first restaurant on a waste incinerator chimney was built in the Peitou incinerator in Taiwan. In fact, many incinerators in Japan are located less than 500 metres from the nearest residential area or community. All these further prove that the incineration technology has been developed maturely where emission from incinerators can be minimised and made harmless.

Besides direct conversion of waste into steam or energy, there are also other WTE technologies which convert waste into solid fuel, which allows storage and transportation such as RDF and carbon. The pyrolysis process in particular, is an innovative technology that is able to carbonise organic wastes into carbon, which has very high calorific value for use as fuel. There is currently a WTE carbonisation pilot plant in Dengkil, Malaysia that converts 20 tonnes of palm oil empty fruit bunches (EFB) into useful carbon everyday, with a high calorific value of more than 6,000 kcal/kg.

Peitou incinerator in Taiwan with a restaurant on the chimney

2. Composting the New Way

Composting is one of the oldest technologies available to turn organic waste into useful composts for agricultural purpose. Conventional composting methods such as vermin composting, bin composting or windrow composting require a long time and large space for the decomposition process of organic waste. However, with improvements

Carbonisation of EFB into useful carbon

Carbonisation pilot plant in Dengkil

An example of an anaerobic digester in UK

in technology especially the application of biotechnology, the composting duration is now much shorter, from several months conventionally to even within 24 hours.

In-vessel composting technology in particular is one of the new innovative methods that utilises effective microorganisms to make composts within a short period, converting organic wastes into useful fertilisers, soil conditioners or even animal feed depending on the type of waste processed. A large scale in-vessel composting facility in the city of Hamilton, Ontario is currently processing about 66,000 tonnes of waste yearly. A similar technology is currently in use at 30 different facilities in Europe.

In Malaysia, in-vessel composting facility is also being used but on a small scale mostly by waste generators such as factories, hotels, markets or food courts. The practise of composting at source reduces the amount of waste that needs to be disposed off to the disposal sites, which will subsequently prolong the lifespan of the disposal sites as well as generally reduce environmental impacts.

3. Aerobic / Anaerobic Digestion

Organic wastes can be degraded under an aerobic condition in the presence of oxygen or in an anaerobic condition without the presence of oxygen. Anaerobic degradation of waste under a controlled condition produces biogas, which is a source of energy for generating electricity or heat.

Anaerobic digesters are widely used in the UK, Germany and Austria. Thousands of on-farm digesters are seen in these countries to treat a mixture of animal manure, crops and food waste where the biogas produced is used to generate electricity. In Port Talbot, UK, the world's largest anaerobic digestion plant to turn wood wastes into biogas is currently under construction. The plant is scheduled to commence in 2010 and is expected to produce 350 MW electricity, sufficient to power 500,000 households in surrounding areas.

Besides developed countries, anaerobic digestion is also practised in developing countries such as in India and China with the installation of simple home or farm-based digesters. In Malaysia, some anaerobic digesters have been built to treat the palm oil empty fruit bunches (EFB) mixed with palm oil mill effluent (POME), as well as animal abattoir wastes. Depending on the amount of biogas produced, the electricity generated from the anaerobic digestion plants are either connected to the national electricity grid or only for internal use within the plant.

On the other hand, an innovative approach to turn household kitchen wastes to useful enzymes is being actively promoted recently, by using a simple aerobic degradation process. The enzyme made from organic kitchen wastes, commonly known as 'garbage enzyme' or 'eco-enzyme' is produced from natural degradation of kitchen waste, supplemented by nutrients such as brown sugar, under aerobic condition. The enzyme produced after several months of degradation can be used for various purposes, such as household cleansing agent, air-freshener, deodoriser, nutrients for plants, vegetables etc. The production of garbage enzymes at household level shows an interesting approach to treat the waste at source, which will subsequently reduce the waste to be discarded and disposed.

4. Recovery and Recycling Technologies

Modern technologies play an important role in 3R (reduce, reuse and recycle), especially recycling, that is, to produce new materials from waste substances. Technology development to convert waste materials into usable resources requires creativity and innovativeness through continuous efforts on research and development (R&D). To date, various innovative technologies have been introduced for recycling and recovery of waste materials, in addition to the conventional types of recycling such as paper, plastic and glass recycling. These include:

- Recovery of paper, plastic and aluminium from tetrapek
- Recovery of precious metals (such as gold, platinum and silver) from electronic wastes
- Recovery of carbon, oil and metals from scrap tyres
- Extraction of crystal from sewage sludge for making tiles
- Recycling of waste cooking oil into bio-fuel
- Recycling of PET bottles into fibre for making clothes
- Recycling of rice husk or EFB into fibre for making chopsticks, food trays and other utensils
- Recycling of plastic waste into liquid oil as fuel
- Recycling of polystyrene into plastic resins

Making of garbage enzyme from kitchen waste

Examples of anaerobic digesters

The Role of the Government

The Government recognises the importance of conducting research and development (R&D) on innovative technologies for waste management. In efforts to encourage and support R&D activities, various grants are offered by various ministries and government agencies. Some examples of Government grants and loans available are:

A. Ministry of Science, Technology and Innovation (MOSTI)

- TechnoFund - to undertake development of new and/or cutting edge technologies in specific areas with commercial potential to create new businesses and generate economic wealth for Malaysia.
- InnoFund - to develop new or improved products, process or services with elements of innovation for commercialisation.
- ScienceFund - to carry out R&D projects that acquire and generate new knowledge in strategic basic and applied sciences.

