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Malaysian Industry-Government Group for High Technology

FUTURE ENERGY: IS OTEC THE SOLUTION?

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inside myForesight

myForesight is a pioneering national level initiative dedicated to the prospecting of technology for business through the field of Foresight. It provides a common Malaysian based platform for the Government, Industry and Academia to share experiences, insights and expertise on the strategic futures issues, both at the loyal and global levels.

Its key components to its mission are intelligence, research, competency and community. myForesight® raison d'etre is to accomplish the following:

1. Shaping Malaysia's future possibilities;
2. Promoting and mainstreaming of foresighting in national, sectoral and corporate planning;
3. Identification of key technologies to support sectoral development;
4. Identification of key and potential industries from technology perspective.

editor's note

Initial Thoughts

by RUSHDI ABDUL RAHIM
rushdi@might.org.my

Now, the question is... Is OTEC suitable for Malaysia? Read through and you be the judge...

Greetings and Salutations!

We here at myForesight® have been very busy indeed. Our works with United Nations Development Programme (UNDP) and the Malaysia Public Service Department (JPA) is entering its final phase. We believe, for the country to move forward policy makers should be equipped with the tools to undertake foresight and that is what our work with them is all about. Therefore the collaborative aspect of the work becomes very critical in ensuring that the project achieved its targeted objectives.

On technology front, we continue to scan and engage various stakeholders, exploring future possibilities and in this particular issue, we at myForesight® are encouraging conversation and dialogue on the potential of Ocean Thermal Energy Conversion (OTEC). This special partnership edition of myForesight® is in collaboration with Universiti Teknologi Malaysia (UTM), is a compilation of viewpoints and opinions on OTEC technology.

For the 11th Malaysian Plan, renewable energy (RE) is expected to generate 2,080MW by 2020 (it was 243 MW in 2014) and contributes 7.8% of total installed capacity in Peninsular Malaysia and Sabah. The plan will enhance RE development by promoting new RE

sources, enhancing capacity of RE personnel and implementing net energy metering.

There is a firm belief, especially by contributors to this edition that new RE sources such as wind, geothermal and ocean energy will be explored. Malaysia should take an advantage of its geographical position which is surrounded by the sea to leverage on ocean energy especially OTEC, since it is clean, sustainable (24/7) and can produce by-products such as fresh water, aquaculture and agriculture.

Nevertheless, OTEC has long been stigmatized with high capital costs compared to other renewable energy such as solar, wind and even nuclear power. This has made OTEC a less attractive proposition. However, the contributors here opined that with the trends of higher energy generation cost, increased concern for global warming and political commitment towards energy security, OTEC technology will be economically attractive.

Now, the question is... Is OTEC suitable for Malaysia? Read through and you be the judge.

I would strongly suggest that you make yourself available on the 1st and 2nd of September to continue the discussion on whether OTEC is the solution for our future renewable source of energy.

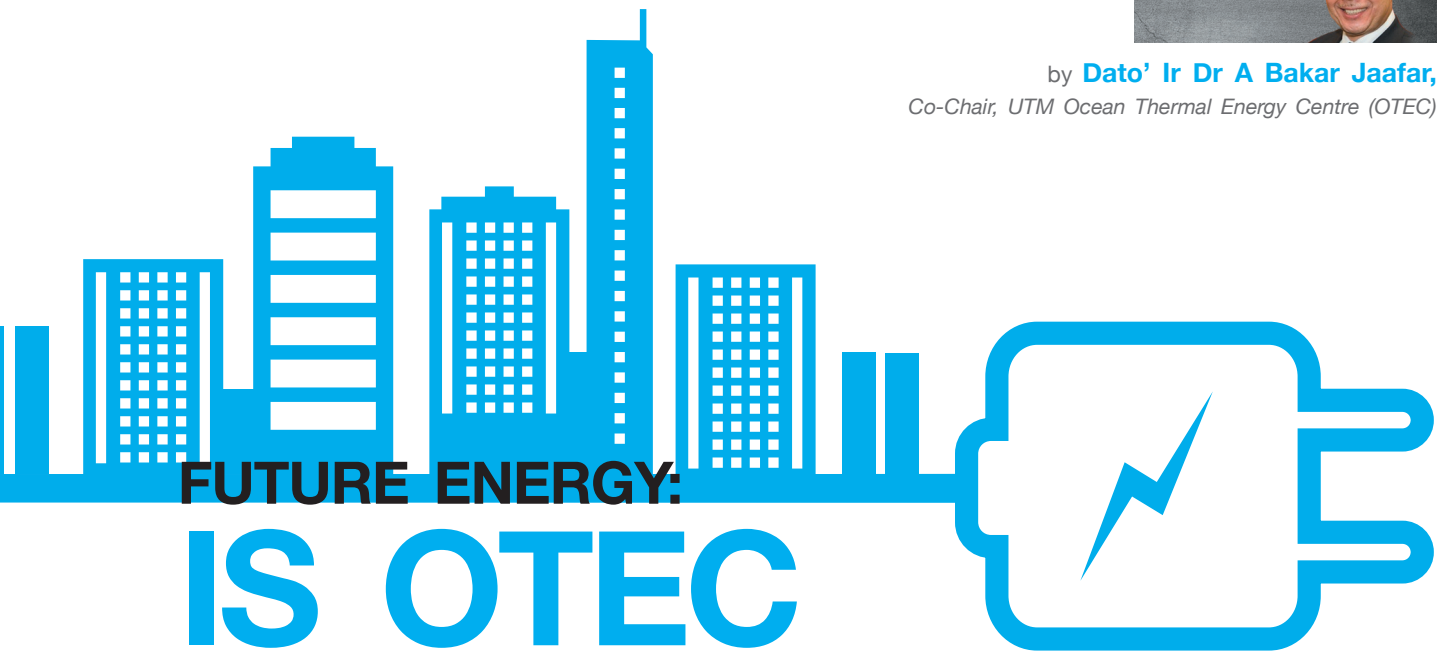
Perhaps an answer could be found during the 3rd International OTEC symposium, held in Royal Chulan, Kuala Lumpur during the dates I mentioned.

As always, we welcome input, opinions and article contributions. Thank you.

Rushdi Abdul Rahim
rushdi@might.org.my

cover story

by **Dato' Ir Dr A Bakar Jaafar,**
Co-Chair, UTM Ocean Thermal Energy Centre (OTEC)



FUTURE ENERGY: IS OTEC THE SOLUTION?

Ocean thermal energy resources could be the latest frontier that ought to be explored and exploited on a sustainable basis, not only for the sake of national interests, but also for "the maintenance of peace, justice, and progress for peoples of the world."[1] Much of the energy from the sun, if not captured by nature in the form of wind, hydro-energy, biomass, waves, and currents, is stored in the surface layers of a body of water in the form of heat.[2] The heat contained in the water column, particularly in the deep waters of the tropics, can be converted[3] into electrical energy or energy product equivalent,"such as hydrogen. If there is no immediate use of the electricity, once generated, it could be converted to hydrogen by electrolysis. It is projected that by the end of the 21st century, hydrogen fuel will make up over 50% of all forms of energy.

Since the conclusion of the Malaysian Marine Survey of the South China Sea (2006-2008) (MyMRS)[4], it has been established that Malaysia has the capacity to generate power up to 105,000 MW from the heat stored in the deep waters (over 700 metres in depth), covering a total area of 131,120 square kilometres, off the states of Sabah and Sarawak. With forthcoming investments to develop this resource, Malaysia will be very

[1] The UN Convention on the Law of the Sea, New York: United Nations, 1983. p.1.

[2] Al-Quran, Surah An-Nur, 24:40

[3] This knowledge of converting the heat into electricity was discovered by Jacques-Arsene D'Arsonval, a French physicist, in 1881.

[4] This survey was undertaken under the auspices of the National Technical Committee on Continental Shelf, Secretariat to National Security Council, Prime Minister's Department, Putrajaya.

With the development of its ocean thermal energy resource, Malaysia's dependency on imported coal from a limited range of countries could be reduced, and thus, its national security would not be subject to needless geopolitical risks.

much in a commanding position to make further progress toward realising its Vision 2020 and other sustainable development objectives as a developed nation.

With regard to energy security, with the development of its ocean thermal energy resource, Malaysia's dependency on imported coal from a limited range of countries could be reduced, and thus, its national security would not be subject to needless geopolitical risks.

In the environment and climate change mitigation areas, increasing use of hydrogen fuel from renewables would not only improve the ambient air quality -- otherwise adversely affected by the vehicular and industrial emissions from fossil-fuel combustion -- but would also boost the economics of transportation of goods and services. This will also offset the fear of the so-called inflationary socio-economic impact of removing fossil-fuel subsidies. The imminent transition of the economy from fossil-fuel dependence to that of a hydrogen economy would also help reduce green-house gas emissions, [6]and thus, lessen the increasing threats of climate change.

The cold and nutrient-rich deep-sea water, after its use in the basic ocean thermal energy conversion to electrical power generation (OTEC) plant for the condensation of the plant's working fluid -- from gas back to liquid form -- in itself is an invaluable resource for:

- Cooling the soil for growing temperate produce and fruits in the tropics[7];
- Raising high-value fish, such as 'fugu'[8], and other types of marine products such as abalone and lobsters
- Growing high-value seaweeds such as 'umi-budou'[9] and 'ogu';
- Growing micro-algae that can be converted into jet-fuel[10];
- Promoting the growth of phytoplankton and thus, zooplanktons that attract small and big fish;[11]
- Extracting lithium,[12] an essential metal in the manufacture of advanced batteries;
- Producing both fresh-water[13] and mineral water[14]; and
- Producing cosmetics, and other health and beauty products.

Such OTEC-related industries could be developed to transform the economy of the underdeveloped rural-coastal and island communities by setting up a number of OTEC Industrial and Techno-Parks, such as those already established in Kumejima, Okinawa, Japan, and Big Island, Hawaii.

With an OTEC Project at Pulau Layang-Layang ensuring a sustainable supply of energy, water, and food to support human habitation, this island could truly live up to its name under international laws, and Malaysia could uphold its national sovereignty as per its published PETA BARU of 1979.

Ocean thermal energy-driven development is highly impactful, not only as a key sustainable development game-changer, but also as a highly strategic resource in terms of national sovereignty and security, including energy security and climate change mitigation.

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[5] Currently, energy pricing does not reflect not only the true cost of energy, but also does not differentiate the various forms of energy carrier. For the same price, one kilogramme is equivalent to one-gallon of petroleum in terms of energy content. But one-kilogramme of hydrogen fuel used in Hydrogen-Fuel Cell Vehicle (HCFV) will travel farther away by 60 kilometres more than the standard petrol-driven car with Internal Combustion Engine (ICE). In our national car programme is not developing its own HCFV, it will soon be wiped out from this Mother-Earth

[6] The 7% shortfall in meeting the YAB PM's pledge in 2009 at COP-15 could be easily met by investing in a total of 875 MW of OTEC by 2020, with total capital outlay of USD 8.75 billion.

[7] Theapplication of cold deep sea-water for cooling the soil for temperate agriculture in the lowlands would relieve the increasing pressure on the nation's montane forest lands and high-hills, including Cameron Highlands.

[8] Fugu fish raised in deep sea-water is no longer poisonous due to the absence of any form of virus and bacteria in such body of water.

[9] This is very high value produce, served as table salad, or otherwise packed and retailed at USD 7 per 50 gm wet.

[10] Cellana, based in Hawaii, is one of the companies that has commercialized the conversion of micro-algae to jet-fuel.

[11] This type of fish-gathering and capture, known as Takuma, has been well demonstrated in the Bay of Tokyo, Japan.

[12] The pilot plant for lithium extraction has been in operation at Saga University Institute of Ocean Energy Systems, Imari, Kyusu, Japan.

[13] Off Chennai, one-MW OTEC plant has been running since 1999 to produce fresh-water to support 20,000 residents. One unexpected benefit from this Project has been the drop in the number of incidents of water-borne diseases to almost NIL.

[14] Koyo USA, Inc of Big Island, Hawaii has been bottling per day one-million bottles of mineral water from the deep sea and exporting them to Japan for retail at USD 7 per bottle. It has also been established that drinking deep-sea mineral water could help reduce obesity, cholesterol, and blood pressure.

viewpoints

by **Prof. Dr. Md. Nor Musa**
Director OTEC UTM

and

Dr. Subhashish Banerjee
Post Doctoral, MJIIT

Science & Technology Of OTEC SYSTEMS

The ocean has immense potential for producing energy. Oceanic energy sources include wave energy, ocean currents, tidal energy and OTEC. Except for tidal energy, all of them are directly sourced from solar energy. Waves are formed due to the differential heating which produces wind, and these waves' mechanical energy is utilised to produce electricity. The energy from higher water levels in high tides – the tidal energy – is also utilised to produce electricity.

Ocean currents exist due to pressure differences between two different locations in the ocean. However, in OTEC (Ocean Thermal Energy Conversion) system, the temperature difference between the warm surface ocean water (SOW) and cold deep ocean water (DOW) is utilised to run a heat engine to generate electricity. The efficiency of such electricity production power plant is mainly dependent on the degree of temperature differential between the source and the sink.

8 SECONDARY FORMS OF SOLAR ENERGY

Source: A. Bakar Jaafar

Science of OTEC

Energy resource is one of the most important criterions in the deployment of any energy system. The ocean absorbs about 15% of solar insolation, of about 1.9*1018 MJ/year. The upper layer of ocean gets insolation from the sun and is heated up. With an increase in depth, the temperature starts falling due to Lambert's law of absorption.

At a depth of 1000 metre the temperature can be as low as 40C whereas at the surface of the ocean it may vary between 250C to 300C. The variation of sunlight penetration with depth is shown in Fig 1.

Normally, in equatorial and tropical regions the temperature of the upper layer of the ocean is above 250C, year round; whereas in the temperate region it can be lower. That is why the deployment of OTEC in the equatorial region is more lucrative than in temperate zones. The minimum 20K temperature differential between the upper-most and lower-most layers of the ocean, for the OTEC power plant to operate, is maintained round-the-clock throughout much of the year.

