UTM-IFE CONCEPT 2015

"*NGAP-NGAP* THEORY: PROSPECTS & GROWTH OF DISTRIBUTED POWER SYSTEMS WITH RENEWABLES"

By

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&

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ABSTACT

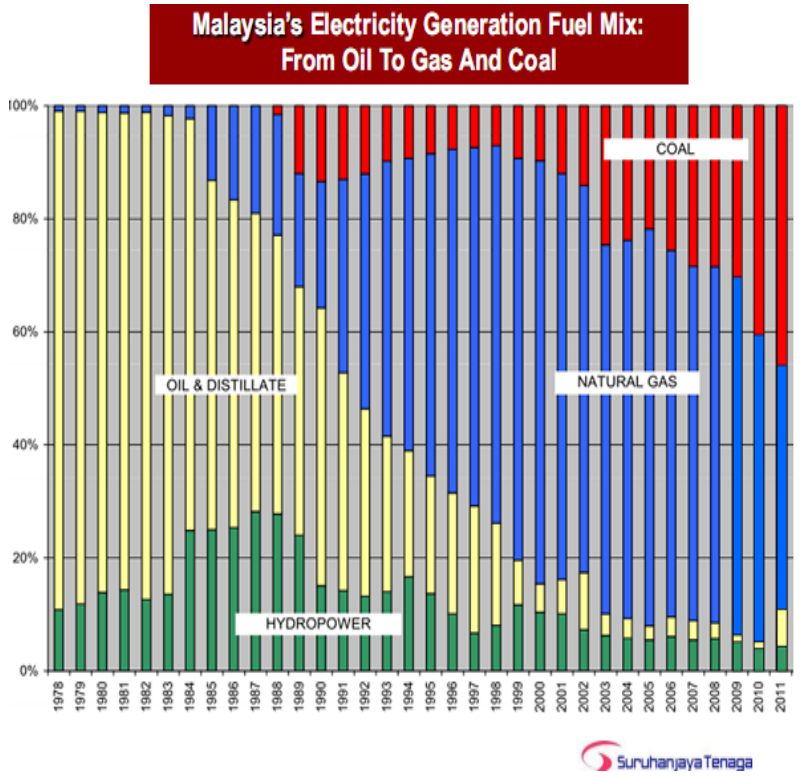
For the sake of energy security, accessibility, reliability, affordability, and sustainability, there shall be an expected growth in dependency on renewables. In the tropics, the renewables would come, in the decreasing order of abundance or potential, from the following sources: ocean energy [ocean thermal energy, salinity gradient, offshore wind, oceanic current, tidal movements, and wave], solar thermal for heating and cooling, solar photovoltaics, biogas, biomass including vermi-compost, pico and mini-hydros, and geothermal. By the end of this 21st Century, hydrogen fuel will be the most dominant energy carrier, as the pricing of energy will be based not only on its energy content but also on its utility. For instance, for the same price, the hydrogen-fuel cell vehicles would clock in much more mileage, by 140%, than that of the standard petrol-driven cars. Such an emerging economics would promote not only longer distance in commuting but would also improve the dispersal of communities away from the congested city centres with expensive housing and accommodation. Such a change in demography would only be feasible with the growth of distributed power systems that are fuelled by renewables, and by "*ngap-ngap*" theory, that will eventually become the major power distribution networks; the existing grids, either Peninsula-wide or State-wide, will still be there, only to complement. Thus, the UTM-Institute of Future Energy motto: "*energy, just around us*", shall soon be realised.