- Intensification of Research in Priority Areas (IRPA) – to focus on areas which have potential for enhancing the national socio-economic position, which is of immediate need to Malaysia.

B. Malaysian Technology Development Corporation (MTDC) – provides grants for R&D with focus on the promotion and commercialisation of local research and investments in new ventures that can bring new technologies from abroad.

C. Ministry of Energy, Green Technology and Water – announced in the recent Budget 2010 that a total of RM1.5 billion will be allocated as government loans for various purposes, including business or R&D related to green technologies.

Technology and innovation on waste management are covered directly or indirectly under the focussed clusters of the grants listed above, under a wide range of topics such as any improved waste treatment technology, new waste recycling technology invention and innovative waste reduction approaches etc.

Conclusion

Advancements in research and innovations have led to new technologies to aid in the management of waste. Technology and innovation in waste management need to be an on-going process in order to cope with the rapid growth and evolution in waste management. Each of the technologies developed may have its own advantage and specialty, targeting a specific category of waste to be treated or recycled.

As the world continues to improve in terms of its research studies, technologies, creations and innovations, Malaysia should also keep pace, moving towards innovative technology developments. In particular, some waste types such as palm oil EFB and POME, are very localised waste categories which require a localised method or technology to deal with. The Government has offered various types of grants and loans through different agencies to support R&D or even businesses on innovative waste management strategies including treatment, recovery and recycling. With the support from the Government, waste management technologies should achieve a new era of evolution, to ensure benefits from various perspectives, especially protection of overall environment and human health.

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Continued from page 7

Eco-Conscious Shopping

Shopping is our favourite past time, and goods purchased are usually packed and carried away using plastic bags. Without doubt, the durable property of the polyethylene plastic bags makes them suitable to carry loads, either wet or dry. However, due to low cost per unit and low consumer consciousness of environmental health and waste, plastic bags are often discarded into landfills or end up on the streets as litter after use.

Biodegradable plastic bags are commonly made from natural materials derived from renewable resources, such as corn starch, tapioca, sugarcanes, or animal products. The biodegradation process occurs in the presence of air (oxygen), moisture, microbes and soil, and the resulting residues are neither toxic nor harmful. As this process only releases carbon dioxide, there is no net gain in carbon dioxide emissions in the environment. Some biodegradable plastic bags are able to disintegrate in approximately one to two months after use.

Eco-conscious plastic bags from local hypermarkets

Our acceptance to the idea of bringing our own plastic bags and using reusable grocery bags has seen a rapid rise. Major hypermarkets in Malaysia are coming up with innovative ideas to encourage the general public towards eco-conscious shopping by introducing colourful and custom-designed reusable cloth bags as collector's item, and offering reward points to customers who use their own plastic bags.

Conclusion

With Malaysia aiming to achieve developed country status in 10 years, it will be a good move for the country to consider eco-innovation as a source of competitive advantage in its move ahead towards First World status in the fast-growing green technologies, and environmental goods and services sector. Seeing the huge potential in adopting green technology towards the country's economic advantage, the Prime Minister has recently announced in Budget 2010 that the government will allocate RM 20 million for promotion of green awareness activities, and a fund of RM 1.5 billion to encourage green technology adoption among industry players.

Being a top producer and exporter of palm oil in the world, it is natural that Malaysia holds the edge in spearheading and driving palm oil-based biodiesel to the forefront in the near future. Though it is still a long way before fossil fuel can be replaced totally, this possibility cannot be discounted with intensive ongoing research and development. Besides, Malaysia should also move towards harnessing other energy source that we are blessed with in abundance such as wind and solar by placing greater emphasis on high value engineering research, development and innovation.

References

http://en.wikipedia.org/wiki/Eco-innovation

http://ec.europa.eu/environment/eco-innovation/index_en.htm

http://ec.europa.eu/environment/etap/index_en.htm

http://www.eco-label.com/default.htm

http://ec.europa.eu/environment/etap/inaction/showcases/eu/438_en.html

http://www.carbonfund.org/site/more/carbonfree_partner/motorola1

http://www.samsung.com/us/consumer/mobile/mobile-phones/sprint-phones/SPH-M560BLASPR/index.idx?pagetype=prd_detail

http://en.wikipedia.org/wiki/Polylactic_acid

http://my-biodiesel.org/web/

http://www.journeytoforever.org/biodiesel.html

http://www.icrepq.com/icrepq-08/271-jaruyanon.pdf

http://www.alternative-energy-news.info/economical-biodiesel-fuel-from-algae/

http://www.syntheticgenomics.com/media/press/71409.html

http://www.sapphireenergy.com/press_release/14

http://en.wikipedia.org/wiki/Bio-ethanol

http://www.btimes.com.my/Current_News/BTIMES/articles/mlab14/Article/index_html

http://www.standardsusers.org/mysr/index.php?option=com_content&view=article&id=393:energy-business-review-malaysia-to-produce-bioethanol-from-sago-palm-&catid=64:initiatives-activities&Itemid=81

http://en.wikipedia.org/wiki/Rapid_transit

http://www.sustainablecitiesnet.com/2008/12/11/ride-the-wind-ctrain/

http://www.sekoplas.com.my/biodegradable-plastic-shopping-bags-asia.htm

http://en.wikipedia.org/wiki/Biodegradable_plastic

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Environmental Reporting: Bringing 'Public Eyes' to Assist the Monitoring Process