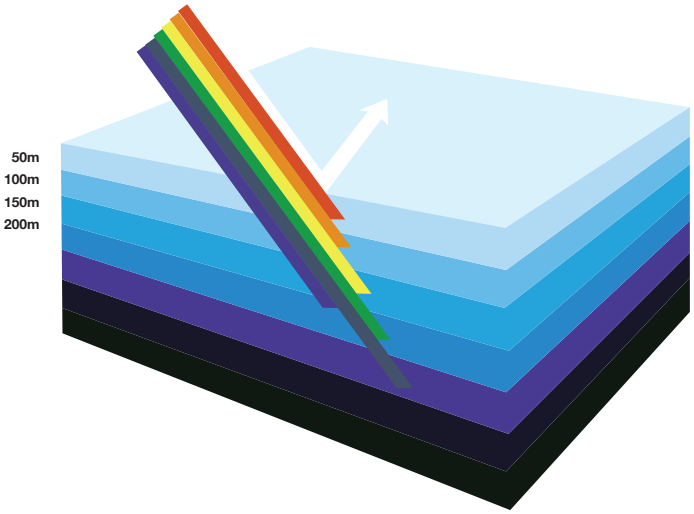

Fig.1. (i) Variation of sunlight with ocean depth; (ii) Forms of Solar Energy (Zakir Naik)

OTEC Technologies

OTEC power plant technologies are classified into three types, depending on the type of fluid used for their power generation.

Open Cycle OTEC

In the open-cycle OTEC power plant, warm SOW itself is used as the working fluid to run the turbine. SOW is pumped into a vacuum evaporator maintaining a pressure at 0.03 bar, at which the boiling point of water lowers down to 26.40C.

The evaporated steam obtained in the boiler is passed through the low pressure turbine connected to a generator which produces electricity. After passing through the turbine, the steam passes through the condenser exchanging heat with

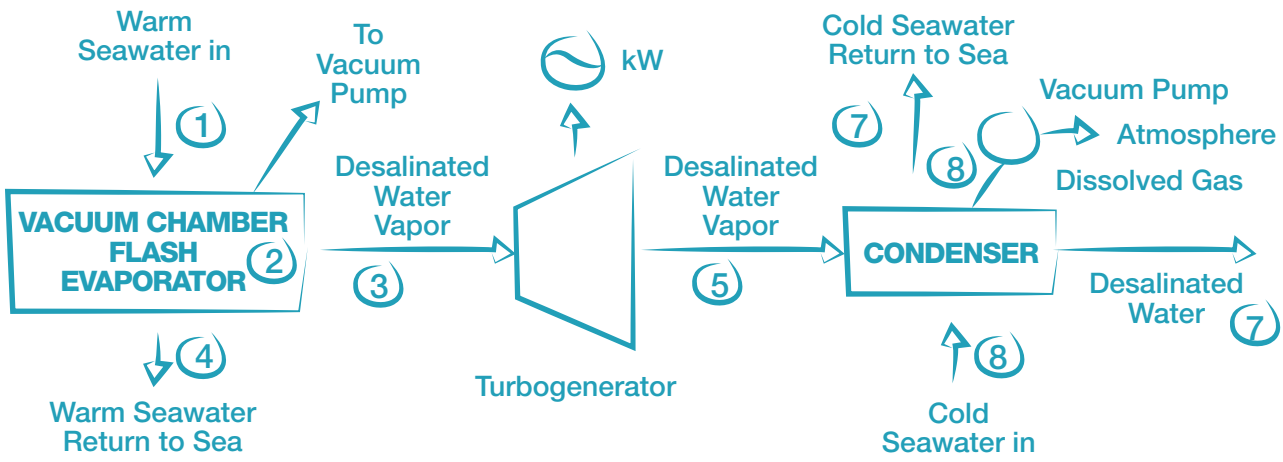

Fig.2. Schematic of OC-OTEC Plant (Vega 1999)

a 40C cold DOW. This is called open cycle because the condensate need not return to the evaporator. The condensate of the evaporated water can, however, be utilized as desalinated water. The schematic flow of such OC-OTEC is shown in Fig 2.

Closed Cycle OTEC

In this plant, a low boiling fluid like liquid ammonia (boiling point 33.50C at 1.013 bar and having vapour pressure 8.88 bar at 210C) is vaporized when in contact with warm SOW passed through the heat exchanger. The expanded vapour runs the turbine which turns a generator. The outgoing vapour from the turbo-generator is cooled and condensed to liquid in a 2nd heat exchanger by a cold DOW.

Low boiling hydrocarbons, e.g. propane, propylene, are also considered for use as working fluids respectively. Recent advancements make use of low boiling non-azeotropic mixtures like ammonia and water to achieve better efficiency of power generation.

The flow sheet diagram of CC-OTEC operation is shown in Fig 3.

Hybrid type OTEC plant

This type combines both CC-OTEC and OC-OTEC in its operations, using both ammonia and warm sea water as the working fluids. It makes steam just as in the OC-OTEC type. But to run the turbine to produce electricity, a low boiling fluid like ammonia etc. is used instead of steam. It produces desalinated pure water as a by-product alongside the power generated. However, it must be added here that the hybrid-type OTEC, unlike the CC-OTEC or OC-OTEC plants, has not yet been tested for practical application. It remains a theoretical concept to maximize thermal efficiency.

On-Sea and On-Land trial runs of OTEC Technology

In 1926 Georges Claude began research on the subject, and in 1930 built a fully-operational closed loop system OTEC in Northern Cuba which showed negative energy balance. His plant however got damaged from tropical storms. The first successful OTEC technological demonstration was achieved in 1979. It was a barge mounted CC-OTEC plant generating net power of 10-15kW, from gross power production of 50kW. It used titanium plate heat exchanger with its cold water pipes extending to a depth of 650m.

MITI of Japan sponsored a 100kW CC-OTEC plant which was commissioned in the island of Nauru in the mid-Pacific Ocean. This land-based plant was run drawing cold water from a depth of 520m, laying a 900m long pipe through the ocean floor. The cell and tube side heat exchangers were copper-coated stainless steel tubes in the evaporator and titanium in the condenser.

Freon was used as the working fluid with the trade name R-22 (Cohen 1982). The 34kW net power successfully produced from this plant since October 1981 was fed into the Nauru Electrical grid for around a year; till the entire plant got wiped out by a hurricane (Takahashi 1999).

In 1993 a land-based experimental OC-OTEC plant in Hawaii successfully generated power of 210kW for five years (Vega 1999). A small fraction of the 10% steam

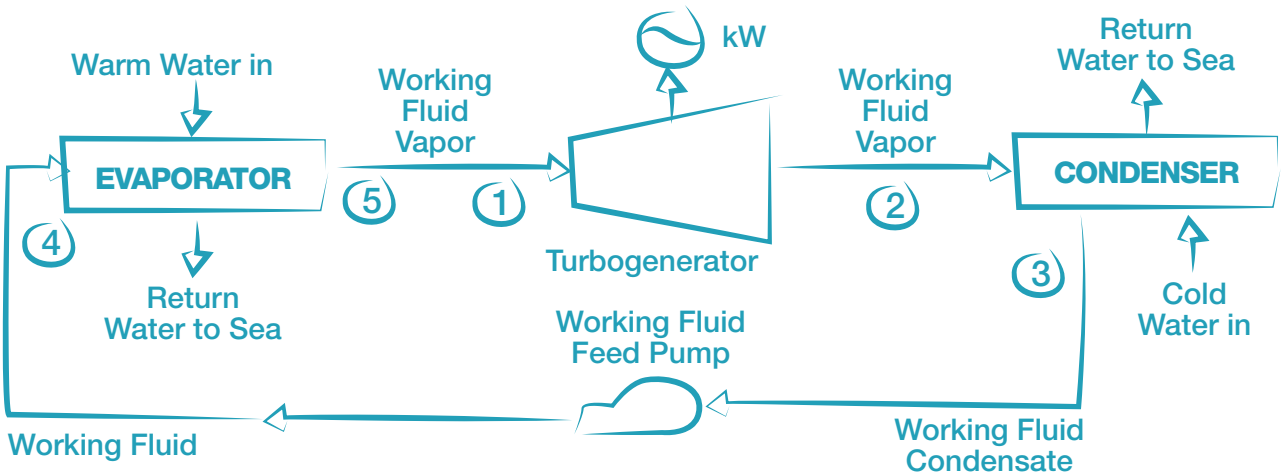

Fig.3 Flow-sheet diagram of CC-OTEC (Vega 1999)

produced in the evacuator was diverted for the production of desalinated pure water as a by-product in the condenser, amounting to 0.4l/sec. The maximum power [gross] produced reached 255kWe, despite the plant been not optimised. A commercial optimised plant is expected to maintain the ratio of gross to net power at 0.7kW, whereas this non-optimized plant showed the ratio to be 0.5kW only (Vega 1999).

It may be concluded that OTEC is a secondary form of energy obtained from the heating-up of the ocean surface by insolation from the sun, and the gradual decrease in temperature with depth. This difference in temperature is fruitfully utilised to run a heat engine to generate electricity. Various types of OTEC designs have been considered and each of them has merits and challenges. Amongst them, hybrid types of OTEC plants seem more promising as they produce both power and desalinated water which is required in many coastal regions. However hybrid types remain theoretical concepts for the maximization of thermal energy.

The efficiency of OTEC power plant is mainly dependent on the degree of temperature differential between the source and the sink.

viewpoints

by **Dr Aini Suzana Binti Haji Ariffin,**
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and

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Malaysia-Japan International Institute of Technology

BRIEF REVIEW ON OTEC DEVELOPMENT, STRATEGIES & WAY FORWARD

Ocean Thermal Energy Conversion (OTEC) is a base-load energy generation system that utilises the differential temperature of about 20°C, between the warm seawater at the oceanic surface and cold seawater at around depths of 700-1000 meters. This creates a potential for tropical regions – a prospect that has been explored by various countries such as Japan, France, United States and the Netherlands.

In the 1930s, one of the main research drivers for OTEC was the possible decline in fuel resources, notably, coal. This research was short-lived after World War II, with the subsequent exploitation of oil. In 1973, the oil crisis emerged, revealing supply vulnerability and this revived OTEC research in France. Today, OTEC industry is gaining growing interest in geographically suitable countries, such as the United States, Japan, the Netherlands, South Korea, Africa, Indonesia, the Philippines, and Malaysia.

Since 2013 Malaysia, through the OTEC Centre of Excellence under Universiti Teknologi Malaysia (UTM), aggressively promotes OTEC development nationwide. The focus is not only on electricity generation, but also hydrogen production to maximize economic potential. As meeting energy demand is an area of national importance because it supports social well-being and economic growth, the Government is always monitoring current and long-term energy needs. Malaysia currently has a capacity of 29,944 MW of electricity, with a recorded peak demand of 16,901MW (leaving a surplus of 4,043MW). Energy sources include coal, piped gas, LNG and hydro.

The Organisation for Economic Co-operation and Development[1] (OECD) has consistently predicted expanding worldwide markets for renewables. This reveals some potential for OTEC development and construction. It is anticipated that by the year 2020, the demand for OTEC in the Asia Pacific region would be 20GW. The demand may rise to 100GW[2] in 2050. However, according to the World Energy Council[3], this projected growth would be highly dependent on the early operation of the technological demonstrators.

A recent study by the French Department of Energy revealed that the global potential for OTEC is a weighted installed base of 150GW, with a priority market of 6GW emerging on islands and 9GW in isolated areas. By 2030, 1.5GW of OTEC should be installed"[4].

Over the last decade, more efforts have been concentrated on the research and development of OTEC. The report published by International Renewable Energy Agency (IRENA)[5] provides a useful perspective of OTEC potentials worldwide. International OTEC Symposiums were held; in Hawaii in 2013, followed Busan, South Korea in 2014 and in Kuala Lumpur, Malaysia in September 2015, in attempt to link up OTEC-related stakeholders and share relevant

knowledge and experience on the development of OTEC.

Global State of Strategizing OTEC Development Projects

The first known OTEC system was proposed by the French Engineer Jacques Arsene d'Arsonval in 1881[6][10] using a closed-cycle system. His student, George Claude furthered his work and was the first to demonstrate the open-cycle system in Cuba during 1930s. On October 6, 1930, Claude's team started a 22kW generator and lit up an array of lamps. The plant operated for only 11 days, as it was destroyed by a storm. Dr. Claude made a second attempt in Brazil, to produce ice. This also failed due to a storm[7]. The research and experiment were discontinued due to lack of financial viability and declining fuel prices[8,9].

Jacques d'Arsonval initial work was resumed almost 100 years later by France's IFREMER in the 1970s, and today by DCNS. DCNS decided to invest in OTEC because of its already-available technical know-how and to fulfil the competency requirements of systems engineering[10]. As of 2012, DCNS has 13,183 employees, 2.9 billion euros in revenue, 14 billion euros in its order book, with 1/3 of its revenue from international sales .[11]DCNS' resources include 30 team members from the thermodynamical engineering and system engineering sectors, naval architects, heat exchangers, risers, mooring systems, and ocean survey equipment (among others)[12]. As France is a pioneer for the OTEC industry, key OTEC players include DCNS; the Ocean Thermal Energy PLD (OTEplc, a UK-based financing company which recently became a partner of DCNS); French Research Institute for Sea Exploitation; Ministry of Ecology, Sustainable Development, Transport and Housing; International OTEC/DOWA Association; and La Martinique Regional Council.

DCNS has established research and development work in Brazil, Ireland, Belgium, Saudi Arabia, India, Malaysia and Singapore. Several OTEC projects have also been carried out in Hawaii, Japan, South India, Southern China, Martinique, Bahamas, Bora Bora and Tetiaroa. The features/status and progress of the projects are presented in Table 1.

