“OVERCOMING BARRIERS THROUGH POLICY ADVOCACY & INVESTMENT PROMOTION: THE CASE OF OCEAN THERMAL ENERGY-DRIVEN DEVELOPMENT IN MALAYSIA”

By

Dato’ Ir Dr A. Bakar Jaafar, FASc

Professor, UTM Perdana School of Science, Technology, & Innovation
& Co-Chair, UTM Ocean Thermal Energy Centre
OUTLINE OF PRESENTATION

1. INTRODUCTION
2. BARRIERS
3. OVERCOMING BARRIERS
4. EFFORTS IN POLICY ADVOCACY & INVESTMENT PROMOTION
5. OUTCOME
6. THE WAY FORWARD
1. INTRODUCTION

• OTEC Resource Assessment
• OTEC Potential in Malaysia
• The First Five Promising Sites for OTEC Projects in Malaysia

Malaysian Marine Survey in the South China Sea (MyMRS) (2006-2008)
OTEC Potential in Malaysia

Total Area = 131,120 sq km (>700 m)

Total OTEC Potential = 105,000 MW

By 2030, installed capacity of OTEC development could reach 2500 MW, i.e. to match nuclear power.
2. BARRIERS

• “OTEC, not viable …”, high initial capital requirement;
• “OTEC in Malaysia, also not viable …”, the deep waters are very far (generally 60 km away from the nearest coastlines);
• “Energy = Electricity,” nothing else!
• “Technology not yet to be developed at commercial scale …”;
• “No laws governing OTEC development in Malaysia …”; and
• “No agency or institution, championing OTEC in Malaysia …”
3.1 OVERCOMING BARRIERS: HIGH INITIAL CAPITAL REQUIREMENT

- By introducing project-life costing;
- By realising that “renewable”, “virtually free”;
- By highlighting “cost-saving” over project life;

**Comparative OTEC vs. Fossil Fuel Life-Cycle Costing**

<table>
<thead>
<tr>
<th>Total Cost (USD billion)</th>
<th>Power Project 100 MW</th>
<th>Initial Capital (USD/MW)</th>
</tr>
</thead>
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<tr>
<td>7.7</td>
<td>OTEC</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>FOSSIL-FUEL</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: Price of Oil : USD 100/barrel
WITH OTEC, TO SAVE OVER USD 5 billion/ 100 MW

100 MW Plant
OIL Total Cost: USD 7.7 billion
OTEC Total Cost: USD 1.5 billion

1 September 2015 UTM KL
A-Bakar Jaafar @3rd International OTEC Symposium
3.2 OVERCOMING BARRIERS:

OTEC in Malaysia, also not viable …”, the deep waters are very far (generally 60 km away from the nearest coastlines)

• There are potential users of OTEC power in the deep waters of Malaysia, because there exists deep water oil & gas production;
Deepwater Production Off Sabah & Promising OTEC Project Sites

Water Depth

10m
12m
52m
55m
55m
71m
162m

KLCC Height 452m

100m
200m
300m
400m
500m
600m
700m
800m
900m
1000m
1100m
1200m
1300m
>1300m

Samarang
St Joseph
Sumandak
Kinabalu
Erb West
*Kebabangan
Kinarut

*Zuhal East
SM Kechil
KNNAG
Tembungo
*Malikai
*Gumusut Kakap

10m
12m
55m
62m
142m
162m

Water Depth

Note:
*Project in progress
**Under study/consideration

Legend:
Jacket Platform
Floating Production, Storage & Offloading (FPSO)
Tension Leg Platform
Subsea Wellhead
PETRONAS Floating Liquefied Natural Gas 2 (PFLNG2)
Truss Spar Platform
Operator

Ref: Mohamed Firouz Asnan, 10 December 2013
Kota Kinabalu, Sabah
... 3.3 OVERCOMING BARRIERS: ENERGY=ELECTRICITY, NOTHING ELSE

• If there is no immediate take-up of the generated electricity, it would be used, by electrolysis, to generate hydrogen fuel;