Saving Mother Nature is an agenda that can no longer be postponed. Not only are natural resources being consumed and destroyed daily, waste from consumption and pollution from production is increasing at an alarming rate. Environmental issues such as the water crisis have become more critical. Rivers are being polluted and they can no longer provide clean water like they used to. Air pollution and haze are serious public concerns because we cannot filter the air that we breathe!

To combat these environmental problems, everybody needs to take part and play their roles effectively; moreover, urgent proactive approaches are necessary. Regulations are effective when enforcement is efficient. However, it will be unfair to place all responsibility on the government authorities alone. There are more than 500,000 establishments scattered all over Malaysia and it will not be possible for the authorities to monitor each and every one.

What is Environmental Reporting?

Environmental reporting is a reporting process whereby the management of an organisation periodically reports their company's environmental status and environmental performance to the multiple stakeholder groups. The medium of reporting is not restricted to the company's annual report only. It can be in the form of stand-alone reports presented to various stakeholders groups or it can also be pages on the company's website.

Environmental reporting is not a new issue. In fact, Agenda 21 adopted by the Malaysian government during the United Nations Conference on Environment and Development (UNCED) which is popularly known as the Rio Summit 1992 already highlights the need for industries "to report annually on their environmental record, as well as their use of energy and natural resources" and "to adopt and report on the implementation codes of conduct promoting best environmental practice" (ACCA, 2002).

Why Environmental Reporting?

Providing information on environmental policies, objectives, targets, environmental management systems implemented, initiatives undertaken and its outcomes fulfil organisations' obligations to be accountable for their environmental impacts. Environmental reporting provides the stakeholders with useful information for decision making. Reporting false information will surely jeopardise the organisation because publicly available written documents will always allow for auditing of the information.

Evaluating environmental reporting by businesses could open 'windows' for the stakeholder groups namely regulators, consumers, suppliers, employees and community at large to keep an eye on the businesses environmental activities as well as assess how these organisations discharge their social obligations to conserve the environment via the introduction of the sustainability element. Once this information is publicly available, the stakeholders will be able to decide whether what is presented is enough or what more should be provided and action to be taken. Businesses could then improve their environmental reporting as well as environmental performance in response.

Who Will Gain? Does Anybody Lose?

Most businesses presume that the environment is a global issue requiring global solutions and actions which should be left alone to larger organisations. They are unaware of the various ways available for organisations to discharge their obligations to be accountable concerning their environmental impacts and the environmental aspects of their activities. In fact, they might have been exercising environmental-friendly activities for years and yet due to lack of expertise are unable to earn competitive benefits. Initiation of recycling programmes, waste minimisation, energy conservation or even creating employee awareness on environmental-related issues are among the many initiatives.

Cost is always an issue and a classic excuse. However, it is time for managers to look at environmental problems as a business issue (Reinhardt, 2007). They should include environmental investments as part of their business' agenda. Environmental investment may not directly guarantee a positive return but it could possibly reduce environmental risks in the long run. Three main areas mentioned in a survey by a UK Environment Agency (2007) as benefits of good environmental practice were:

- reduced risk of prosecution (81%)
- creating good relations with customers (69%)
- reduced operating costs (53%)

Environmental reporting should create a win-win situation for everybody. Businesses will be able to communicate their performance on issues which are essential to their stakeholders through environmental reporting. Organisations that already have sustainable products or have been exercising environmental good practices will see environmental reporting as an opportunity to create competitive advantage. Willingness to engage in environmental reporting will portray their readiness to be more transparent and accountable. Businesses need to realise that being environmentally responsible could promote good reputation to win over customers and secure employee loyalty (Revell *et al.*, 2007).

Since environmental reporting is a continuous process, management needs to consider its environmental goals carefully and draw up achievable plans. This will create a more systematic and organised internal process on environmental issues. Reporting allows businesses to stay alert on their environmental impacts and encourages them to plan for their future.

Moving Forward with Environmental Reporting

There is growing awareness of the importance of environmental reporting globally and on its value as an evaluation tool for investment and financing decisions (Ministry of the Environment, Government of Japan, 2007). Financial and time constraints, limited knowledge and expertise as well as lack of staff should not be an excuse for businesses, especially small and medium-sized enterprises (SMEs) to ignore environmental issues.