Table 1: List of Known OTEC Projects

Location	Power output planned	Features/Status/Progress	Developer
Hawaii	103Kw	Closed cycle system. One of the oldest installations. Installed in 1979	NELHA Natural Energy Lavboratory
Hawaii	1MW	Open cycle system. Operated between 1993 and 1998. It is a land-based plant for power generation. It also focused on use of water for aquaculture.	OTEC International LLC and NELHA Natural Energy Laboratory Hawaii
Hawaii	10MW	Closed cycle system. Near shore platform. Planned to be functional by 2013 but was shelved. Funded with a grant of USD 4.4 million from the Naval Facility Engineering Command. Prior to 2009, Lockheed Martin was also awarded USD 12.2 million for preparatory OTEC design and exploration.	Lockheed Martin Naval Facility Engineering Command
Japan/ Nauru	120 Kw	Closed cycle system. Operated in 1982 and 1983.	Japan Institute for Ocean Energy Research
Japan, Imari	30Kw	Served as demonstration plant. several others have been builit in earlier stages by Saga University.	Saga University; other partners
Japan/ Okinawa	50Kw	Completed on in June 2013 – a demonstration and R&D plant near Kumejima Island. It is a land-based plant for electricity, research, aquaculture, agriculture, cooling systems etc. There is possibility of scaling up to 125 MW.	Xenesys Incorporated, IHI, and Yokogawa
India- Tuticorin South India	1MW	Ammonia-based closed cycle system. Started in 2000, not completed due to problems with pipes for pumping the seawater. It is a floating plant	Indian Government/ Indian Institute of Technology

Table 1: List of Known OTEC Projects (continue)

Location	Power output planned	Features/Status/Progress	Developer
Southern China	10 MW	In April 2013, an agreement was signed for the development of a 10 MW offshore OTEC installation on the Southern Coast of China between Beijing Based Reignwood Group and Lockheed Martin.	Lockheed Martin, Reignwood Group
Martinique/ Bellefontaine 10 MW	10MW	This is a floating platform of the DCNS Consortium. Progressing well and aims to be operational from 2016. A second plant (in Reunion Island) has been considered.	DCNS France-South Korea 20 kW Installed in 2013 KISOT
Bahamas/ Baha Mar	NA	USD 104 million project providing cooling for Baha Mar Resort. Facing permit issues/ infrastructural and ecological issues, conflicts with navigation issues and cabling, coast protection issues. The project seems to have at least temporary stalled.	Ocean Thermal Energy Conversion Corporation
Bora Bora	NA	It is a land-based plant. Used for air conditioning only with no power generation.	Intercontinental Hotel Bora Bora

Source: IRENA [1]

Strategic Approach

In June 2013, OTEplc and DCNS signed a Memorandum of Understanding (MOU) to jointly develop and build Ocean Thermal Energy Conversion, among other systems in selected markets[13]. OTEplc, a UK-based company, will develop, build, own and operate OTEC and SDC Systems, and procure financing for these projects. DCNS will be the EPC (Engineering, Procurement, and Construction) contractor for the OTEC and SDC Systems. Two initial projects have been selected: Land-based OTEC and SDC Systems for the US Virgin Islands (USVI) and a floating OTEC system for Asia.

More major industrial groups are interested to participate by offering turnkey OTEC power plant, giving guarantees on performances. DCNS will be launching several commercial plants, including onshore 4-6MW and 30MW+ power plants.

DCSN has invested an ambitious development budget since 2008, comprising 30 team members with various expertise. Table 2 shows their activities and milestones from 2008-2016:

Table 2: OTEC milestones by DCNS

Year	Activity
2008	Pre-feasibility study in Martinique
2009	Feasibility study in “La Réunion”
2010	Feasibility study in Tahiti Evaluation was done on the impact of the installation, design confirmation, additional measurements and studies to ensure required parameters and characteristics.
2010-2011	Contract for a land based prototype. Onshore small scale prototype will be installed by 2011 to test, to optimize and to validate the energy system of the OTEC [23].
2011-2013	MoU’s with export utilities and SPV’s
2012-2017	Design of a 16MW offshore pilot plant in La Martinique.

Table 2: OTEC milestones by DCNS (continue)

2013	OTEC/ SWAC combined cycle project developments. 1st onshore 4-5MW OTEC plant to be announced.
(June) 2013	OTEplc and DCNS signed a Memorandum of Understanding (MOU) to jointly develop and build Ocean Thermal Energy Conversion, among other systems, in selected markets [24]
2014	First offshore OTEC project to be announced. Targeted the installation in Reunion Island as the first World experimental offshore OTEC power plant in 2014. The project's financial pooling outlined by the end of 2010. [23]
2015-2016	DCNS later shifted the location of its proposed 10 MWe offshore ocean thermal pilot plant from Réunion to Martinique, where it is scheduled to commence operation around 2015. If this project is selected as one of the thirty renewable energy projects being funded by a multi-billion-euro initiative sponsored by the European Commission (EC), half the cost of this pilot plant project will be financed by the EC.

Source: Chino[14]

Japan, in her effort to comply with the Kyoto Protocol, which calls for the reduction of her greenhouse gas emissions by 6% of the 1990 level, proposed to build OTEC plants in Indonesia in a carbon emission exchange programme.

Lockheed Martin, a US-based company, has formulated a market entry strategy for OTEC by identifying the convergence point among countries with availability (temperature gradient), dependency on oil markets and limitation of other renewable sources. Apart from the commercial market, it targets the Department of Defence as potential customer. Lockheed Martin estimated a production capacity of between 10MW-100MW is required to fulfil the demand of these markets.

The Way Forward

OTEC is a niche industry that demands systems engineering competencies and industrial capacities that limit the number of players involved in its development . Its development requires an integrated and strategic approach. Advances in technology and the unpredictable price of conventional fuel make this venture a necessity.

The OTEC Centre of Excellent, UTM, is working on the Environmental Impact Assessment (EIA), feasibility study, and the development of an OTEC Foresight and Roadmap as part of a comprehensive multi-national vision, strategy and collaboration effort. At the same time, it will conduct fundamental and applied OTEC research, develop a stable market structure for OTEC and identify areas suitable for further development.

Currently, there is no policy to support the development of OTEC in Malaysia. It is suggested that the Government formulate and gazette a law on OTEC development in order to expedite and facilitate this major national initiative.

One of the main research drivers for OTEC was the possible decline in fuel resources.

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viewpoints

by **Prof Dato' Ir Dr Abu Bakar Jaafar,**
Professor in STI Policy & Co-Chair, UTM OTEC

Mohd Haris Abdul Rani,
PhD Candidate with UTM OTEC

Dr Aini Suzana Haji Ariffin,
Lecturer Perdana School of STIP

and

Datin Sharina Shaukat,
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A LEGAL AND POLICY FRAMEWORK ON OTEC THERMAL ENERGY-DRIVEN DEVELOPMENT

In Malaysia

A nation's economic activities are governed by regulations that oversee events taking place within that economy or their relationship with others. Securing adequate legal provisions to regulate such activities will go a long way towards ensuring the viable and robust development of a nation's economy.

Instituting clear and reliable legal provisions is paramount to promoting and protecting the interests of both local and international investors; ensuring proper protection of the natural environment; creating opportunities to embrace sustainable energy implementation; and safeguarding public interest. Without proper regulations, the cohesiveness of economic success and social integration would not be there. Any kind of prolonged existence without a suitable regime of regulations might lead to a possible collapse of any given economic activity.

Ocean thermal energy-driven development (OTEDD)[1] was first coined

[1] Refers to any kind of technology, equipment used for the generation of energy, and the production using the ocean thermal energy concept and/or design on land and in the deep sea.

[2] UTM OTEC: Preferred Path for existing knowledge of technology: Commercialisation> Development > Research rather than the traditional route: Research > Development > Commercialisation.

Instituting clear and reliable legal provisions is paramount to promoting and protecting the interests of both local and international investors; ensuring proper protection of the natural environment; creating opportunities to embrace sustainable energy implementation; and safeguarding public interest.

by A. Bakar Jaafar as a technology-based activity which can gear itself into becoming a new economic activity with investment potential worth billions of Ringgit. The need to promote and protect investments, ensure sustainability of the marine environment, create new and reliable sources of energy (preferably renewable), and securing stakeholder interests are key national concerns. The failure to address them may result in major adverse impact on the Malaysian economy and its stakeholders. Therefore a proper regulatory framework on ocean thermal energy-driven development is critical to ensuring the success of any Ocean Thermal Energy Conversion (OTEC) programme in Malaysia. Such a framework should also embody the principles of natural justice by ensuring its proper administration and in promoting fairness for all members of society.

Since research on OTEC development is ongoing and its implementation is about to take off , all legal determinants must be completed. As there is no local literature to help guide investigations into the legal requirements for OTEDD in Malaysia, it is important that a study be carried out to determine the adequacy of the current regulatory framework on OTEDD. It is fortunate, however, that a preliminary study conducted in late 2014 noted that there are elements of legislative support on OTEDD and OTEC.

Ocean Thermal Energy-Driven Development And Current Laws

The main question in that study was whether there are sufficient laws that support or obstruct the implementation of OTEDD and OTEC. Twelve legislations were reviewed[3] and initial findings show that any legal and policy impediments affecting both activities are minimal. However, this does not necessarily mean that the answers are definitive and do not require further clarification or interpretation. Unlike the United States which created an act specifically for OTEC – the Ocean Thermal Energy Conversion Act 1980 (OTEC Act, 1980) – Malaysia does not have a specific law on OTEC or OTEDD.

There are two principal legal questions. First, the constitutional rights conferred by the Federal Constitution on the subject of 'energy' and its 'legal jurisdictions'. As a nation with a federated state system, Malaysia upholds the principle of division of power in the laws between the federal Government and the States. This division is clearly spelled out under the 9th Schedule comprising the Federal List, State List, and Concurrent List. The Federal List relates mainly to matters of national interest like treaties, agreements, and conventions with other nations, defence, military, civil and criminal law, financial matters, and internal security. The State List covers state sovereignty issues like land, protection of wild animals, town planning, water, drainage and irrigation, among others. The Concurrent List is a joint authority list covering subjects where the federal and state governments share responsibilities authorising both entities to create their own unique laws depending on needs arising from time to time. Social welfare, scholarships, and public health are examples of matters under this list.

As ocean thermal energy is a form of energy, it falls directly under the Federal List[4] which confers exclusive rights to the Federal Government to enact all types of laws on energy. Therefore, the Federal Government has complete authority to legislate laws on OTEDD and OTEC.

Such clarity in the constitutional provision would assist in promoting a well-defined and clearly-regulated OTEDD and OTEC development programme and to avoid a multiplicity or overlapping of regulations. The success story of Petronas which has its origins in the enactment of the Petroleum Development Act 1974[5] is a

[3] (1) Federal Constitution, (2) Renewable Energy Act 2011 (Act 725), (3) Energy Commission Act 2001 (Act 610), (4) Sustainable Energy Developing Authority Act 2011 (Act 726), (5) Exclusive Economic Zone Act 1984 (Act 311), (6) Territorial Sea Act 2012 (Act 750), (7) Baseline of Maritime Zones 2006 (Act 660), (8) Continental Shelf Act 1966 (Act 83), (9) Electricity Supply Act 1990 (Act 447), (10) Gas Supply Act 1993 (Act 501), (11) Atomic Energy (licencing) Act (Act 310), (12) Petroleum Development Act (Act 144)

[4] Item No. 11. [mentioned only once throughout the entire document]

[5] Act 144.

[6] Act 725.

[7] Section 2.

good example of an energy production law created by the Federal Government, the sole authority for making laws on petroleum.

The second area of concern is on the terminology of energy itself; OTEDD comprises economic by-product activities created by applying OTEC technology to produce energy. OTEC is recognised as a method of producing energy which is acknowledged as a renewable energy source.

In Malaysia, renewable energy is governed by the Renewable Energy Act 2011 . However, the subject of 'ocean thermal energy' is not specifically mentioned in this Act as a source, neither as energy nor as renewable energy. This is because the act identifies 'renewable energy' as electricity produced from renewable sources while 'renewable resource'[7] refers to renewable energy mentioned in the first column of the first schedule of the same Act, that is, 'biogas', 'biomass', 'small hydropower', and 'solar photovoltaic energy'. However, although there is no mention of 'thermal energy' in the first column of this act, the inclusion of OTEC technology can be seen in the same definition section on 'renewable energy installations' where 'renewable thermal… energy' is included. [8]Therefore, the word 'thermal energy' implicitly includes ocean thermal energy.

Policy And Institutional Framework Of Otec

The energy sector has been the pillar of Malaysia's economic growth as it contributes to about 20% of the national GDP. The target is to increase the total GNI to RM241 billion by 2020 from RM 110 billion in 2009. The development of OTEC may also contribute to the increase in GDP as well as GNI for the country. Therefore, the formulation of an OTEC policy and institutional framework is very crucial. Amongst major elements that need to be studied and incorporated into the policy are OTEC-relevant technology development, Economic Infrastructure, Energy Pricing, Investment, Security, Human Capital Development, Green Mobility, Education, Employment, ICT, Public Health and Risk, Water Supply, Green Agriculture, and Waste Management. Formulation and effective policy implementation may bring better coordination, management and collaboration in expediting OTEC development projects in Malaysia.

The Way Forward

The two main legal questions do provide strong indication that although potential challenges may arise in terms of the legal provisions over OTEDD or OTEC implementation, such activities could now gather greater momentum towards becoming a reality. OTEDD and OTEC have the potential to provide Malaysia with a new source of power that could meet the ever-increasing demand for energy as well as promote stronger economic growth. An ongoing study on providing further data, information and suggestions will greatly assist federal government agencies to formulate -- and for the Parliament of Malaysia to enact -- specific laws for governing OTEDD and OTEC activities in Malaysia in the coming years.

In the meantime, any investments related to OTEC could be governed by either the Territorial Seas Act of 2012 or the Exclusive Economic Zone Act of 1984.

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[8] Section 2: 'renewable energy installation' means an installation which generates renewable energy and includes any technical facility of that installation which converts mechanical, chemical, thermal or electromagnetic energy directly into electricity.

viewpoints

by **Mizuan Abdul Manaf**
CEO UTM Holdings Sdn Bhd

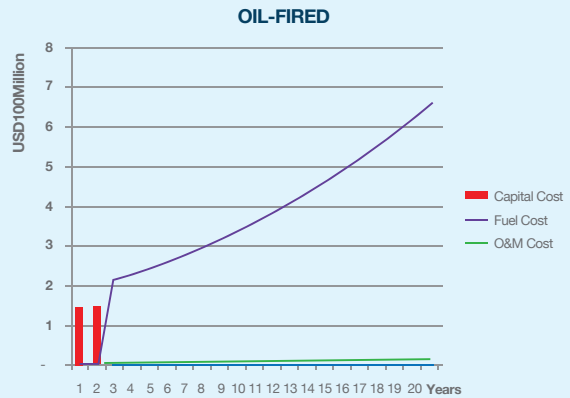
Investments of the Future: OTEC BUSINESS PLAN

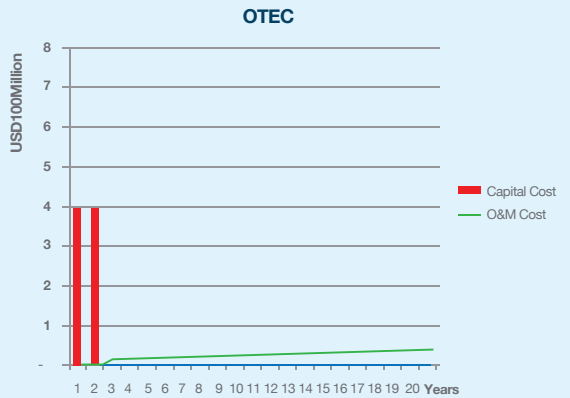
Ocean Thermal Energy Conversion (OTEC) in Malaysia can be considered a "blue ocean" sector and a potentially disruptive technology that can eventually affect the existing Malaysian energy industry and its value chain. Therefore, getting the attention of investors requires a holistic approach whereby the journey from idea to revenue generation – followed by strategy on sustainability and growth – must be clearly detailed.