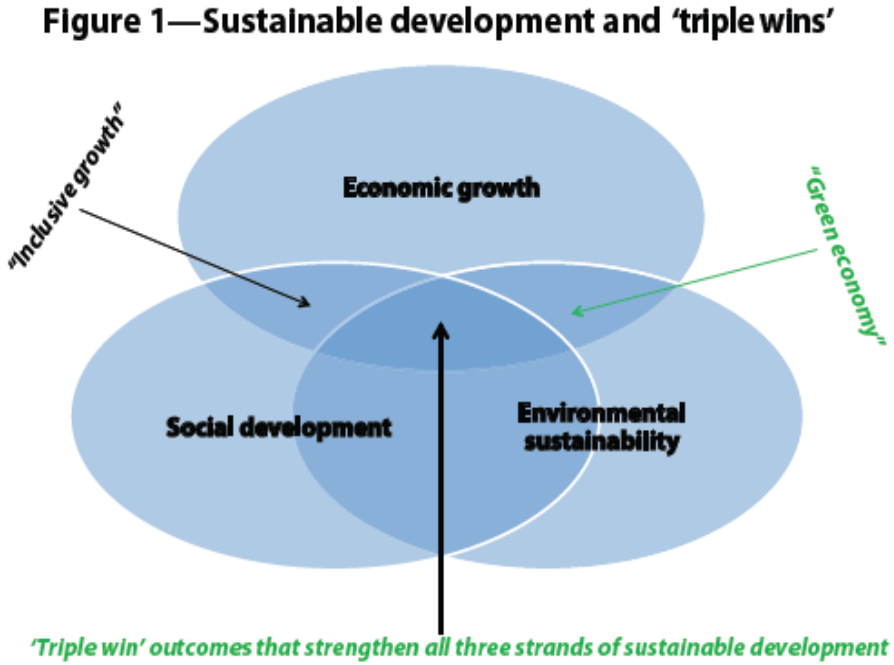
OUTLINE OF PRESENTATION

1. Introduction
2. Energy Development: Security, Reliability, Affordability, & Sustainability
3. Sources, Forms, and Classification of Energy, Renewable & Non-RE