There is increasing attention to assist SMEs worldwide to prepare environmental reporting. A number of guidelines have been published to help SMEs. Malaysian businesses also need to keep abreast with current environmental practices to become competitive players and enhance their export performance in this era of globalisation.

References

ACCA (Association of Chartered Certified Accountants). 2002. The State of Corporate Environmental Reporting in Malaysia. ACCA: London. Retrieved *www.accaglobal.com*

Ministry of the Environment Government of Japan. 2007. Environmental Reporting Guidelines : Towards a Sustainable Society. Retrieved *http://www.env.go.jp/en/policy.*

Reinhardt, F. 2007. Bringing the environment down to earth. *Harvard Business Review on Green Business Strategy,* pp. 41-64.

UK Environment Agency. 2007. 'NetRegs SM-Environment 2007'. *http://www.netregs.gov.uk/netregs.* Retrieved 8 Aug 2009.

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Clean Sources of Water
Will Innovation and Technology Help Our Survival?

Sources of fresh water are reported to be scarce in many parts of the world including Malaysia. Will we be hit by a tragic water shortage? The answer is yes. The current state of uncertainty about our climate patterns affects the availability of fresh water resources. The change in climate patterns affects both surface water and groundwater resources. We need to acknowledge that groundwater resources play a very important role in maintaining a base flow of the surface water resources. The three main sectors that will be badly affected are domestic consumers, and the industrial and agricultural sectors.

In many ways, we have utilised many shapes and sizes of technology to assist us to identify and obtain water resources for consumption. However, it seems insufficient to feed the growing need for water consumption. Some have even resorted to large scale extraction of groundwater resources for human consumption. Unfortunately, such efforts will not address the mismanagement of water resources and in fact might further induce wastage. Efficient management of water usage through technology can assist us in our survival on planet earth.

Preservation and Conservation of Surface Water Resources

In Malaysia, surface water resources (mainly rivers) are more abundant than groundwater resources. While both resources are being developed, in terms of treatment for conversion into portable water, surface water is more cost effective; moreover its impact on the environment is reduced if better managed. According to a report by the Food and Agriculture Organisation (FAO, 2005), the estimated amount of surface water resources in Malaysia is 566 km^2 compared to 64 km^2 of groundwater resources. This clearly indicates the need for Malaysia to emphasise the preservation and conservation of surface water resources. This includes sustainable utilisation and conservation responsibility for surface water by all stakeholders. We should not forget that the base flow in surface water is maintained by groundwater resources.

Water resources preservation includes protection of raw water resources, efficient management of rivers, ensuring water needs of flora and fauna are met and ensuring water catchment areas are gazetted as permanent reserves. There should be buffer zones to the water catchment areas to ensure full protection.

The conservation of water resources will be a good move compared to investment of millions of Ringgit to build new infrastructure such as dams, reservoirs, treatment plants and distribution network systems. In the longer run, this will be more economical as treatment costs for unpolluted raw water are less compared to costs involved in treating polluted water.

Reduction in Non-Revenue Water

Non-Revenue Water (NRW) can be categorised as loss in production for the water supply industry. In Malaysia, according to the National Water Services Commission (*Suruhanjaya Perkhidmatan Air Negara*), the NRW value can reach approximately 37% for the whole water supply industry. This is one of the main sources of loss in income for the water industry in general. The International Water Association (IWA) has broken down NRW into three components namely:

i) Unbilled Authorised Consumption (UAC) – Includes water used for fire fighting or free water distributed at standpipes or provided to religious institutions.
ii) Apparent Losses – Unauthorised consumption and metering inaccuracies. This includes illegal connections, meter inaccuracies and misreading water meters.
iii) Real Losses – Leakage from transmission or distribution mains, leakage and overflow from utility storage and balance tanks and leakage in reticulation systems.

Steps to reduce NRW value need to be continued as NRW means loss in treated water and revenue. A reduction in NRW also means that we can accommodate more water demand without new investment to build additional infrastructure. According to the Malaysia Water Industry Guide 2009, 37% is the national average for NRW. The average tariffs for domestic and industrial consumers are RM 0.645 and RM 1.318 respectively. Based on national drinking water production statistics, we produce 13,243 million litre per day. Eventually, NRW costs us RM 1.57 billion, just in 2008 alone. This means huge savings can be made and is worth investment in technology to reduce NRW for water supply utilities. This is, however, not an option if only immediate profit becomes the focus.

NRW reduction mainly lies with the mechanism of monitoring quantity of water flow in particular sectors. Based on a water usage analysis study, the root cause was identified as leaking water pipe networks, in some cases excessively. Technology has helped lately as X-Ray equipment and ultrasonic methods have been used to identify leakages in pipes.

Such leakages also pose a threat to water supply quality if we are to base it on Bernoulli's principles. In pipe junctures where pressure is less than the external pressure due to water flow (velocity), suction of water into the piping system causes deterioration in water quality. Certainly, a reduction in NRW offers more pros than cons.