The energy demand for electricity and transportation in Malaysia is estimated to be approximately 20,000MW and 25,000MW respectively. OTEC can definitely play a big part with its potential for installed capacity of more than 50,000 MW. Designing an OTEC Power Plant from concept to completion is very modular and can be integrated to suit the identified site. The whole supply chain can be easily established to assure investors that nothing will be left out from resource to production.

2015 - Signing MoU between UTM Holdings (Joint Venture with Deep Sea Thermal Solutions Sdn. Bhd.)

The OTEC Power Plant business model and financial projection are very similar to typical power plants, which are mostly fuel powered. Nevertheless, investors need to





100 MW Plant

OIL Total Cost: USD 7.7 billion

OTEC Total Cost: USD 1.5 billion

look at the total life cycle cost and be less critical of the initial capital expenditure. By comparing total life cycle between OTEC and a Fuel Powered Power Plant, we shall see that even though OTEC capital expenditure appears to be 2.5 times more, the total life cycle costs indicate that OTEC saves US$6.2 Billion / 100MW. This is due to the fact that OTEC is not fuel dependent and therefore, not affected by volatile fuel costs.

OTEC Power Plant has two primary products: Electricity and Hydrogen. Since most of OTEC potential areas in Malaysia are relatively far from the shore, the main customers for electricity are the Deep Sea O&G Platforms. Hydrogen demands shall be from the fuel cell industries such as transportation, smart-grid and data centres. At this point however, it is important to note that the OTEC Power Plant in Malaysia should not be designed to compete with the existing energy carriers but rather to complement them. For example, OTEC Power Plant can help solve current energy issues such as peak hour electricity demand, remote area power supply and replacement for subsidized transportation fuel.

The secondary OTEC Power Plant by-products are potable water and recycled deep-sea water (DSW). While the former can be used for consumption at deep-sea O&G platforms, the latter is very valuable for its relatively chilled temperature and high nutrient content. Proven DSW usage in cooling systems and cultivation of aquaculture and agriculture can be seen in Hawaii and Japan.

It is always challenging to start up a venture and get returns quickly. It is even more challenging to sustain and continuously grow the business. That is why investors do not normally stop at being convinced with just the feasibility and viability studies. For venture like OTEC Power, investors also look for the “essential values” that strengthen and protect the venture.

OTEC Power Plant in Malaysia should not be designed to compete with the existing energy carriers but rather to complement them.

These essential values can take the form of patented Intellectual Properties within the integrated modules of OTEC Power Plant (i.e. Turbines, Heat Exchangers, Membrane, Integrated Design and Controls System). Strict NDA with principal manufacturers and the whole OTEC supply chain can be part of the essential values as well. Another important value is strong equity partners and, to a certain extent, the involvement of the principal manufacturer and/or EPCC contractor. Finally the most crucial value to investors is government support and involvement in the venture in the form of a comprehensive Malaysia OTEC Act and Policy.

It would be an additional bonus to investors if the venture is able to contribute via royalty/savings and Green Technology spin-offs respectively. Spin-off companies and job creation throughout the supply chain of fuel cells and DSW by-products would definitely have a great impact on the venture as well.

Distinguished Participants @ EWC-EAPI Workshop on Shipping Energy &the Environment, Honolulu, November 1981

US companies ready to pump more money into Malaysia

NAZLIAN ISMAIL

NEW YORK: At least two major American companies have expressed their interest to make additional investments in Malaysia, thus attesting to their continued confidence in the government's efforts to create a positive environment for investors.

ConocoPhillips, the United States' third largest integrated energy company and fifth largest refiner in the world, may make an additional US$1 billion (RM3.57 billion) investment in their operations in offshore Sabah, which will see a production of 300,000 barrels of oil a day by 2016.

It had already pumped in US$1.5 billion in terms of investments for its interests in three deepwater blocks off Sabah, Block G, Block J and the Kebabangan (KBB) Cluster. It is expected to start production next year.

Eastman Chemical Company is looking at making an additional investment of US$300 million for its co-polyester plastics plant in Pahang.

Officials from these two companies met Prime Minister Datuk Seri Najib Razak at a roundtable meeting with American business leaders at the Harvard Business School Club here.

"These companies expressed confidence in the investment opportunities in Malaysia and

Prime Minister Datuk Seri Najib Razak addressing leaders of Fortune 500 companies during a meeting at Harvard Club of New York on Thursday. Bernama pic

PM happy with investors' feedback

From Page 1

of their satisfaction with our policies.

"This also reflects on our ability to compete with other countries in the region and that we are at the forefront in attracting foreign investments to our shores."

Najib said he had agreed to the undertaking of a study on the potential of generating power from the ocean to offshore Sabah.

The request came from the Ocean Thermal Energy Corporation chairman and chief executive officer Jeremy Haynes, whom he met after the roundtable.

Adi Charis, an international insurance and financial services ar-

gumentation, is also keen to set up backroom operations in Malaysia.

Najib said he was happy with the outcome of his two-day working trip to the US, as he was able to get firsthand feedback from the investing community here.

"One constraint raised was of our skill sets, especially among degree and PhD holders, to undertake high-value jobs. It is crucial for us to produce the right skill sets."

He also said it was the government's task to narrow the divide between the perception and reality of what was happening in the country.

"We have to encourage these to Malaysia to be third-party validators to convince the others who don't know about us."

19 May 2012 – Prime Minister's Press Conference at New York, USA

by PM. Dr. Fauziah Sh. Ahmad
International Business School, UTM

The Q & A of TECHNO-ECONOMIC ANALYSIS OF OTEC

What is Techno-Economic Analysis (TEA) in Ocean Thermal Energy Conversion (OTEC) and why it is important?

TEA is basically a combination of feasibility and viability assessment of an intended technology-based project. For example, in the case of OTEC, we have to combine the process modelling of the OTEC engineering design with economic evaluation to gain both qualitative and quantitative understanding of the market and financial impacts of the conversion breakthrough.

In other words, we must understand thoroughly the conceptual process design, the energy gains, the capital and project cost estimates, the capital budgeting and the environmental analysis.

How do we evaluate and develop appropriate perspectives towards the viability of long-term technology infrastructure projects such as OTEC?

From a micro perspective, developing a commercially-viable project is crucial to firstly ensure adequate revenues to cover costs, operation and maintenance; and secondly in mitigating risks and attracting commercial investments.

However, we must also adopt the macro perspective in anticipating project spinoffs in the form of development catalyst, social impact and environmental sustainability. These positive impacts might not be captured in the cash flow or income statement of the OTEC investment. So, we have to be more positive and open to see things in a bigger perspective.

What are the essential elements for a good financial viability study in the TEA of OTEC?

Basically, some elements of the Financial Plan include: Important Assumptions, Key Financial Indicators, Break-even Analysis, Projected Income Statement/Profit and Loss, Projected Cash Flow, Projected Balance Sheet and Business Ratios.

An analysis of the cash availability and cash needs of the business must reflect a company's operating, investing, and financing activities on its cash balance. The considerations include how much cash does the venture generate from operations? How to finance fixed capital expenditures? How much new debt to leverage on? Would the cash from operations sufficiently finance the business?

Financiers would normally rely on **a cash flow budget which may be the best approach to start a venture.** They also rely on Capital Budgeting which explains Payback Period or the length of time required to 'pay back' (recapture) the original investment. It must also reveal the Net Present Value (NPV) which relies on the premise that a dollar today is worth more than a dollar in the future.

The cost of capital is the rate used to adjust future cash flows to determine their value in present period terms. This procedure is referred to as discounting the future cash flows—cash value is determined by the present value of the cash flow. Another consideration is the Internal Rate of Return (IRR method) which is similar to the net present value method, but future cash flows are discounted at a rate that makes the net present value of the project equal to zero.

How viable is the OTEC project in Malaysia based on your TEA Study?

We have the capacity and the required natural temperature differences in sea water based on the required depth of the water. These technical aspects have been thoroughly investigated by our engineers. So my focus is to translate the conversion process into financial statements to appreciate the potential financial returns. We need to anticipate the value of the energy gained, in this case in terms of hydrogen power revenue vis-a-vis a comparable energy. The market is more comfortable comparing renewable energy prices to current oil rates although, I must say, this is not the best of solutions as certain attractive aspects like energy efficiency, renewable capacity and non-greenhouse gas emissions would not be accounted for. Nonetheless, we follow the 'popular market' needs and work on numbers based on oil prices which have dropped significantly from US$100/barrel to US$70/barrel recently.

We made certain assumptions on plant capacity, capital costs per Megawatt and exchange rate; and the findings indicate reasonable net present value (NPV) and internal rate of return (IRR) which is at RM41 million and 14.32% for 5MW Plant at an oil price of US$100/barrel. When the oil price dropped to US$70/barrel, the NPV dropped to RM23 million and the IRR became 12%. So we can conclude that it is a reasonable financial return for a small capacity plant. With a bigger plant, we can anticipate better conversion efficiencies and better returns as well.

by Dr. Akbariah Mohd Mahdzir
and Marziah Hj. Zahar,
Malaysia-Japan International Institute of Technology

OTEC SPIN-OFF INDUSTRIES AND SOCIO-ECONOMIC TRANSFORMATION

In facing the universal challenges of dealing with energy issues and global warming, various solutions have been proposed including solar power, hydroelectric power, wind power, hydrogen power, nuclear power, biomass and other renewable power sources to address rising energy demands. OTEC, with its immense resources, clean and renewable energy, and base-load power capability, is a very attractive solution to face these challenges.

It is almost clear that OTEC development in Malaysia could be the next catalyst for sustainable development to address issues as diverse as biodiversity, cyber security, energy security, environmental and climate change, food security, medical and healthcare, plantation crops and commodities, transport and urbanization, and water security. It can significantly contribute to the socio-economic transformation

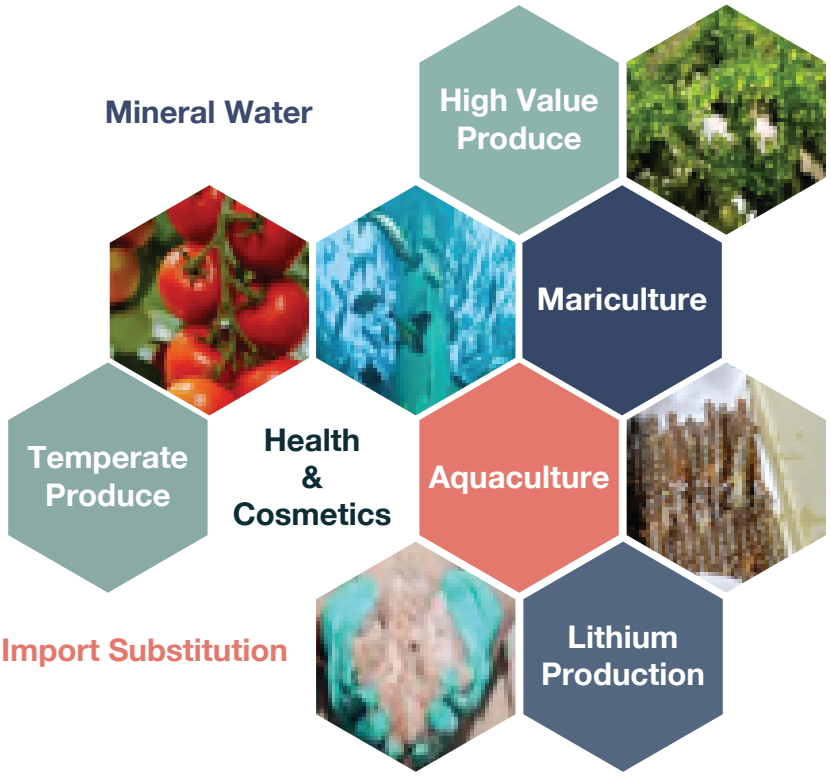
OTEC development in Malaysia could be the next catalyst for sustainable development to address issues as diverse as biodiversity, cyber security, energy security, environmental and climate change, food security, medical and healthcare, plantation crops and commodities, transport and urbanization, and water security.

of society at large. The main by-products of an OTEC plant, deep sea water in particular, supports numerous spin-off industries that range from industrial cooling to mariculture.

The Hawaii Ocean Science & Technology (HOST) Park, the site of the first net energy producing OTEC plant, has been the leading test facility for OTEC technology since 1974. It is a good example of the success of OTEC spin-offs for socio-economic transformation. To date, this park hosts tenants that include industries from aquaculture, mariculture, agriculture, pharmaceuticals, nutrient producers, bottled water production and renewable energy. Amongst the tenants of HOST are Big Island Abalone; Kona Cold Lobsters; and Black Pearls Inc, known for its oyster hatchery technology; Ocean Rider, a commercial seahorse farm; and Kona Coast Shellfish, a shellfish nursery/hatchery; Pacific Planktonics; Cyanotech Corporation, which produces natural nutrients using microalgae technology; and Blue Ocean Mariculture. In 2012 alone, Cyanotech ended the year with revenues of US$27 million.

OTEC spin-off industries have also been successfully developed in Japan. Deep sea water utilization has transformed Kumejima Island into one of the highest earning fresh-food producers in Japan. The revenue for 2013 is over US$20 million, constituting 25% of the island's Gross National Product. Apart from the financial returns, thousands of job opportunities have been created as a result of these booming industries.

Taking the successes of Hawaii and Japan as examples, Malaysia should tap into the possibility of developing OTEC spin-off industries such as Production of Temperate Produce; Marine Culture of High Value Fish, Prawns, Lobsters, Abalone, Oysters; Culture of Seaweeds; "Takumi" Fish-Aggregation; Production of Micro-algae for Jet-Fuel; District Cooling; Lithium Production for Batteries and Mineral Water Production. OTEC Spin-off industries can elevate the country to developed-nation status by 2020, with our targeted GNI per capita of RM15,000.