• Why H2 fuel?
HYDROGEN: THE MOST DOMINANT ENERGY CARRIER IN 21ST CENTURY

Figure 1. Evolution of global market shares of different final-energy carriers for the period 1990-2100 based on the scenario by Barreto et al. [4]. The alcohols category includes methanol and ethanol.
3.4 OVERCOMING BARRIERS: OTEC TECHNOLOGY NOT YET DEVELOPED @COMMERCIAL SCALE

• Blue Rise of the Netherlands
• DCNS of France
• Energy Island of UK
• KRISO of the Republic of Korea [ROK]
• Lockheed-Martin of USA
• [Technip of France]
• Xenesys Inc of Japan/POSCO of ROK

• Not quite true;
• Offshore 10 MWe net is to be commissioned by 2018

[Refer presentation by Mr Thierry Bouchet of DCNS]
... 3.5 OVERCOMING BARRIERS: NO LAWS GOVERNING OTEC DEVELOPMENT IN MALAYSIA

There exists:

1. Territorial Sea Act of 2012; or

[Refer presentation by Datin Sharina Shaukat of MIMA & Mohd Haris Rani of UTM OTEC]
... 3.6 OVERCOMING BARRIERS: “NO AGENCY & INSTITUTION, CHAMPIONING THE CAUSE ...”

Our Vision:
From Three Columns of Knowledge to Three Towers of Prosperity for Sustainable Future

KNOWLEDGE & THE SOURCE OF KNOWLEDGE
(Al-Quran 24:40; 18:109; 31:27)

Ocean of Discovery

On 3 January 2013,
University of Technology Malaysia established its Ocean Thermal Energy Centre

UTM Ocean Thermal Energy Centre [U-OTEC],
Block Q Ground Floor, UTM Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
E-mail: bakar.jaafar@gmail.com Mobile: +60 12 320 7201
@UTM OTEC: The Preferred Path, with Existing Knowledge of Technology, for Commercialisation=>Development=>Research
4. EFFORTS IN POLICY ADVOCACY & INVESTMENT PROMOTION: POST & PRIOR TO ESTABLISHMENT OF UTM-OTEC
[Since 3 January 2013]