An example of a water treatment plant
Source: course.cas.sc.edu/.../geole103/prospective.html

Cross-sector Efficient Use of Water Practices and Policy

Water usage comes basically from 3 sectors: domestic, industrial and agricultural sectors which contribute 17%, 21% and 62% respectively (FAO, Population Division of The Department of Economic and Sosial Affairs of the United Nations, World Bank). While we acknowledge the importance of domestic water demand management, the impact of industrial and agricultural water demand management to contribute to overall increasing water demand is greater.

Management of surface water (mostly rivers) is vital as it contributes to most of the raw water resources for consumption. The protection of these resources is still lacking in Malaysia. Integrated Water Resource Management (IWRM) may be a great tool but its implementation may result in an immediate reduction in profits for many parties.

Rainwater Harvesting and Storm Water Management

Rainwater harvesting is an alternative to water required to carry out activities such as flushing toilets, watering plants, washing vehicles and other non-potable (non-drinking, non-eating, and hygienic) purposes. Concrete innovative steps towards rainwater harvesting can help to reduce the consumption of treated water in residential units, businesses and industries.

The Water and Energy Consumer Association of Malaysia (WECAM) is conducting a 5-year rainwater harvesting project on a gravity based design (Figure 1). These units are running efficiently to reduce dependency on treated water for non-potable water usage but will require maintenance for continued performance. I am hopefil that the findings from these projects will be published to encourage the public to participate. A simple way to harvest rainwater is by using large containers such as pails and drums. However, these containers must be kept closed to prevent mosquitoes from breeding.

Secondly, effective storm water management may alleviate water needs while simultaneously nullify flood effects of the storm. Rainwater causes havoc in many cities due to poor planning of drainage and quick loss of forest covers. Use of storm water for drinking water supply is not new. We can see that our neighbour, Singapore, has successfully utilised the source for ensuring supplies of potable water. While high water content provides for a diluting effect on pollutants, the water quality is suspect as it would depend on the locations and areas that the surface run-off passes. The move to use storm water for potable supplies needs careful planning, including wastewater generation in populated areas.

Figure1: One of our gravity based systems operational in Petaling Jaya

Reusing and Recycling Wastewater

Domestic wastewater is divided into greywater and darkwater. Greywater means wastewater produced from daily activities and which is eventually channelled to sewerage treatment or directly to the rivers. Such activities include washing clothes, water use in the kitchen, bathing, etc. but do not include toilet wastewater. Toilet wastewater is known as darkwater and is not suitable for reusing or recycling without proper treatment. According to statistics, 50%–80% of domestic wastewater is greywater. Reusing and recycling greywater can help in efficient water usage which further improves domestic water demand management. Reusing is basically using greywater to wash drains, flush toilets and for other suitable non-potable use. While technology can help in cleaning greywater, just manual use itself should go a long way in conserving water resources.

Industrial wastewater is usually contaminated with unwanted residues. To reuse the wastewater, industries must at the least carry out simple treatment. In case, the requirement for water quality is high, recycling of wastewater needs to be incorporated and this requires high investment. There should be incentives given to industries which reduce their water footprint per unit product or per unit service rendered. Such a move supports the implementation of Life Cycle Assessment (LCA).

Several industries, hotels and hangers have been exposed to training on reusing and recycling water as well as the need to reduce water usage in production process. These training sessions have been largely organised by NGOs.

Conclusion

Water is essential not only to human survival but for environmental conservation as well. According to the Malaysia Water Industry Guide, we used nearly 5, 390, 540 litres of raw water for drinking purposes in 2008. While we need to survive, the environment needs it much more. It is important that technology that helps in operating tools and equipment towards water usage reduction is placed directly into the consumers shopping basket. For example, front load washing machines are both energy efficient and water efficient. However, the cost of owning one is much higher compared to top load washing machines. A good tax incentive can help consumers buy a better product. We have many water faucets that reduce water consumption such as low pressure shower heads, bubbly kitchen taps, dual flush systems and many more. If options are offered to consumers for selection, there will be takers. With growing awareness of environmental protection and green technology initiatives, we will need better research, and definitely eco-friendly and consumer-friendly products in the market.

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Treatment Technology for the Control and Management of Ballast Water: Available Options

Ballast water is essential for ships to maintain balance, stability and structural integrity, especially when sailing without cargo. The International Maritime Organization (IMO) defines ballast water as 'water with its suspended matter taken on board a ship to control trim, draught, stability, or stresses of a ship' (IMO, 2005). As a general rule, ballast water is taken aboard when cargo is unloaded and it is discharged at the port of destination before loading new cargo (Figures 1 and 2). For tankers and dry bulk carriers, ballast water is used in large quantities to make up for weight loss after unloading cargo.