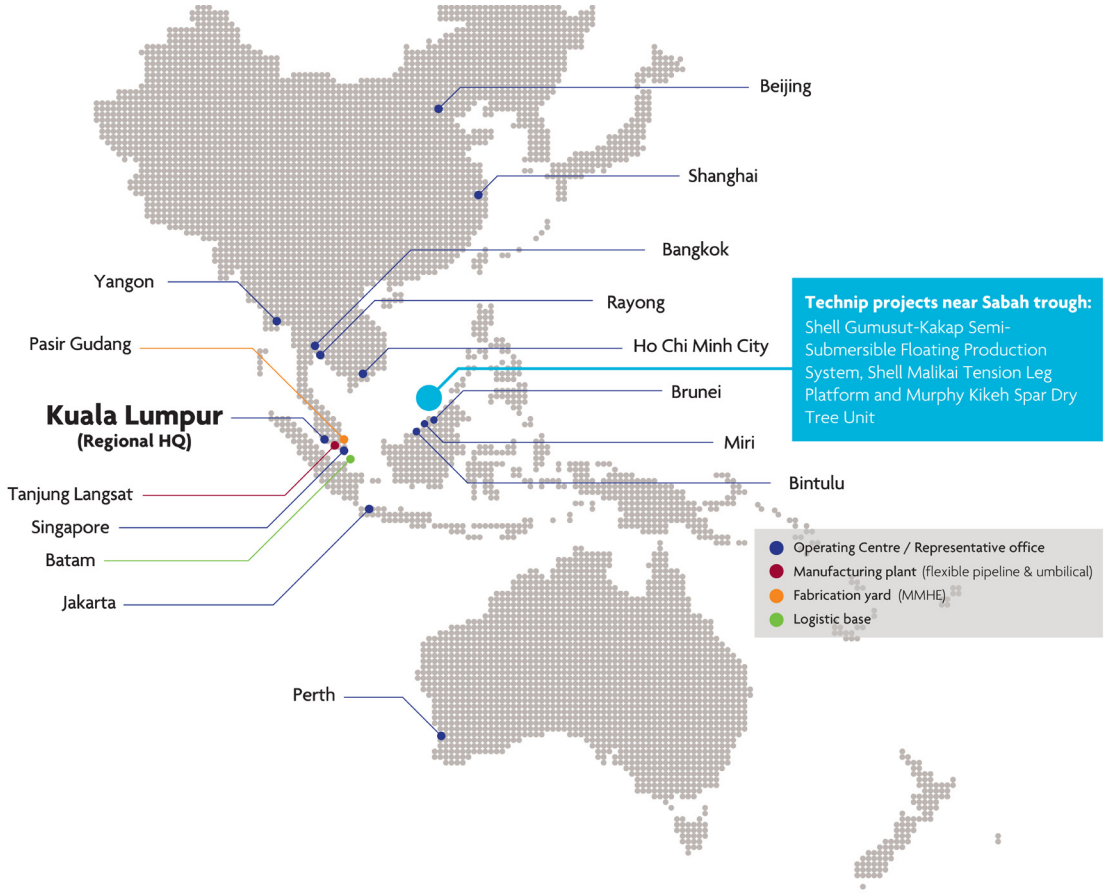


viewpoints

by Technip

TECHNIP'S OTEC CAPABILITIES IN MALAYSIA

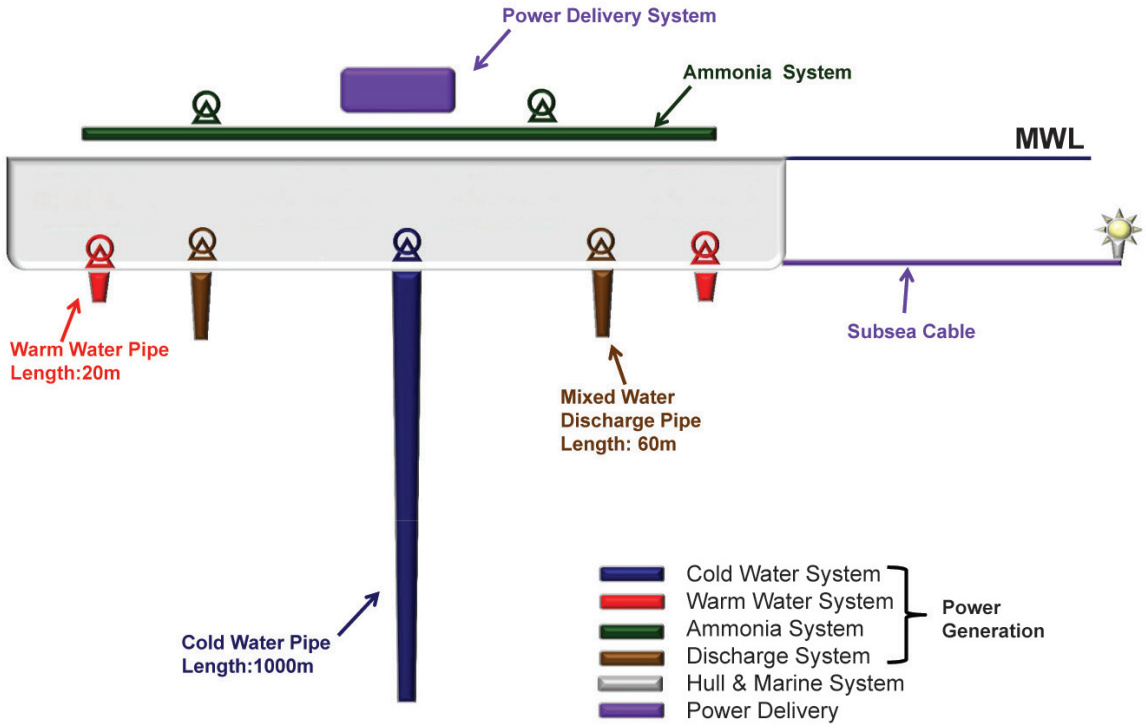
For many years academic and industrial researchers in Malaysia, particularly Universiti Teknologi Malaysia (UTM), have been doing research on the commercialization of Ocean Thermal Energy Conversion (OTEC) development for power generation (5MWe to as high as 100MWe) using the Sabah Trough as the cold water source. Technip had independently considered the technical and commercial feasibility of OTEC, pooling resources from its various global operating centres with a focus on the Sabah Trough by virtue of its depths of beyond 1000m. These two independent initiatives culminated in an OTEC Workshop in April 2015 between Technip and UTM. Both parties had already been mutually benefiting from their long-standing collaboration for general Offshore R&D and technical competency development of Malaysian university students.



To further the industry-academia relationship, an OTEC Technology Collaboration has been advanced between the two to fulfil academic as well as business objectives, which would be in line with the Malaysian government's aspiration of further diversifying its energy resources. Technip's vast experience in offshore engineering projects for O&G operators close to this trough adds to the effectiveness of this collaboration.

Having presence in the region for more than 30 years, Technip is a world leader in project management, engineering and construction for the energy (subsea, offshore and onshore) industry. In addition to its flexible and umbilical manufacturing plant in Tanjung Langsat, Johor, Technip has marine assets – the G1201 and Deep Orient – dedicated to subsea construction and

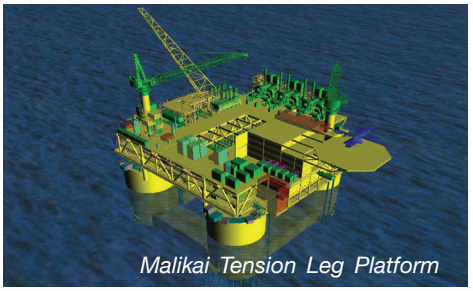
Technip's projects near Sabah trough



installation works, and fabrication capability through its affiliation with MMHE, Malaysia's largest fabrication yard, located in Pasir Gudang, Johor.

Providing a range of services, Technip in Asia Pacific, with Kuala Lumpur as its regional headquarters, is at the forefront of the industry with technological leadership in deepwater developments and innovations such as the Spar, Floating Liquefied Natural Gas and Tension Leg Platform facilities in the region.

Technip has built many of Malaysia's 'Offshore Firsts' including the nation's first and second deepwater development – the Kikeh Spar in offshore Sabah, which is the first spar outside the Gulf of Mexico; and Gumusut Kakap – a semi-


Malikai Tension Leg Platform


Gumusut Kakap Semi-Submersible


Kikeh Spar

Both parties – Technip and UTM – had already been mutually benefiting from their long-standing collaboration for general Offshore R&D and technical competency development of Malaysian university students.

submersible floating production unit for Shell. Currently, Technip is carrying out Malaysia's third deepwater development which is the Malikai Tension Leg Platform.

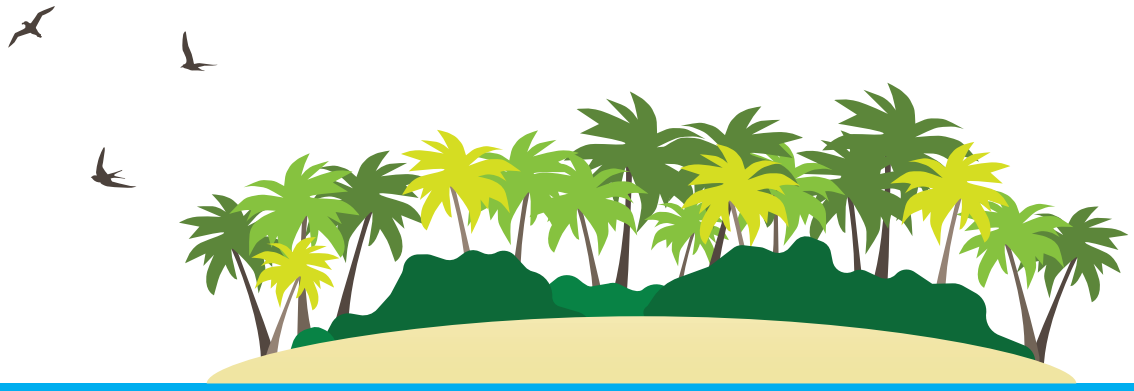
An OTEC facility described in this article would constitute equipment supplied from reputable Malaysian and global suppliers, and could be assembled/constructed in a Malaysian fabrication yard. In addition, Technip is able to offer its offshore R&D, engineering, procurement and installation know-how, along with the same high QHSES standards used in oil and gas projects.

Through OTEC, Technip as a key contributor to global energy solutions is developing its renewable energy strategy and capability to harness the power of nature which is crucial to meeting the world's future energy needs.

by **Dr. Shadiya Baqutayan**
Perdana School STIP

and

PM Dr. Jennifer Chan Kim Lian
Universiti Malaysia Sabah



Social Transformation Of Undeveloped Coastal And Island Communities With OTEC SOLUTION

Islands share many common attractions including natural resources, coral reefs, fishes, mangroves, coastal vegetation, and beautiful white sandy beaches with clear blue waters. Lives on the islands are normally peaceful and harmonious. However, some islands are well-developed while others remain relatively undeveloped. The common pertinent questions asked with regard to islands are: How do we maintain and protect islands' ocean resources? What will happen to the resources in undeveloped islands? What are the threats that affect undeveloped islands? And, more importantly, how can the government transform these undeveloped islands and their populations?

Challenges such as climate change (Richardson et al. 2009), high levels of environmental degradation (UNEP 2009), peak oil consumption (Kerr 2007), decline of water quality (Spait, 2001), and limitation in energy sources (Ooi & Chew, 2012) have a strong impact on these islands and make them unsustainable. Therefore, the ability to change to new arrangements when the current state is no longer viable (Gass 2010; Brookfield 2012) are needed to protect such islands and their communities. Transformation in communities is seen in the way society and culture change in response to such factors as economic growth and development, industrialization, modernization, and

war or political upheavals (Polanyi, 1944). The transformation of an island is often the result of its dependence on tourism that brings about cultural, social, economic and political changes, and it affects its ethnic and historical identity and geography (Currin, 1999).

An example on the impact of transformation of an island and its communities is Pulau Banggi, Sabah. The coastal communities of Pulau Banggi are economically underdeveloped, and they are overly dependent on the island's reef fisheries for livelihood. Population growth, international market demand, and the arrival of illegal fishing vessels have combined to increase pressure on reef fishery resources, leading to perceived declines in catch rates over the past 20 years.

Energy source was another concern at Pulau Banggi. Limitations in energy sources and overdependence on fossil fuels have impeded development. The introduction of Ocean Thermal Energy Conversion (OTEC) activities is possibly the best solution for Pulau Banggi and its communities. Through the OTEC Solution, Pulau Banggi may experience a great transformation that could have major implications, particularly for the economic, social and environmental development of the island.

According to Chan (2014), OTEC implementation may herald economic and social development of the coastal and rural areas of Sabah. With the supply of reliable and cheaper source of electricity, the quality of life and wealth of the local communities will be enhanced. It also enhances fishermen's livelihood along the island coastal area. It is postulated that OTEC may bring more business opportunities in the coastal and rural areas of Sabah, especially in the diversification of tourism products and services undertaken through community tourism. The transfer of skills and knowledge to the local community is envisaged in multiple areas, leading to better quality products and services. The implementation of OTEC offers more avenues for research and innovation in various product developments in various fields, such as marine and coastal aquaculture, agriculture, tourism products, tourism leisure and recreation activities, water quality and skin care products. More importantly, the implementation of OTEC brings an alternative reliable and cheaper source of electricity to the coastal areas of Sabah.

OTEC will likely support the region in terms of job creation; lower oil dependency; improvements in the efficiency of technologies; promotion of self-sustaining industries and greater employment opportunities; boosting of leisure, recreation and tourism activities; improvements in the transportation of goods, services and people; provision of a viable source of renewable energy; sustenance of biodiversity and waste disposal systems; and a natural sea defence. It would also promote research and education resources and help preserve the geographic heritage.

It is important to note that the Federal Government of Malaysia and the Sabah state government are embarking on aggressive policies to promote large-scale use of renewable or green energy, and there is strong consensus that Malaysia is looking at OTEC as a primary source of ocean-based renewable energy (Yaakob 2013).

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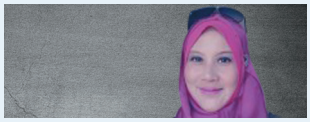

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STRATEGIC MARKETING FOR EMERGING TECHNOLOGIES

Marketing hi-tech technologies and industries is never easy, and marketing OTEC technologies and industry needs a gigantic effort.

Regis McKenna, a well-known consultant and author in the areas of technology and marketing, states that high-tech industries are characterized by complex products, large numbers of entrepreneurial competitors, customer confusion and rapid changes. McKenna and William Davidow are considered pioneers in this area as they made a name for themselves in Silicon Valley. McKenna addresses the aspects of communication while Davidow takes a more comprehensive look at the topic of high-tech marketing.

Shanklin and Ryans, in a Harvard Business Review article stated that key high-tech characteristics include a strong scientific/technical basis. However, they also point out that the new technology can turn obsolete and become old technology rapidly as new technologies come on stream and their applications create or revolutionize demand.