4. Outcome of Policy Advocacy: RMK-11 & Ocean Energy
5. Global RE Development: Where is Malaysia?
6. Off the Grid with Distributed Power Systems
7. Conclusions: The Game Changer

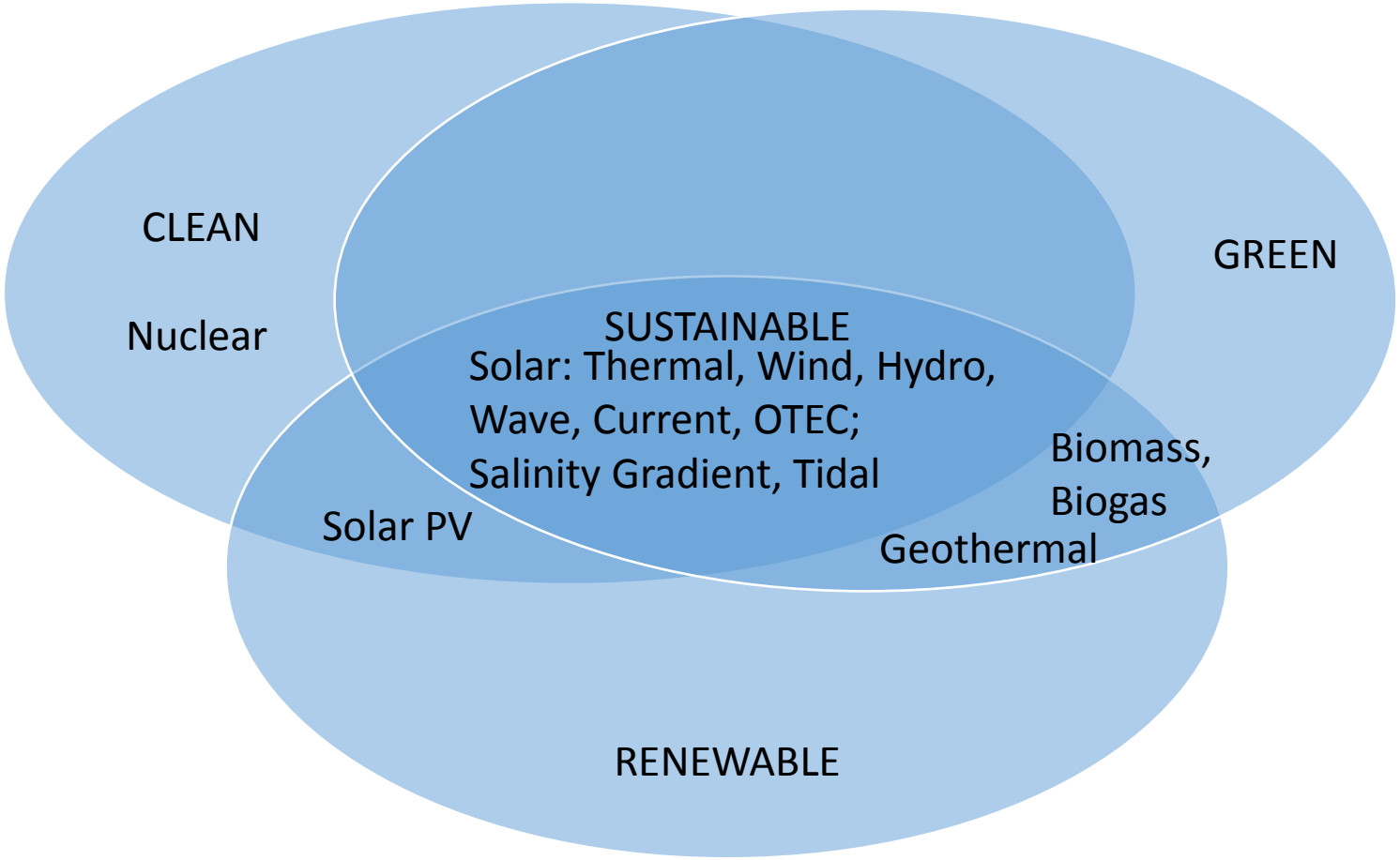
2. THE 4 MAJOR ASPECTS OF ENERGY DEVELOPMENT