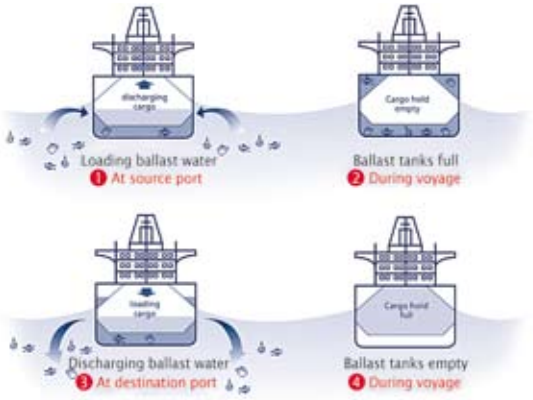

Figure 1: Ballast water cycle by a ship
Source: IMO

Figure 2: Ballast water discharge by a ship
Source: *http://www.providence.edu/polisci/students/megaport/images/ballast.jpg*

Unfortunately, ballast water is also considered as one of the major vectors for the transport of invasive organisms around the world. According to the World Conservation Union (IUCN) 2002, marine bioinvasions through ballast water is the second greatest threat to marine biodiversity after over-exploitation (Ballast Water News, 2003). Marine bio-invasions from ballast water not only impose detrimental ecological impacts on the marine ecosystems along with its economic repercussions, but also threaten human health.

The issue is largely due to the expanded trade and traffic volume around the world. Around 90% of the world trade is seaborne (World Trade Organisation, 2000). Besides the development of faster and larger ships, the increasing amount of seaborne trade has enabled larger quantities of ballast water to be carried more quickly and frequently to a greater number of destinations around the world, thus giving organisms the opportunity to invade new areas. Although most organisms do not pose threats when disposed to areas outside their natural environmental settings, some species could compete with native organisms and multiply rapidly to form harmful breakouts, sometimes to the extent of wiping out the natural species. Catastrophic introductions of species have been documented worldwide, and the effects of most of them have been irreversible. For example, Table 1 lists ten most significant invasive species around the world as documented by the IMO.

The IMO International Convention for the Control and Management of Ships' Ballast Water and Sediment, 2004

Due to the transboundary nature of shipping activities around the world, the resolutions of the above convention was adopted by consensus at the IMO Diplomatic Conference in February 2004. The convention builds on the complementary roles of coastal, port, and flags States as well as the shipping industry in protecting the marine environment by embracing effective ballast water management measures.

The IMO conventions calls for ships to implement a Ballast Water Management (BWM) Plan approved by the Administration (Regulation B-1) which among other things require the ship to have a Ballast Water Record Book (Regulation B-2) to record when ballast water is taken on board; circulated or treated for ballast water management purposes; and discharged into the sea. It should also record when ballast water is discharged to a reception facility and accidental or other exceptional discharges of ballast water occurs.

(A) Guidelines for Ballast Water Exchange

Under Regulation B-4 Ballast Water Exchange, all ships using ballast water exchange should:

- Whenever possible, conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account Guidelines developed by IMO;
- In cases where the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.

Table 1: Ten major examples of invasive marine plants and microbes introduced around the world.

Organism	Native to	Introduced to	Impacts
Cholera *(Vibrio cholera)*	Various strains	South America, Gulf of Mexico, and other areas.	Some cholera epidemics appear to be directly associated with ballast water.
Cladoceran water flea *(Cercopagis pengoi)*	Black and Caspian Seas	Baltic Sea	Reproduces to form very large populations dominating zooplankton community, and clogging fishing nets and trawls.
Mitten crab *(Eiocheir sinensis)*	Northern Asia	Western Europe, Baltic Sea and West Coast North America.	Undergoes mass migrations for reproduction. Preys on native fish and invertebrate species, leading to local extinctions.
Toxic algae1 *(red / brown / green tides)*	Various species with broad ranges.	Several species have been relocated to new areas through cysts transfer in ships' ballast water and sediments.	Forms harmful algae blooms (HABs), causing massive kills of marine life through oxygen depletion and release of toxins, foul beaches and impacting tourism and other recreational activities. Some species also contaminate filter-feeding shellfishes and the consumption by humans could cause illness or death.
Round goby *(Neogobius melanostomus)*	Black, Asov and Caspian Seas.	Baltic Sea and North America.	Highly adaptable and invasive. Competes for food and habitat with native fishes and also preys on their eggs and young.
North America comb jelly *(Mnemiopsis leidyi)*	Eastern Seaboard of the Americas.	Black, Azov and Caspian Seas	Reproduces rapidly under favourable conditions, causing depletion in zooplankton stocks. As a result, this causes alteration of food webs and ecosystem functions. For example, it caused collapse of the Black and Asov Sea fisheries in the 1990s, with a similar threat imposed on the Caspian Sea.
North Pacific Seastar *(Asterias amurensis)*	Northern Pacific	Southern Australia	Reproduces in large numbers rapidly. Feeds on shellfish, and commercially valuable scallops, oyster and clam species, imposing economic repercussions.
Zebra Mussel *(Dreissena polymorpha)*	Eastern Europe (Black Sea)	Western and Northern Europe, including Ireland and Baltic Sea, as well as the Eastern half of the North America.	Alters habitats, ecosystems and food webs, besides causing severe fouling problems on infrastructure and vessels. This organism is perhaps the most popular example of bioinvasion from ships' ballast water.
Asian Kelp *(Undaria pinnatifida)*	Northern Asia	Southern Australia, New Zealand, West Coast of USA, Europe and Argentina.	Grows and spreads rapidly causing alterations on habitats, ecosystems and food webs.
European Green Crab *(Carcinus maenus)*	European Atlantic Coast	Southern Australia, South Africa, USA and Japan.	Highly adaptable and invasive. Resistant to predation due to its hard shell. Consumes and depletes a wide range of prey species, especially the native crabs.