According to an influential 1989 article by Moriarty/Kosnik of the Harvard Business School, the first discussions on the possibility of high-tech marketing began at the end of the 1970s. They remarked that the fast-paced global high-tech industry is not without its own distinct and complex challenges. Every player in the industry is striving to gain and maintain competitive differentiation by adopting new approaches or by realizing latent sources of success in existing operations. Even the best innovation in the world is meaningless without customers.

Marketing is the area most cited by technology intensive companies as being neglected. According to market researchers, many of the problems faced by new technology companies are marketing related. These problems include lack of corporate identity, lack of marketing expertise; poor customer relations, difficulty in gaining channels of distribution, lack of international contacts and inability to reach target markets.

What are the target markets for OTEC, specifically in Malaysia? The

High-tech industries are characterized by complex products, large numbers of entrepreneurial competitors, customer confusion and rapid changes.

future is hard to predict, risky and has its own physiognomies.

There are a variety of characteristics that describe the high-tech market (assuming otherwise heterogeneous conditions), and the OTEC industry is no exception. This includes the high level of uncertainty with the seller and the customer, as well as product complexity. According to high-tech marketing researchers, complexity is often seen as an additional high-tech characteristic. Complexity in penetrating the market and reaching its customer needs a strategy. Strategic marketing is derived from strategic management. The father of management, Peter Drucker, began with the question "What account for superior results?" And then came up with the answer: outputs – management and markets of success.

Successful marketing in high-tech industries like OTEC means that firms must find their own distinct marketing and technological areas of competence and use these strengths to establish a position in the market. In order to do this, a consistent strategic thrust is essential. Despite the turbulence which characterizes such markets, a constant presence is the only way to ensure a relatively stable and significant profile. Although strategic planning forms an indispensable first stage in the marketing process, the specific implementation largely determines the ultimate success.

Malaysia is blessed with the opportunity to explore the hydrogen generation market via OTEC; supply of power, either electricity or hydrogen fuel, as a competitive energy carrier. The Sabah trough in East Malaysia is identified as geographically fit for the generation of electricity from its deep ocean. In its embryonic stage, Malaysia is ready to take off the emerging technologies by advancing in technology for sighting. Foresight activities of any kind imply a future orientation of the participating entities and attempt to successfully deal with change. Foresighting OTEC's market for Malaysia posits a clear value for the practice. One of the productions of OTEC system is the generation of hydrogen fuel cells. The report, 'Hydrogen Generation Market by Geography, by mode of Generation & Delivery, by applications and by Technology - Global Trends & Forecasts to 2019', defines and segments the global hydrogen generation market with an analysis and forecast of revenues. The hydrogen generation market will grow from an estimated $103.5 billion in 2014 to $138.2 billion by 2019, with a CAGR of 5.9%. The huge market can only be tapped by adopting the best practices that expand its orientations in high-tech marketing holistically.

Appropriate strategic conception is thus a necessity. Attention should also be drawn to the significant temporal element and dynamic uncertainty which pervades high-tech markets and frequently overrides the familiar conventional ordering of strategic analysis, planning and implementation. In other words, what makes dealing with all this so complex is that in practice, effective strategies do not unfold in a comfortable and conventional pattern, but rather in a heuristic process based on the viability and feasibility within a framework of a given market and competitive circumstances.

The high-tech market includes the high level of uncertainty with the seller, the customer, and product complexity.

UTM-OTEC is embarking into the heuristic process in all aspects of OTEC technological innovation by integrating key activities into the strategic management process. One of the key emphasis in its strategic marketing development is to immerse everyone into the OTEC notion. A new wave of technology in Malaysia is making its entry for the benefit of future global society.

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viewpoints

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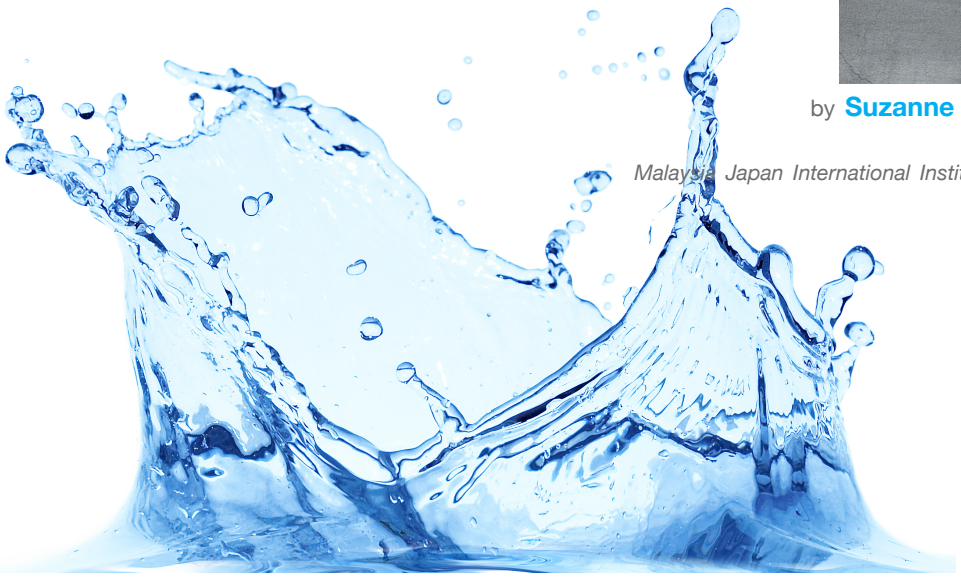


CREATING POTENTIALS
OTEC INDUSTRY

The economy of our future is replete with growing concerns over the energy trilemma; energy security, energy equity and environmental sustainability. Innovative technology solutions are needed to prepare ourselves for projected growth in energy consumption and ensure a sustainable future. Various technology solutions have been explored, including solar, geothermal, wind and wave. However, only Ocean Thermal Energy Conversation (OTEC) has the potential to deliver baseload energy supply, in addition to creating a multitude of spin-off industries, such as mariculture, aquaculture, cosmeceuticals, district cooling, chilled soil agriculture, and potable fresh water all at once.

Research on OTEC started as early as the 1880s, but interest declined due to declining fuel prices and the accompanying lack of project viability. However, recent global developments have invoked renewed interest, especially from stakeholders based in tropical waters regions. These regions are ideal for OTEC operation, which requires a water temperature gradient of at least 20°C to function.

Several countries are actively pursuing large-scale deployment of OTEC. Companies and governments in France, Japan, the Philippines and South Korea have developed roadmaps for OTEC development (Brochard, 2013; Marasigan, 2013; Kim and Yeo, 2013; Okamura, 2013). Indonesia is mapping out its own OTEC potential (Suprijo, 2012), and the Philippines has been considering feed-in tariffs for OTEC (NREB, 2012).

In the case of Malaysia, a new law on ocean thermal energy development is being proposed (Bakar Jaafar, 2013). In addition, the Malaysian government has given approval for the Ocean Thermal Energy Corporation to conduct a study to generate electricity from the deep sea in Sabah. (Bernama, 2012).

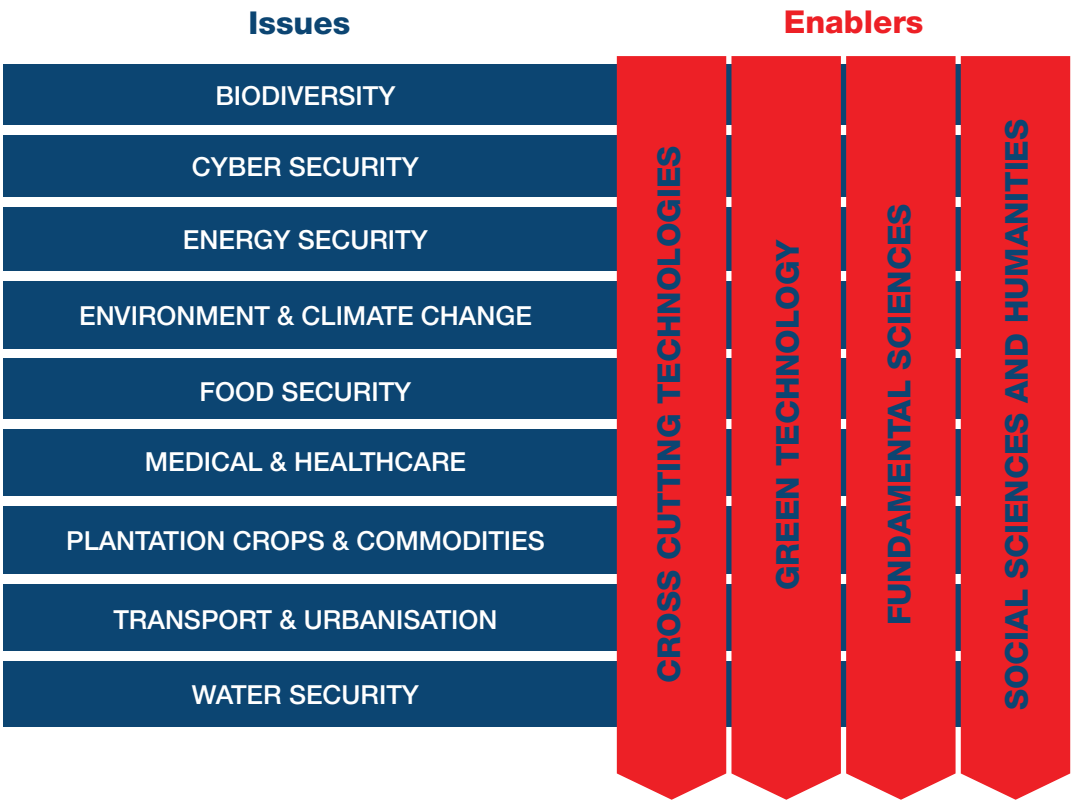


Figure 1: Focus Areas of National Council For Science & Research Of Malaysia

OTEC has the potential to address all nine Focus Areas of the National Council for Science and Research of Malaysia. This 24-hour, non-intermittent energy supply ensures energy security and cyber security (as a backup power generation). This zero-emission technology also acts as a carbon sink that may help mitigate environment pollution and climate change. Food security, plantation crops and commodities, and biodiversity are also ensured through the repurposing and irrigation of the nutrient-rich deep sea water. Water security is also addressed, with potable water being an important OTEC spill-over product. Finally, transportation and urbanization can be eased through the sustainable use of hydrogen — a by-product of OTEC, and a fuel source for rapidly-emerging hydrogen fuel cell vehicles.

As with any new technology, strategic planning and sound management are needed to capitalize on its potential and to make most effective use of resources. Reference guidelines and technical inputs are needed to inform policy formulations, gauge readiness, and support investment decisions. Therefore, there is a need for an OTEC roadmap as a 'multi-national vision, strategy and collaboration needed to: conduct fundamental and applied OTEC research, develop a stable market structure for OTEC, identify areas suitable for development, perform in situ environmental studies, build a trained OTEC workforce, contracting services and infrastructure, improve performance and reduce costs, and resolve grid integration issues' (Kehoe 2013).

With Malaysian OTEC development only at its infancy stage, treading this path is new terrain. While some may be apprehensive over this uncertainty, OTEC's benefits, abundance, and prosperity are difficult to ignore. It is best expressed in the poem below,

Two roads diverged in a wood, and I— I took the one less travelled by, And that has made all the difference."

Robert Frost, 1916

viewpoints

by **Dr Aini Suzana Haji Ariffin,**
Lecturer Perdana School of STIP

Advantages and Challenges of OTEC

OTEC has been viewed as an attractive technology due to its vast potential and benefits. Its main goal is to create a source of clean energy by harnessing the abundant seawater in tropical climates for base load electricity generation. However, it has its advantages and challenges.