Figure: Malaysia, Ocean Thermal Energy-Driven Development: Growth in Activities relating to OTEC Policy Advocacy and Promotions of Investment
1. ACC-Arab Construction Corporation of Dubai
2. AFG-AFG Listings of New York
3. Akhtiar-AKHTIARJAYA
4. ANGKA-ANGKASA Co-Op
5. APEX-ENIGMA
6. ARK-ARKITEK JURURANCANG
7. ASM-Akademi Sains Malaysia
9. CCMB-CCM Bhd
10. CETDEM
11. DCNS
12. DELTA-DELTA MARINE
13. EC-Energy Commission
14. ENSE-ENSEARCH
15. EPU
16. FELCRA CEO
17. FELCRA Chairman
18. FELDA FIC
19. FIDES-FIDES Advisory
20. Harvest-Harvest Crest Industries Bhd
21. IEM
22. IOC-WESTPAC
23. JKCS-JAWATANKUASA KEBANGSAAN CONTINENTAL SHELF
24. JPM—YB Senator Dato’ Sri Abd Wahid Omar
25. JUPEM
26. KEJORA
27. KETTHA
28. KRISO-Korean Research Institute of Ships & Ocean Engineering
28. Kumpulan Modal Perdana(KMP)
29. LTAT
30. LOBS-LOBSTERS AQUA TECHNOLOGIES
31. MASER-MASER MARINE
32. MENTOR
33. MIDA
34. MIER
<table>
<thead>
<tr>
<th>No.</th>
<th>Institution/Entity</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>35.</td>
<td>MIDF</td>
<td></td>
</tr>
<tr>
<td>36.</td>
<td>MIGHT</td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>MFA-MINISTRY OF FOREIGN AFFAIRS-Permanent Representative to UN</td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>MKN-Secretary of National Security Council</td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>MOE – Ministry of Education</td>
<td></td>
</tr>
<tr>
<td>40.</td>
<td>MOSTI-Ministry of Science, Technology, and Innovation</td>
<td></td>
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<tr>
<td>41.</td>
<td>MOT-Ministry of Transport</td>
<td></td>
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<tr>
<td>42.</td>
<td>MFC -MUAMLAH FINANCIAL CONSULTING</td>
<td></td>
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<td>43.</td>
<td>NUSANTARA</td>
<td></td>
</tr>
<tr>
<td>44.</td>
<td>NOAA-US National Oceanographic &amp; Atmospheric Administration</td>
<td></td>
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<tr>
<td>45.</td>
<td>OTE C–OTE Corporation USA</td>
<td></td>
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<tr>
<td>46.</td>
<td>PASDEC</td>
<td></td>
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<td>47.</td>
<td>PEMA-PEMANDU</td>
<td></td>
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<tr>
<td>48.</td>
<td>PETR-PETRONAS</td>
<td></td>
</tr>
<tr>
<td>49.</td>
<td>PETR-Petronas Chemicals Bhd</td>
<td></td>
</tr>
<tr>
<td>50.</td>
<td>PM –MIMA Notes &amp; Letter to YAB PM</td>
<td></td>
</tr>
<tr>
<td>51.</td>
<td>SAGA-Institute of Ocean Energy of Saga University (IOES)</td>
<td></td>
</tr>
<tr>
<td>52.</td>
<td>SOJ-Secretariat to Japanese Cabinet on Ocean Policy</td>
<td></td>
</tr>
<tr>
<td>53.</td>
<td>SEDIA–Sabah Economic Development and Investment Authority: CEO &amp; Board</td>
<td></td>
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<tr>
<td>54.</td>
<td>SEKRETARIAT KEPADA MAJLIS KESELAMATAN NEGARA</td>
<td></td>
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<tr>
<td>55.</td>
<td>TECHNIP</td>
<td></td>
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<tr>
<td>56.</td>
<td>TOKYO, University of Tokyo</td>
<td></td>
</tr>
<tr>
<td>57.</td>
<td>UKAS, JPM</td>
<td></td>
</tr>
<tr>
<td>58.</td>
<td>UM-University of Malaysia</td>
<td></td>
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<tr>
<td>59.</td>
<td>UMT-UniversitiMalaysia Terengganu</td>
<td></td>
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<tr>
<td>60.</td>
<td>UNA-UNIVERSITY OF NEWCASTLE ALUMNI</td>
<td></td>
</tr>
<tr>
<td>61.</td>
<td>UPM–UniversitivPutra Malaysia</td>
<td></td>
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<td>USM–Universiti Sains Malaysia</td>
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<td>63.</td>
<td>UTM–Universiti Teknologi Malaysia</td>
<td></td>
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<tr>
<td>64.</td>
<td>UTM Holdings Sdn Bhd</td>
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<td>65.</td>
<td>UUM–Universiti Utara Malaysia</td>
<td></td>
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<td>66.</td>
<td>WOLF -WOLF INDUSTRIES</td>
<td></td>
</tr>
<tr>
<td>67.</td>
<td>WZ-WZ SATU BHD</td>
<td></td>
</tr>
<tr>
<td>68.</td>
<td>XENESYS –Xenesys Inc. (Japan)</td>
<td></td>
</tr>
<tr>
<td>69.</td>
<td>YEE PRECAST DESIGN–[Yee Dsg.]</td>
<td></td>
</tr>
</tbody>
</table>
Figure 2. Stakeholders’ Engagement by Type of Institution in Malaysia and Abroad, 2007-2014
5.1 OUTCOME: INVESTMENT PROMOTION