Table 2: Ballast water management systems that make use of Active Substances which received Type Approval Certification by their respective Administrations, following Final Approval by IMO (resolution MEPC 175 (58))

Approval Date	Name of the Administration	Name of the Ballast Water Management System	Copy of Type Approval Certificate	Active Substance Employed	MEPC Report Granting Final Approval
June 2008	Det Norske Veritas, as delegated by the Norwegian Administration	Pure Ballast System	To be provided	Free radicals Cl_2^-, $ClBr^-$, Br_2^- and CO_3^- (refer to MEPC 56/2/2,annex 5)	MEPC 56/23, paragraph 2.8
10 June 2008	Federal Maritime and Hydrographic Agency, Germany	SEDNA® Ballast Water Management System (Using Peraclean® Ocean)	Provided	PERACLEAN® Ocean (refer to MEPC 57/2/10 annex 7)	MEPC 57/21, paragraph 2.16
31 December 2008	Ministry of Land, Transport and Maritime Affairs, the Republic of Korea	Electro-Cleen™ System	Provided	HOCl (OCl^-), HOBr (OBr^-), O3 (H_2O_2), OH^- (refer to MEPC 58/2/7, annex 7)	MEPC 58/23, paragraph 2.8
17 April 2009	Det Norske Veritas, as delegated by the Norwegian Administration	OceanSaver® Ballast Water Management System (OS BWMS)	Provided	HClO, Cl_2, O_3, H_2O_2, ClO_2 and ClO^- (refer to MEPC 58/2/8, annex 4)	MEPC 58/23, paragraph 2.10

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Table 3: Ballast water management systems that do not use Active Substances certified by their respective Administrations (resolution MEPC 175 (58))

Approval Date	Name of the Administration	Name of the Ballast Water Management System	Copy of Type Approval Certificate
2 September 2008	Office of the Maritime Administration, Marshall Islands	NEI Treatment System VOS-2500-101	Provided
29 April 2009	Lloyd's Register, as delegated by the Administration of the United Kingdom	The Hyde GUARDIANTM ballast water management system	Provided

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When these requirements cannot be met, areas may be designated where ships can conduct ballast water exchange. All ships shall remove and dispose off sediments from spaces designated to carry ballast water in accordance with the provisions of the ships' Ballast Water Management Plan (Regulation B-4).

(B) Treatment Technology Development

However, ballast water exchange is limited by safety considerations, making a ship especially vulnerable to rough conditions, posing serious threat to its crew and cargo. As such, ballast water treatment standards were adopted and are currently the main focus of the IMO convention as a long-term and effective measure to control the spread of alien invasive species by ships' ballast water. A number of different types of ballast water treatment methods have been proposed (Tables 2 & 3). These include filtration, hydrocyclones, heat treatment, UV treatment, ozone treatment, chemical treatment (e.g chlorine), electro-ionisation, gas-supersaturation; also combinations of more than one methodology for better results. However, it is also stressed that the treatment systems (e.g. the use of chemicals to threat the ballast water which would then be released into the sea) developed pose no additional harm or threats to the natural marine life or the marine environment as a whole.

A review of the status of development was conducted at the MEPC 53 and continued during the MEPC 55 and is still ongoing. To date, a total of 16 different systems have already been submitted. However, until these systems are approved and fitted, most of the current requirements still rely on requiring vessels to undertake ballast water exchange in conformance with specified criteria such as the minimum distance from the coast with depth of water, necessary documentation, pre-arrival notification requirements, signed ballast water reporting forms etc.

Situation in Malaysia

As one of the world's top twenty trading nations, the importance of the maritime sector to Malaysia cannot be underestimated. About 95% of the country's goods traded are transported by sea. There are more than 100 landing facilities in the country, ranging from major ports to small jetties either under federal or state control. Some of the world's major ports, maritime hubs and trans-shipment harbours are also located in Malaysia. These include Port Klang, Penang Port, Bintulu Port, Port of Tanjung Pelepas, Kota Kinabalu Port, to name a few. In addition, Malaysia is also strategically located along the Straits of Malacca, which is one of the busiest shipping lanes in the world. The Straits is a maritime superhighway that hosts a tremendous amount of maritime activities and seaborne trade that facilitates a high volume of vessel traffic daily. These range from small boats owned by fishermen earning subsistence living off its resources and barter traders, to giant container ships owned by major shipping lines as well as supertankers carrying crude oil from one part of the world to the other. For instance in 2007, over 70,000 movements of ships were reported in the Straits, making it the world's busiest shipping lane for merchant shipping traffic. In addition, it has been projected that annual traffic in the Straits will increase to above 100,000 vessels by 2020. As such, the growing size and number of ships traversing the Straits would increasingly add to the challenge for ballast water management to protect the marine environment.