- Security
- Reliability
- Affordability
- Sustainability

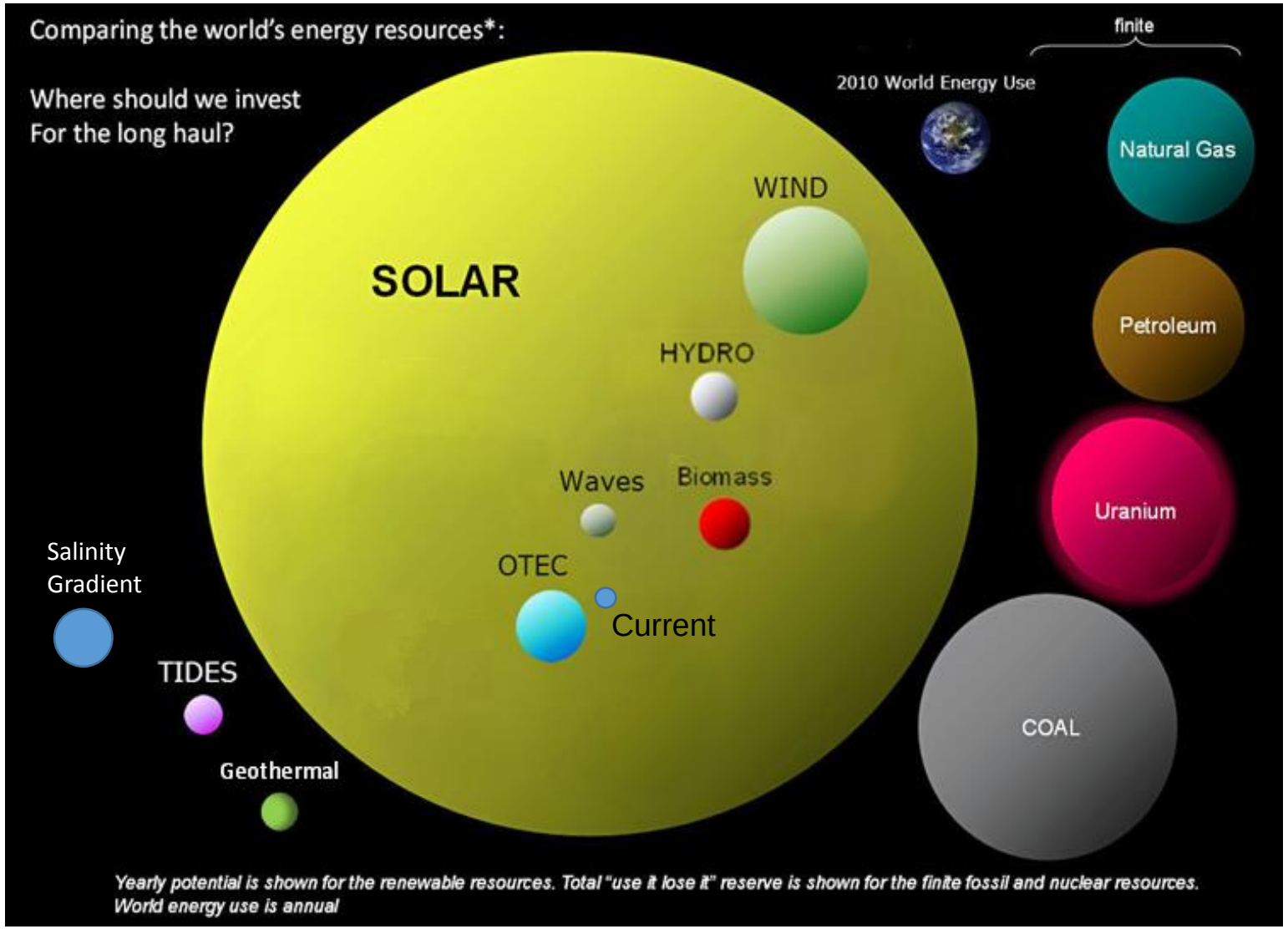




FORMS OF ENERGY & CLASSIFICATION



3. GLOBAL ENERGY, RENEWABLES & NON-RENEWABLES IN PERSPECTIVE



4. OUTCOME OF POLICY ADVOCACY: 2013-2015

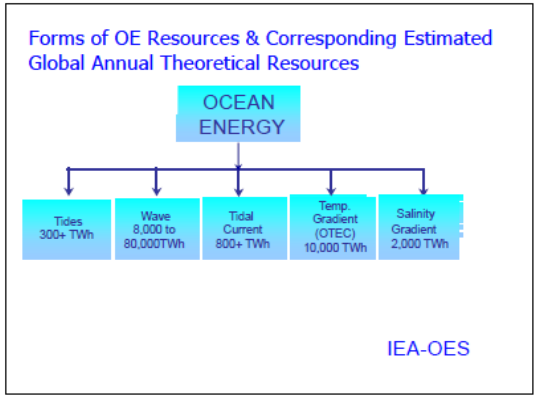
- The subject of "ocean energy" has been incorporated in 11th Malaysia Plan (2016-2020), Chapter 17:

Exploring New Renewable Energy Sources

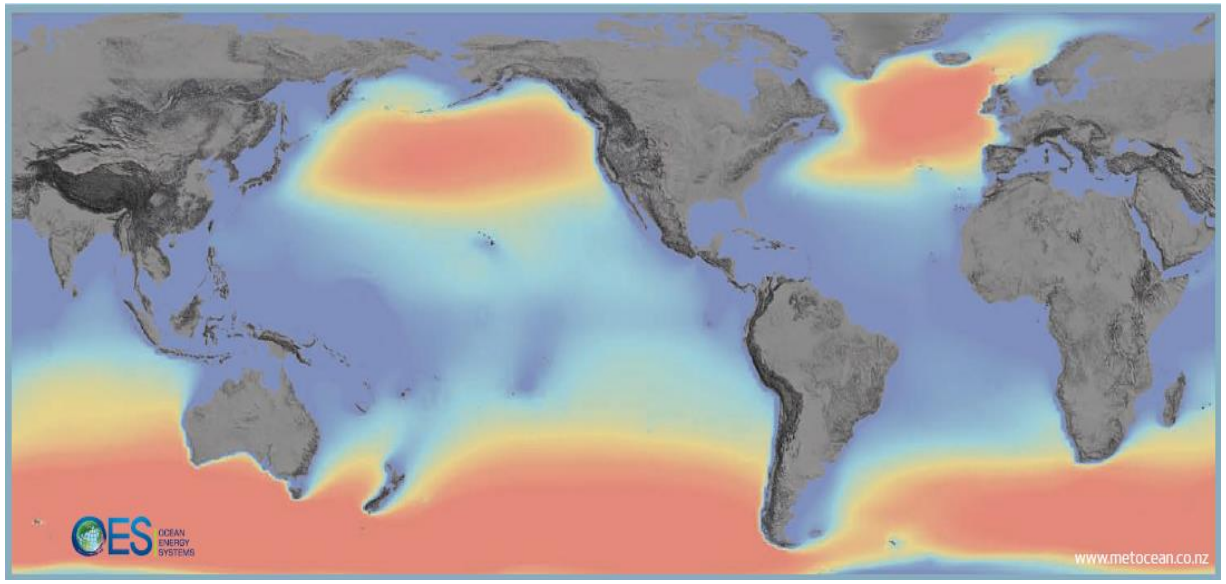
17.78 Studies will be conducted to identify new RE sources to diversify the generation mix. In the Eleventh Plan, new RE sources such as wind, geothermal and ocean energy will be explored. Currently, the national wind mapping exercise is underway and it is expected to be completed by 2016. The exercise 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.

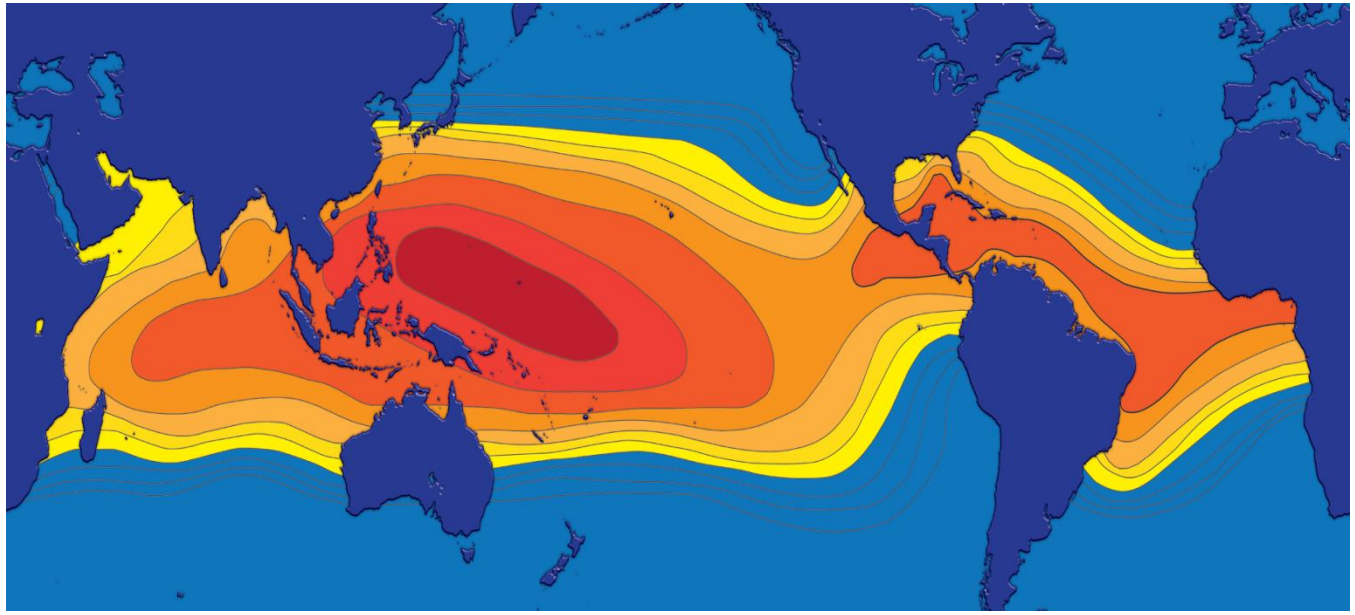
"Ocean Energy"=>

- Ocean thermal energy;
- Offshore wind energy;
- Tidal movements;
- Oceanic current;
- Wave energy; and
- Salinity gradient