OTEC has been promoted in Malaysia since 2007;
But, since the establishment of UTM OTEC in January 2013, the number of activities has increased by 140% in the last two years over the first 6-year period of 2007-2012; and
• As a result: the first four or 5 SPVs have been incorporated, namely,
  - Deep Sea Thermal Solutions Sdn Bhd [(90-X%) PASDEC; (X+10 in kind) % UTM Holdings Sdn Bhd];
  - UTM OTEC Sdn Bhd;
  - UTM OTEC Solutions Sdn Bhd;
  - Pro-Active MH Resources Sdn Bhd; and
  - [Sustainable Ocean Thermal Energy Resources Sdn Bhd (SOUTHER)]
5.2 OUTCOME OF POLICY ADVOCACY

• The subject of “ocean energy” has been incorporated in 11th Malaysia Plan (2016-2020):

Exploring New Renewable Energy Sources

17.78 Studies will be conducted to identify new RE sources to diversify the generation mix. In the Eleventh Plan, new RE sources such as wind, geothermal and ocean energy will be explored. Currently, the national wind mapping exercise is underway and it is expected to be completed by 2016. The exercise will further enable a study on the feasibility of wind energy to be developed. Geothermal potential will also be further explored with the discovery of a 12 square kilometres geothermal field in Apas Kiri, Sabah. Viability of ocean energy will be explored to take advantage of Malaysia’s geographical position of being surrounded by sea.

“Ocean Energy” =>
• Ocean thermal energy;
• Offshore wind energy;
• Tidal movement;
• Oceanic current;
• Wave energy; and
• Salinity gradient
5.2 OUTCOME OF POLICY ADVOCACY

• An OTEC project can gain access up to RM 200 million of Facilitation Fund under the Public-Private Partnership Unit, Prime Minister’s Department;

• A proposed OTEC project can be submitted to Malaysian Investment Development Authority (MIDA), under one-stop approval centre, and be eligible to a range of incentives, including Investment Tax Allowance, Exemption of Import Duties etc;

• An OTEC project is eligible for a “green certificate” issued by Malaysia Green Technology Corporation (MGTC) for a 2% reduction in loan interest rate; and

• OTEC, is the next choice, over nuclear energy
6. THE WAY FORWARD

• The 1st Public-Funded OTEC Project off Pulau Layang-Layang under 11th Malaysia Plan (2016-2020)

• The 1st Private-Funded OTEC Project supplying power to deep water oil & gas production, the surplus of which to generate H2 fuel
11th MALAYSIA PLAN: OTEC-CITY off PULAU LAYANG-LAYANG

[Proposed to be commercialised, with RM 350m OTEC Plant, Public Funded]

"... to sustain human habitation or " with "the economic life of their own." [UNCLOS, 1982 Article 121 (3)]
OTEC POTENTIAL IN MALAYSIA & THE FIRST FIVE OTEC POTENTIAL SITES

Total Area = 131,120 sq km (> 700 m)

Total OTEC Potential = 105,000 MW

By 2030, installed capacity of OTEC development could reach 2500 MW, i.e. to match nuclear power
FURTHER INNOVATION WITH THE REST OF EMERGING TECHNOLOGIES:
=> OTEC SPIN-OFF INDUSTRIES

Import Substitutions
High Value Produce

Health & Cosmetics

Lithium Production

OTEC-H2

Temperate Produce

Capture-Fisheries

Ms Earth Japan, 2012

Smart-Grid With All Renewables
Future Target and Proposed Roadmap for OTEC in Malaysia 2020-2050 [As at 24 April 2015][Revised after ASM CFE Workshop by Dato’ Ir Dr A Bakar Jaafar]

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity (MW)</th>
<th>Growth Rate (%)</th>
<th>Remark</th>
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<tbody>
<tr>
<td>2020</td>
<td>20</td>
<td>-</td>
<td>2x10 MW public-private RMK-11</td>
</tr>
<tr>
<td>2025</td>
<td>850</td>
<td>-</td>
<td>For 7% reduction in carbon intensity</td>
</tr>
<tr>
<td>2030</td>
<td>2500</td>
<td>14</td>
<td>To match nuclear power</td>
</tr>
<tr>
<td>2035</td>
<td>5000</td>
<td>14</td>
<td>To match nuclear power</td>
</tr>
<tr>
<td>2040</td>
<td>10000</td>
<td>14</td>
<td>To meet H2 demand</td>
</tr>
<tr>
<td>2045</td>
<td>20000</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td>40000</td>
<td>14</td>
<td></td>
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### Scenario-2: Electricity Generation by Energy Source, GWh