Accordingly, an increasing number and sizes of ships calling on Malaysian ports has also been recorded over the years. For instance, the total number of ships calling by some of the major ports in Malaysia, which stood at 57,156 (277,734,000 GRT) in 1996, has drastically increased to 65,499 ships (503,963,000 GRT) in 2006. All these factors represent a huge challenge for Malaysia in terms of ballast water control and management. Moreover, the problem could be further compounded as any introduction of exotic species could be spread domestically by coastal vessels. It has been well documented that domestic movement of ballast water has the potential to move marine invasive species outside their normal ranges and expand the range of established transoceanic invaders (Burkholder *et al.*, 1992; Carlton, 1996a).

Options for Malaysia

Since this convention is being considered by the government for ratification, local ship owners should be aware of the progress being made on the issue at the IMO and take note of the requirements that might directly or indirectly affect them. As to the path ahead on the control of the spread of invasive alien species, looking at the various options of treatment technology available and those that will be coming into the market soon, Malaysian ship-owners have an option to choose from the best performance standards, costs and maintenance of the treatment system for best results.

While there is no firm evidence to suggest that ballast water discharges have resulted in major species introductions within the waters in Asia, there has been an increase in red tide occurrences in this region. Similarly, Malaysia has also experienced an increase in red tide caused by toxic algae causing fish mortalities, paralytic shellfish poisoning (PSP), and human health problems over the years.

References

Burkholder *et al.* 1992 and Carlton, 1996a. In: Lavoic, D.M., Smith, L.D. and Ruiz, G.M. 1999. The potential for intracoastal transfer of non-indigenous species in the ballast water of ships. *Estuarine, Coastal and Shelf Science.* 48:551-564.

Ballast Water News. 2003. Global Ballast Water Management Programme. International Maritime Organisation. BWN 12: 01-03/2003, 12 pp.

Buck, E.H. 2007. CRS Report for Congress on Ballast Water Management to Combat Invasive Species. Congressional Research Service. Prepared for Members and Committees of Congress. 14 pp.

Cheryl Rita Kaur. 2006. Legal and Technical Aspects of Ballast Water Management: Should Malaysia Ratify the IMO International Convention for the Control and Management of Ships' Ballast Water & Sediments 2004? MIMA Studies Report.

International Maritime Organization (IMO) website. International Convention for the Control and Management of Ships' Ballast Water and Sediments adopted in 2004. Retrieved from *http://www.imo.org/*

International Maritime Organization (IMO). 2005. Ballast Water Management Convention. Polestar Wheaton Ltd., United Kingdom. 138 pp.

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Event Highlights

Department of Environment, Malaysia

October 2009

Malaysia Environment Week 2009 (MASM)

The annual Malaysia Environment Week (MASM) is a premier event organised by the Department of Environment, primarily to inculcate and enhance environmental awareness among Malaysians. The 18th MASM at national level was jointly launched with the *Rakan Alam Sekitar* (RAS) Programme at State Level on 21 October 2009 at the Borneo Convention Center, Kuching, Sarawak. Several interesting activities namely, environmental exhibition, colouring contest for primary school children and tree planting which saw participation from 400 school children were organised to coincide with the event.

The highlight of the day was the conferring of the Langkawi Award 2009. The recipient of the award for 2009 was Professor Dato' Dr. Ibrahim Komoo, Director of Southeast Asia Disaster Prevention Research Institute (SEADPRI). This award was given to him for his outstanding contribution in the field of environmental management. The award was presented by Datuk Patinggi Tan Sri Dr. George Chan Hong Nam, Deputy Chief Minister of Sarawak who represented the Chief Minister of Sarawak, Pehin Sri Haji Abdul Taib Mahmud. Also present were Datuk Patinggi Tan Sri Alfred Jabu anak Numpang, Deputy Chief Minister of Sarawak, Datuk Douglas Uggah Embas, Minister of Natural Resources and Environment and Dato' Zoal Azha bin Yusof, Secretary General, Ministry of Natural Resources and Environment.

November 2009

The 8th Malaysia - Singapore Joint Committee on the Environment (MSJCE) Working Group Meeting

The 8th Malaysia-Singapore Joint Committee on the Environment (MSJCE) Working Group Meeting (WG of MSJCE) was held from 12 -13 November 2009. Co-chaired by Dato' Hajah Rosnani Ibarahim, Director General of Environment, Malaysia and Mr. Andrew Tan, Chief Executive Officer, National Environment Agency, Singapore, the Meeting was held in Pulau Langkawi, Kedah Darul Aman.

The Malaysian delegates to the Meeting were senior officers of DOE and representatives from Universiti Kebangsaan Malaysia and the National Hydrographic Centre.

The Meeting discussed and exchanged views on environmental issues which are of concern to both countries namely vehicular emission control, water quality in the Straits of Johor, chemical and oil spills along the Straits of Johor, and environmental training programmes. Following the $1^{1}/_{2}$ day meeting was a technical visit to the world renowned Kilim Geoforest Park, which holds the distinction of having been awarded the World Geopark status with a listing in the UNESCO Global Geoparks Network.

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