Dominant Energy Potential in Temperate Regions:
Wind & Wave





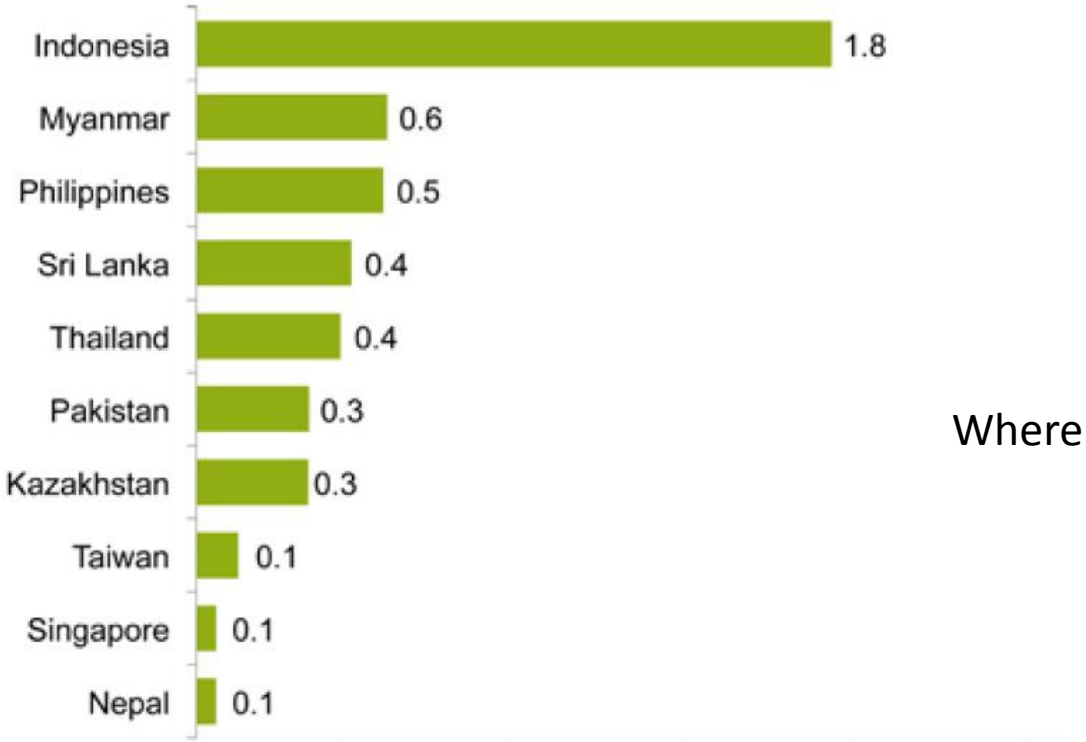
Dominant Energy Potential in the Tropics & Subtropics:
OTEC

5. Global RE Development:Where is Malaysia?

Outside the top 10, a growing number of emerging economies attracted investment over $1 billion last year: Mexico ($2.1 billion), Indonesia ($1.8 billion), Turkey ($1.8 billion), Chile ($1.4 billion) and Kenya ($1.3 billion). Even more saw investment over $500 million: Costa Rica, Jordan, Myanmar, Panama, the Philippines, Thailand and Uruguay.

http://apps.unep.org/publications/pmtdocuments/-Global_trends_in_renewable_energy_investment_2015-201515028nefvisual8-mediumres.pdf.pdf. Bakar.jaafar@gmail.com

FIGURE 22. TOTAL VC/PE, PUBLIC MARKETS, AND ASSET FINANCE INVESTMENT IN RENEWABLE ENERGY IN NON-OECD ASIA (EXCL. CHINA & INDIA) BY COUNTRY, 2014, $BN



Where is Malaysia???