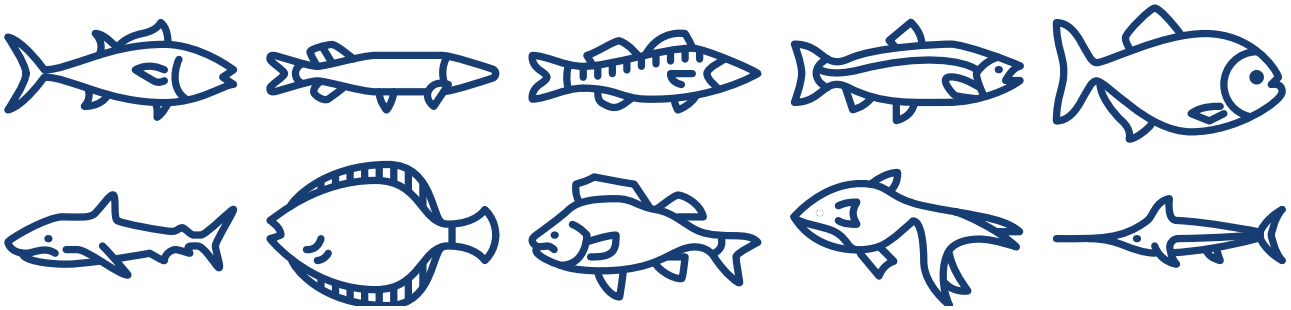
Advantages

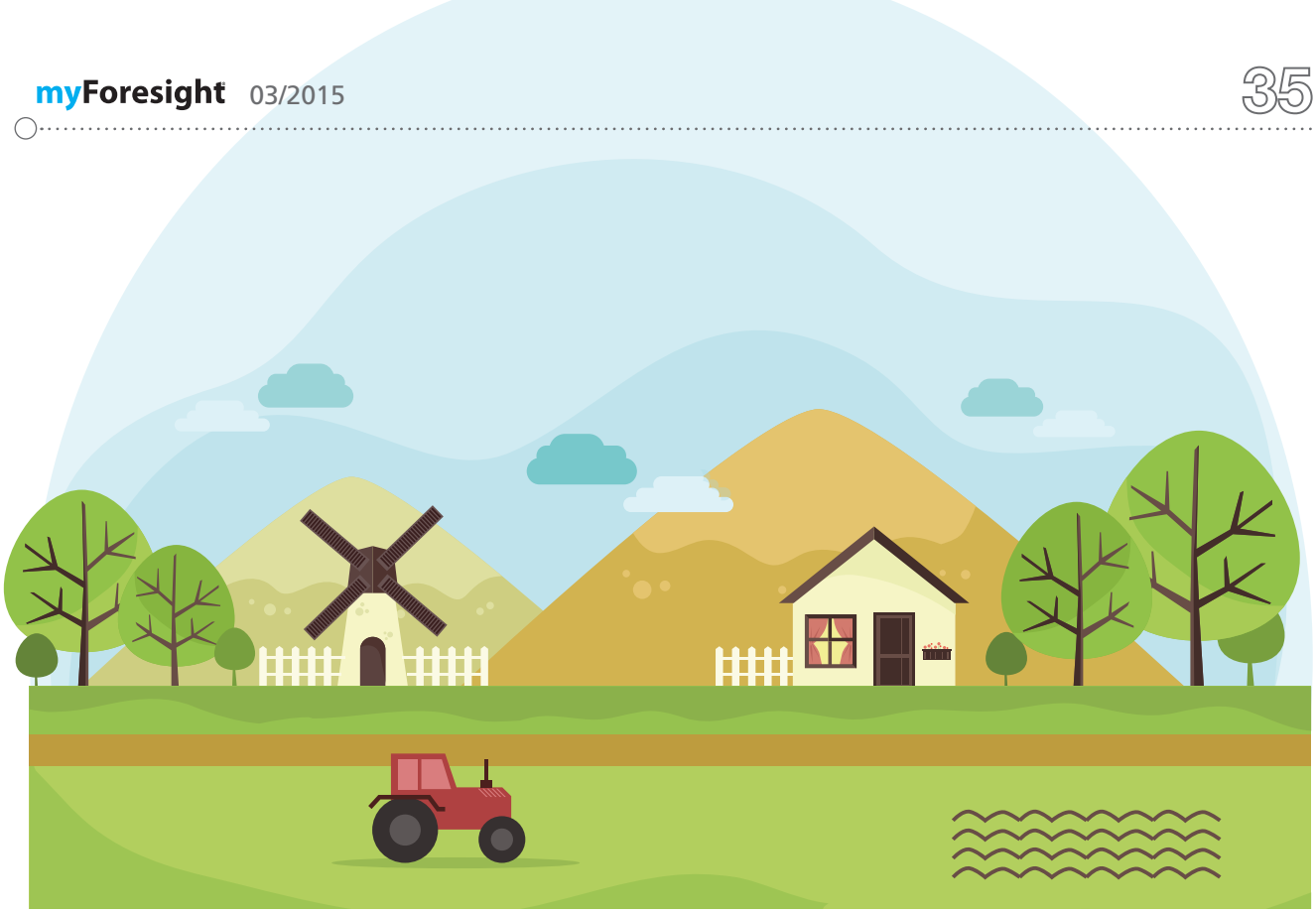
The energy output is constant, reliable, and environmentally-friendly, as it does not discharge any CO^2, but works as a CO^2 sink. This makes it suitable for supporting energy-intensive manufacturing in tropical regions[1,2].

OTEC brings various economic benefits through co-products such as potable water, enhanced fish farming, seawater-cooled greenhouses and air-conditioning systems. Its massive release of mineral-rich Deep Sea Water is applicable to industries such as pharmaceuticals, aquaculture and cosmetics.

Fresh water can be produced in open-cycle OTEC plants when heated water is vaporized to turn the low pressure turbine. Once electricity is produced, the vaporized water is condensed to make fresh water[3]. This water has been found to be purer then water found in most communities. It is estimated that 1 MW plant can produce 55 kg of water per second. Once cold water pipes are installed for an OTEC power plant, the cold water pumped to the surface can be used for other projects besides functioning as a working fluid for the condenser. It can also be used to circulate through the space of heat exchangers or to cool the working fluid within heat exchangers[4]. This technology can be applied for hotel and home air conditioning as well as for refrigeration schemes.

Seawater life including salmon, abalone, American lobster, flat fish,





sea urchin and edible seaweeds can be harvested for food using the cold water pipes that would be readily available from the OTEC power plants[5]. There is also the potential of increasing overall food diversity by using cold water originating from the deep ocean. By burying a network of cold water pipes underground, the temperature of the ground would be ideal for spring-type crops like strawberries and other plants that are generally restricted to cooler climates.

Challenges

Challenges to OTEC have several dimensions: Engineering, Financial, and Regulatory Uncertainty.

The OTEC community should be planned to suit various economic ventures associated with OTEC projects. This includes fresh water production, air conditioning and refrigeration, aquaculture and cold water agriculture.

Environmental concerns include habitat destruction from the installation of moorings, cables and pipes; biota toxic response from biocide/ammonia release; biota attraction and interference from platform, noise, and electromagnetic fields. One major concern is the closed-loop and hybrid system that depends on a low-boiling-point working fluid (ammonia or chlorine) to facilitate heat exchange[6]. These potentially harmful substances could leak into the ocean if the pipes were to ever be damaged.

Another problem would be the habitat disruption in the ocean due to the installation of the pipes[7]. There are also other obstacles faced by almost all new technologies as they are introduced -- the lack of experience with the operation of an OTEC pilot plant of sufficient size, and the time required to build up investor confidence and to better assess environmental benefits as well as the limits of the resource[8]. In addition, there exists competition from other renewable energy sources which are less technologically challenging and easier to deploy[9].

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viewpoints

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MARINE MICROBE

Secrets from the Ocean

How many of us have realised that the ocean has its own "elf" to ensure sustainability in the marine ecology system so that it can thrive forever? Studies by scientists show that the "elf" is actually a marine microbe. Microbes such as bacteria have existed in the oceans for billions years[1]. It has been scientifically proven that one millilitre of the seawater contains millions of bacteria cells[2].

Research in marine bacteria diversity in the ocean is very difficult, expensive and treacherous. Bacterial mechanisms that survive under extreme pressure and in complex physio-chemical environments are still not properly understood[3]. Collecting and preserving bacteria cells are very challenging as it cannot be cultivated in the laboratory.

One possible way to understand how bacteria affect the marine ecosystem is to study the common marine bacteria that have already infected humans and marine animals. There are findings that strengthen the hypothesis and create an understanding of the virulent mechanisms that causes infection and fatality in human and marine life. However, certain bacteria are able to degrade some chemical compound such as hydrocarbons (e.g. oil), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), heterocyclic compounds, pharmaceutical substances, radionuclides and metals[4]. These finding encourage the effort to investigate the true potential of bacteria for bio-remedial purposes.

Malaysian waters are found to contain a high abundance of sulphur-degrading bacteria. To ensure reliability and to minimize the loss in bacteria identification, Malaysian scientists have implemented Next Generation Sequence (NGS) technology to achieve precise and accurate results[5].

It has been proven that bacterial presence is larger in sediment than in open water and many of these species seem to be non-pathogenic towards humans, while still carrying pathogenic genes. Therefore, it is important to have an in-depth study on bacterial abundance to evaluate whether our deep sea water can be utilized for OTEC by-products such as drinking water, mariculture enhancers and pharmaceutical products.

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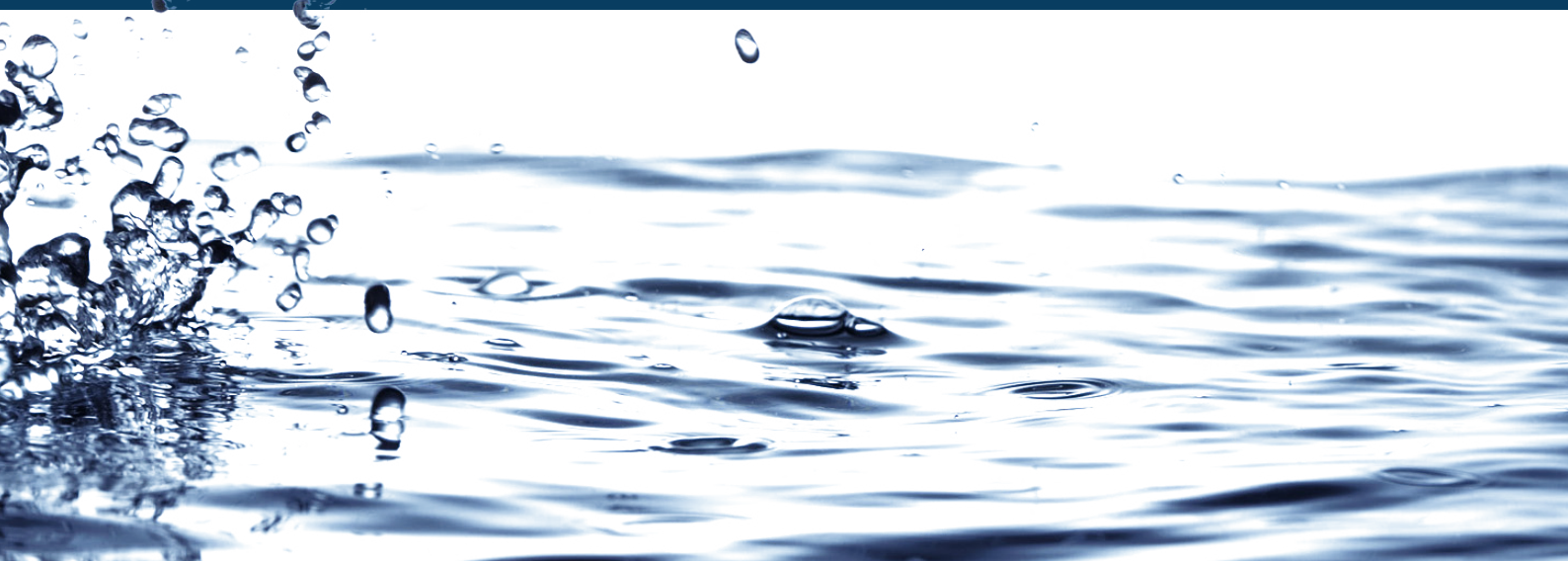

viewpoints

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Mineral Water from the Deep Sea:

A MIRACLE TO THE HEALTH

People keep assuming that drinking water is just for hydration purposes, thirst, and detoxification etc. Water however is not just H_2O but a nutrition source. Drinking water that has rich nutrient content is definitely a good choice. There are many kinds of water available such as mineral water, ionized water, reverse osmosis water, alkaline water and the healthy water known as Zam-Zam water. Research on the production of various kinds of drinking water for health benefits leads to the discovery of deep sea water (DSW). DSW contains mineral ions including magnesium (Mg), calcium (Ca), potassium (K), chromium (Cr), selenium (Se), zinc (Zn), and vanadium (V) that are essential to our bodies[1,2]. DSW contains lots of minerals because it has been subjected to less photosynthesis in plant planktons, less consumption of nutrients, and much organic decomposition that releases lots of nutrients to the immediate environment. Deep sea drinking water (DSDW) is currently produced in many countries, Japan, Taiwan, South Korea and USA.[1,2,3,4] through the process of desalination to remove its high salts concentrations. Blending of minerals (originated from DSW) is a common method used to restore the minerals in DSDW.

The most promising benefits attained from the intake of DSDW include its ability to improve cholesterol profiles in the serum and liver. DSDW can reduce triglyceride (TG), non-high-density lipoprotein cholesterol (non-HDL-C) levels, and total cholesterol (TC) in the serum and liver of animal models [3,5,6,7]. Drinking water made from DSW in Japan contains Magnesium (600 and 1000 ppm) in the so-called "Amami no Mizu" bottled water which decreases cholesterol by 18% to 15%[8]. Interestingly, a study of DSDW consumption in hypercholesterolemic individuals shows that DSDW can reduce TC, LDL and decreased lipid peroxidation. Furthermore, treatment with DSDW can help prevent the atherogenesis process (the formation of plaque in the inner lining of an artery, which deposits fatty substances, cholesterol, and other substances) [3, 9].

DSDW can reduce body weight [2,10]; improve cardiovascular hemodynamics and lower the blood pressure [1,3,6]; improve glucose intolerance and suppress hyperglycemia which indicates a possibility to treat diabetic problems[11]. DSDW can also treat skin problems. In the study of patients with atopic eczema/dermatitis syndrome (AEDS) who were treated with DSDW, the improvement of skin symptoms such as inflammation, lichenification, and cracking in skin were observed [12]. In another study, intake of DSDW has reduced allergic skin responses and serum levels of total IgE, Japanese cedar pollen-specific IgE, in patients with allergic rhinitis.

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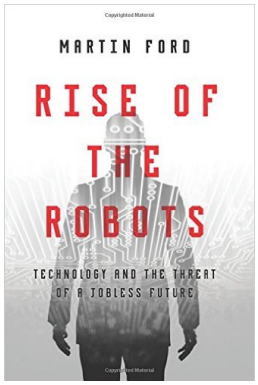
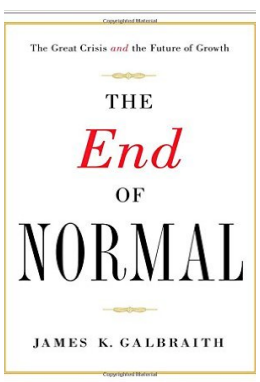
myForesight Book Club



Rise of the Robots: Technology and the Threat of a Jobless Future

ISBN: 0465059996
ISBN-13: 978-0465059997
Author : Martin Ford
Publisher: Basic Books

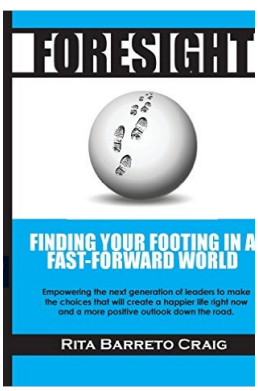
What are the jobs of the future? How many will there be? And who will have them? We might imagine—and hope—that today's industrial revolution will unfold like the last: even as some jobs are eliminated, more will be created to deal with the new innovations of a new era. In Rise of the Robots, Silicon Valley entrepreneur Martin Ford argues that this is absolutely not the case. As technology continues to accelerate and machines begin taking care of themselves, fewer people will be necessary. Artificial intelligence is already well on its way to making "good jobs" obsolete: many paralegals, journalists, office workers, and even computer programmers are poised to be replaced by robots and smart software. As progress continues, blue and white collar jobs alike will evaporate, squeezing working- and middle-class families ever further. At the same time, households are under assault from exploding costs, especially from the two major industries—education and health care—that, so far, have not been transformed by information technology. The result could well be massive unemployment and inequality as well as the implosion of the consumer economy itself.



The End of Normal: The Great Crisis and the Future of Growth

ISBN-10: 1451644922
ISBN-13: 978-1451644920
Author : James K. Galbraith
Publisher: Simon & Schuster

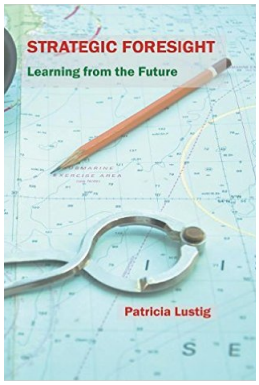
The years since the Great Crisis of 2008 have seen slow growth, high unemployment, falling home values, chronic deficits, a deepening disaster in Europe—and a stale argument between two false solutions, "austerity" on one side and "stimulus" on the other.Both sides and practically all analyses of the crisis so far take for granted that the economic growth from the early 1950s until 2000—interrupted only by the troubled 1970s—represented a normal performance. From this perspective the crisis was an interruption, caused by bad policy or bad people, and full recovery is to be expected if the cause is corrected.