<table>
<thead>
<tr>
<th>Year</th>
<th>OTEC</th>
<th>Fuel Cell</th>
<th>Bioenergy</th>
<th>Wind Energy</th>
<th>Solar PV</th>
<th>Nuclear</th>
<th>Wave/ Tidal/ Current</th>
<th>Hydropower</th>
<th>Geothermal</th>
<th>Fossil Fuel</th>
<th>Total</th>
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<tr>
<td>2012</td>
<td>0</td>
<td>0</td>
<td>809</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>9,056</td>
<td>0</td>
<td>124,596</td>
<td>134,468</td>
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<tr>
<td>2015</td>
<td>0</td>
<td>0</td>
<td>1,455</td>
<td>0</td>
<td>437</td>
<td>0</td>
<td>0</td>
<td>9,084</td>
<td>0</td>
<td>134,571</td>
<td>145,547</td>
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<tr>
<td>2020</td>
<td>134</td>
<td>16</td>
<td>1,567</td>
<td>547</td>
<td>790</td>
<td>0</td>
<td>219</td>
<td>9,531</td>
<td>216</td>
<td>151,656</td>
<td>164,675</td>
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<tr>
<td>2025</td>
<td>2,848</td>
<td>354</td>
<td>4,088</td>
<td>1,095</td>
<td>1,579</td>
<td>0</td>
<td>548</td>
<td>9,531</td>
<td>382</td>
<td>165,891</td>
<td>186,316</td>
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<tr>
<td>2030</td>
<td>7,884</td>
<td>1,665</td>
<td>7,553</td>
<td>2,601</td>
<td>2,631</td>
<td>0</td>
<td>548</td>
<td>9,531</td>
<td>531</td>
<td>165,388</td>
<td>210,800</td>
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<td>2035</td>
<td>15,768</td>
<td>4,054</td>
<td>12,535</td>
<td>5,913</td>
<td>3,999</td>
<td>0</td>
<td>548</td>
<td>9,531</td>
<td>1,264</td>
<td>169,623</td>
<td>238,500</td>
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<td>2040</td>
<td>27,594</td>
<td>11,603</td>
<td>14,832</td>
<td>10,052</td>
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<td>0</td>
<td>548</td>
<td>9,531</td>
<td>2,122</td>
<td>169,661</td>
<td>269,841</td>
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<td>2045</td>
<td>47,304</td>
<td>27,782</td>
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<td>14,520</td>
<td>9,502</td>
<td>0</td>
<td>548</td>
<td>9,531</td>
<td>3,174</td>
<td>155,798</td>
<td>305,300</td>
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<td>2050</td>
<td>59,129</td>
<td>53,194</td>
<td>21,049</td>
<td>18,922</td>
<td>11,913</td>
<td>0</td>
<td>548</td>
<td>9,531</td>
<td>4,318</td>
<td>146,047</td>
<td>345,417</td>
</tr>
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**Source:** ASM TF CFE

1 September 2015 UTM KL

A-Bakar Jaafar @3rd International OTEC Symposium
Scenario-2: Shares of Energy Sources in Electricity Generation, %

Source: ASM TF CFE (2015)
TERIMA KASIH

GRACIAS
MERCi
SPASBO
SYUKRAN
THANK YOU
XIE-XIE

UTM Ocean Thermal Energy Centre [U-OTEC],
Block Q, Ground Floor, UTM Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Malaysia
E-mail: bakar.jaafar@gmail.com Mobile: +60 12 320 7201

3W Micro-OTEC @UTM OTEC Block Q Commissioned on 22 May 2015