Omits countries with less than $0.1bn investment. Investment volume adjusts for re-invested equity

Source: UNEP, Bloomberg New Energy Finance

Renewables faced challenges as 2015 began – notably from policy uncertainty in markets such as the US and the UK, retroactive policy changes in countries such as Italy and Romania,

and concerns about **grid access**

for small-scale solar in Japan and some US states.

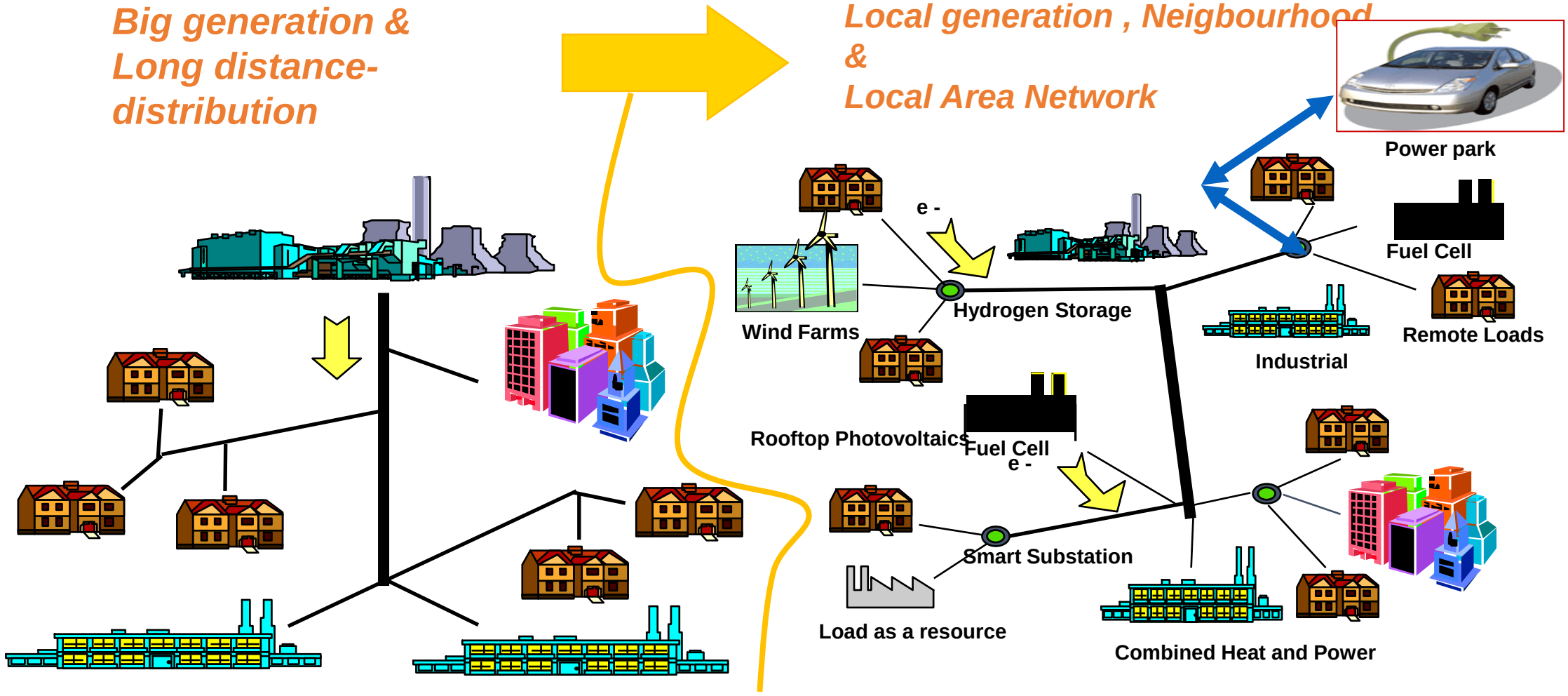
In Malaysia: the "right" policy is to do away with "quota system":