Foresight: Finding Your Footing in a Fast-Forward World

ISBN-10: 098557125X
ISBN-13: 978-0985571252
Author : JRita Barreto Craig
Publisher: Top Tier Leadership

It's a common thing to end a career and look back - on the triumphs, mistakes and things you might have done just a bit differently. But instead of peering out the rear view mirror longingly, what if you could look forward and see around the corner to what your future holds? This book is focused on empowering the next generation of leaders to make the choices that will create a happier life right now and a more positive outlook down the road. Learn easy to implement strategies that will achieve a better work/life integration. Learn from two Baby Boomers about what to do to have a fulfilling life/career!



Strategic Foresight- Learning from the Future

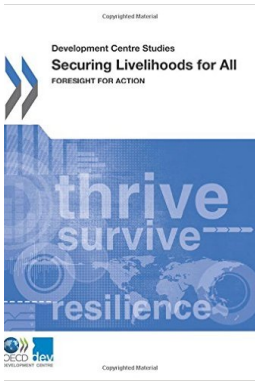
ISBN-10: 190947066X
ISBN-13: 978-1909470668
Author : Patricia Lustig
Publisher: Triarchy Press Ltd

This is a book is for leaders, to aid their practice in strategy, decision making and change - it's a very practical (field) guide to foresight and foresight tools. It's aimed at leaders in manufacturing, service, non-profit, government and fourth sector organizations. Strategic Foresight is a set of skills and tools used to explore potential futures exercising your 'futures muscles' so that you are able to plan for and take advantage of these possible futures. The book first explores how we think about the future, looking at ambiguity and uncertainty and how these play a role in our ability to think into the future. It introduces a simple model of preferred thinking styles and talks about the 'baggage' and values that form our perceptions. The next section covers models, tools and maps that people will find useful for developing their own Foresight and using this knowledge to make decisions, whilst uncovering innovation and creativity to turn this Foresight knowledge to competitive advantage. This is not a comprehensive list - just a selection of the most effective tools with their use and case studies that are easy and effective to use. The next two sections cover: How to identify emerging trends; what impact they may have on your business; the strategic importance of early recognition; and how to apply the knowledge in your business. Harnessing Foresight as a spring board for innovation and creativity to develop new paradigms and take advantage of what may come. Finally, the author pulls it all together by showing how to develop a practical method of exploring potential futures in the context of your existing business in order to take robust decisions and develop strategies that help you work towards your preferred future. Case studies are interspersed throughout the book to illustrate the points made along with exercises, where appropriate, to encourage people to 'think along' with the ideas and new ways of approaching Strategic Foresight.

Making Innovations Happen: Fostering innovations by inducing foresight

ISBN-10: 1505294525
ISBN-13: 978-1505294521
Author : Ravi Arora
Publisher: CreateSpace Independent Publishing Platform; 1 edition

The journey from idea to innovation is fraught with risks, uncertainty and ambiguity. This journey needs a lot of perseverance from the teams that work on such ideas. It also needs a lot of courage by the senior management to allow their teams comprising very capable people to work on such projects, the output of which is uncertain. Organizations are expected and designed to deliver on a consistent and predictable manner. Any adverse deviation from the predicted outcomes are punished by the investors. While business leaders and the board are keen that their company performs equally well on innovation, the pressure of short term results and fear of failure need leaders to be courageous to start this journey. The Book offers several ideas for the Board and Senior Leaders to induce and drive innovations. They include newer ways to incentivize ingenuity, including compensating executives across the board for nurturing creativity with a long term focus on execution. It also suggests creative yet pragmatic ways to make the innovation plan and its execution measurable, flexible and nimble. The book also seeks to unravel cultural nuances that can either significantly drive or impede inventiveness. It proposes several tips for the organizational practitioners to benefit from, and aims to enhance the innovation quotient from ideation to execution. Managers, CEOs and Board members of modern day organizations can draw useful insights from the many narratives the book provides. Written in the mold of a fictional novel set in a Socratic style of dialogues, the book reveals a mix of truths with myths and jubilation with tribulations, all in the interest of bringing newer perspectives and solutions to benefit the readers.



Securing Livelihoods for All: Foresight for Action

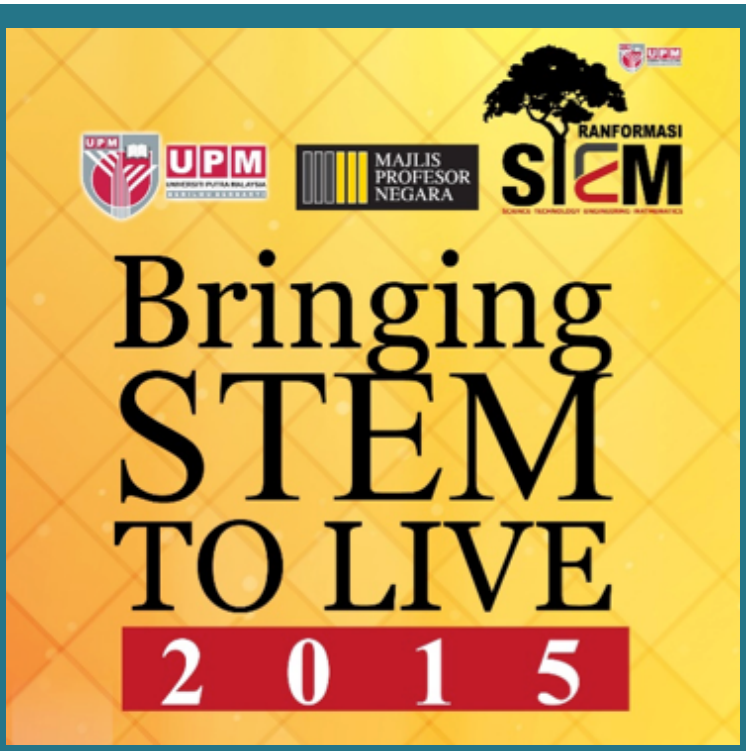
ISBN-10: 9264231749
ISBN-13: 978-9264231740
Author : Organization for Economic Cooperation and Development OECD
Publisher: OECD

The world has made good progress in improving global livelihoods. More than two billion people have emerged from extreme poverty over the last four decades. Other notable improvements include real increases in wages for unskilled workers, better life expectancy, greater gender equality and more widespread literacy. However, a number of daunting challenges threaten to undo this progress, particularly on the demographic and environmental fronts. While outlining the status of livelihoods today, this fascinating report enumerates the main emerging trends which will have a significant impact on livelihoods in the near future. It looks at a whole range of issues: economy, technology, demography, environment, security and governance. This book presents five possible future scenarios for livelihoods, whose positive or negative outcomes depend on how several emerging challenges are dealt with. It concludes with ideas for global, national and local action that hold significant promise for securing resilient livelihoods for all.

Happenings

BRINGING STEM TO LIFE

Dewan Taklimat Serdang, Universiti Putra Malaysia
28 July 2015



The aspiration to get youths to pursue Science, Technology, Engineering and Mathematics (STEM) education has never been bigger, the world over. It is important that stakeholders work together to understand and handling the global issues around STEM. Enough research has been done and there have been numerous pilot projects and activities. The discussion is no more about when or why we ought to do this. We require more knowledgeable scientists, engineers, technologists and mathematicians and we need them now, for our economies to develop as we move through the third millennium.

Bringing STEM to Life 2015 was held as a platform for knowledge exchange and sharing, and gathering researchers from academic institutions in science and mathematics. This conference focused on research and ideas in teaching and learning STEM fields. The seminar presented the progress made by various esteemed organisations towards the 60:40 goal.

Looking into the future, Rushdi Abdul Rahim, Director of myForesight®, talked about "Future Demands in STEM" – a bit of reality check on the current status of the STEM value chain (i.e. from school up to industry). He also highlighted ongoing initiatives under the Science to Action (S2A) agenda.

Other initiatives presented included the Children's Engineering Teaching Module by the Faculty of Education (University of Malaya), UPM-STEM (UPM), Kuala Lumpur Engineering and Science Fair (UTAR). There was also an experience sharing session by Universiti Kebangsaan Malaysia.

JAPAN MEETS MALAYSIA: UNDERSTANDING CULTURAL DIFFERENCES

Jom Ngeteh Corner, Institut Darul Ridzuan (IDR)
25 May 2015

Since 1988, Ipoh and Fukuoka have had a close relationship by hosting various programmes such as cultural and sports visits. Known as Twin Cities, the aim is to strengthen and develop the cooperation between the two cities in order to promote understanding between the people of Malaysia and Japan.

Sharing the stage at the Japan Meets Malaysia event were Nurul Azammi Mohd Nudri representing myForesight® and Shin Kajiwara, the CEO of NTT Data (M) Sdn. Bhd.

You can watch the excerpt of the session at https://www.youtube.com/watch?v=TbHJiWu5Bxk.

NRE SCHOOL OF LEADERSHIP (SOL)

Sungkai, Perak
26-29 May 2015

The Ministry of Natural Resources and Environment (NRE) organised its School of Leadership (SOL) programme as a competency development and empowerment platform. For this programme, myForesight® was invited to share insights on foresight understanding with the participants in order to inculcate forward-looking leadership among high ranking

FORESIGHT ALLIANCE WORKSHOP

Academy of Sciences Malaysia, Kuala Lumpur
19-21 May 2015

Malaysian Foresight Alliance is an initiative that brings together all national think-tanks in a joint partnership. Currently, the members are MIGHT, Science Malaysia (ASM), Institute of Strategic and International Studies (ISIS), Malaysian Institute of Economic Research (MIER), Khazanah Research Institute, Institute of Ethnic Studies (KITA), and Multimedia Development Corporation (MDEC).

Through a project supervised by Academy of Science Malaysia (ASM) called "Envisioning Malaysia in 2050", each member is expected to contribute their expertise to jointly construct the future scenarios for Malaysia in 2050. Together with the foresight guru Professor Sohail Inayatullah and other speakers, the role of myForesight® is to advise the alliance on overall framework, scenario planning methodology and processes.

THINK.SHARE.ACT

Balai Berita, NST Press, Bangsar
8 May 2015

The Future Malaysia Forum (FMF) is a platform for national think yanks and Research Institutes (RIs) to come together and share their findings (analyses) to help policy makers, government ministries and agencies make informed decisions for the nation. Six think tanks and RIs were invited in presenting their insights on various topics namely economics, culture and social, policies and science.

Cutting edge technologies will impact most aspects in our live as new ideas transform the currently-accepted rules, processes, strategies and management approach of business. With the topic entitled "Game-changing technology 2025", Rushdi Abdul Rahim, shared Top 10 game-changing technologies that can produce great disruption in our near future as they might transform the economy and our lives.

For example, the mobile Internet is expected to generate $3.7 trillion to $10.8 trillion of economic activity annually by 2025. This cuts across a range of applications including healthcare, education, the public sector, retail and payments and worker productivity. Other game-changing technologies including automation of knowledge work, advanced robotics, energy storage, 3D printing and advanced materials.

These technologies have already started to be integrated into society, changing the way we drive our cars, operate our homes, do our jobs, communicate and consume. With constant innovations on the horizon, too little is left to the imagination. As Samsung says –next is now!

OTEC's Implication

The OTEC technology is believe to provide solution on three main global issues of energy, water and food in a sustainable way. The advantage of OTEC development is not limited to its energy generation, but also on it by-products. Currently the main challenge in OTEC development is on the cost of the power plant compared to its energy produce. In near future, with the increased rate of awareness towards green and improvement on technology advancement it is believe the cost will become competitive. With the advantage of the by-product, it is believe that the OTEC technology can become sexier that other renewable energy that are available now. Here are the implications towards the Social, Technology, Economy, Environment and also Policy & Governance.

Social

Support social well-being and economic growth by providing job creation, lower oil dependency, improve the efficiency of technologies, promote self-sustaining industries and greater employment opportunities.

Creation of new jobs and skills requirement. E.G. Thermodynamic engineer, system engineer and naval architects

Eradicating poverty through growth in OTEC related industry

Society transformation on the way society and culture respond due to economic growth and development, industrialisation and modernization.

Change in quality of life and wealth of local community by bringing more business opportunities.

Technology

Development of new energy related technology/industries such as deep sea oil & gas platforms, fuel cell technology for transportation, smart grid and data centres.

Introduction on new marine technology. E.G. Hatchery technology, seahorse farm, shellfish nursery/hatchery and technology to produce natural nutrient using microalgae technology

Create more avenue for research & innovation in various product development in various field. E.G. Marine & coastal aquaculture, agriculture, tourism product, tourism leisure and recreation activities, water quality and skin care products

Economy

Reduce dependency on imported coal

As key sustainable game changer

Increase use of hydrogen fuel, boost economics of transport of goods and service

Developing new economic activity with high investment potential worth billion of ringgit

Bring various economic benefits through co-production (OTEC by-product), support numerous spin off industries especially in deep sea water industry.

Environment

Improve the ambient air quality by promoting the used of hydrogen fuel

Act as highly strategic resources in terms of national sovereignty and security, including energy security and climate change mitigation

Ensure sustainability of the marine environment and create new and reliable sources of energy to industry

Protects and conserves natural resources, especially in the coastal and marine zones through a green and responsible economic ecosystem.

Act as carbon sink that help mitigate environment pollution and climate change .

Policy & Governance

Increase awareness due to development of OTEC centre of excellent (OCE) to promote the OTEC development nationwide

Increased collaboration between government & industry, government role to give greater support towards OTEC development.

Development of clear and reliable legal provisions to promote and protect investors, ensuring proper protection to environment and creating opportunities to embrace sustainable energy implementation

Aggressive involvement by government to promote large scale use of renewable or green energy

PASDEC

A leading government linked investment holding company, seeking for new business ventures and acquisition to expand its investment portfolio.

OUR PROJECTS:

Property development, project management, civil and building construction, manufacturing of electrical wiring harness, seat components and catalytic converters for the automotive industry in South Africa, renewable energy, installation of UniFi, telecommunication services and provision of data centre services.

MAP THE FUTURE

As a strategic policymaker or stakeholder, you can help map out a desired future for Malaysia

This is an invitation by **myForesight** to build a collective future. Do you find this magazine thought-provoking? Do you think we could have done better? Perhaps you would like us to cover a specific angle in the study of Foresight.

Or maybe, you would like to contribute articles to **myForesight** magazine? Send your feedback and articles to foresightinternal@might.org.my Website: www.myforesight.my

We look forward to hearing from you.

myForesight team