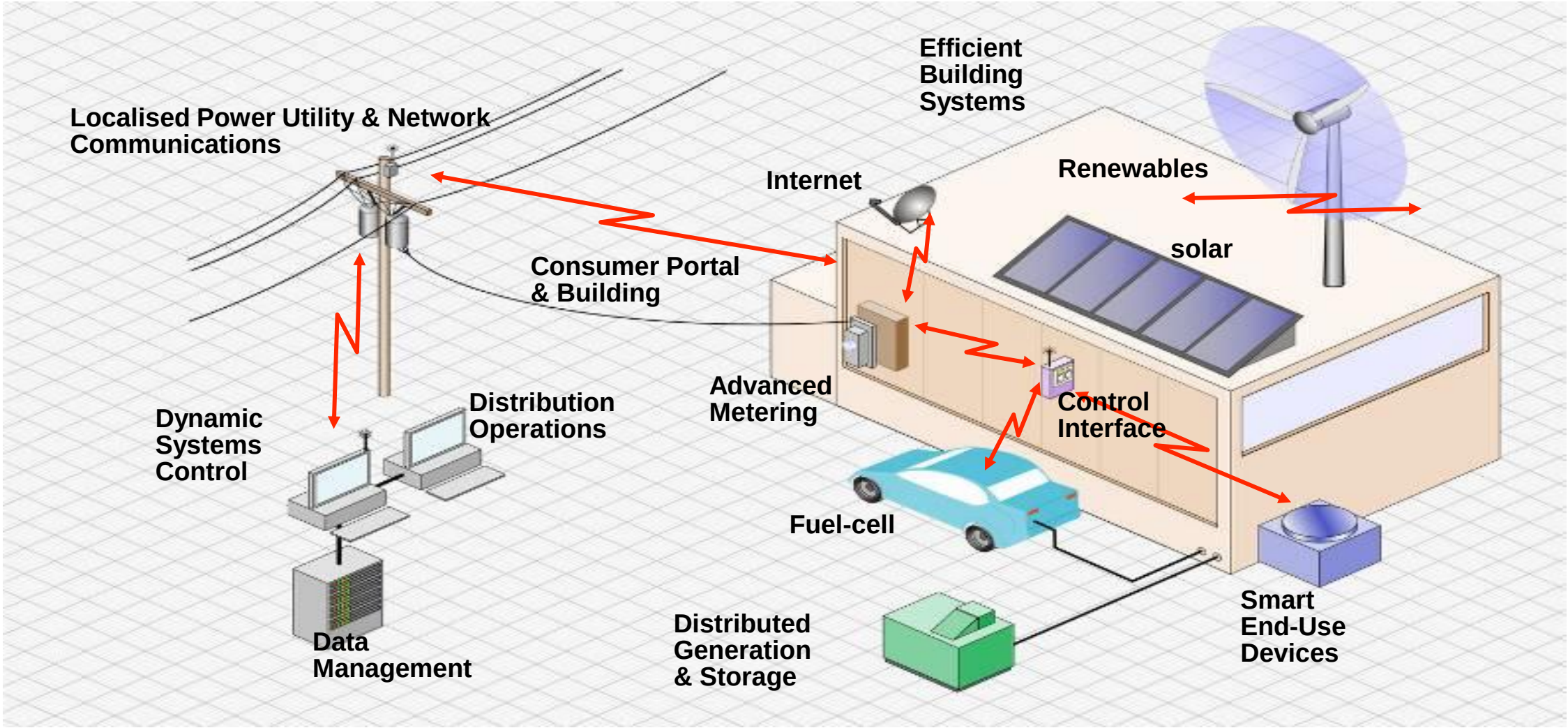
- Those who could …, should …!
- It is not fair for consumers, the like of you & I, to pay additional 1.6% of the electricity bill;

because the Treasury & TNB are the Major beneficiaries of the RE generation i.e. Savings in foreign exchange & peak-power Shaving.

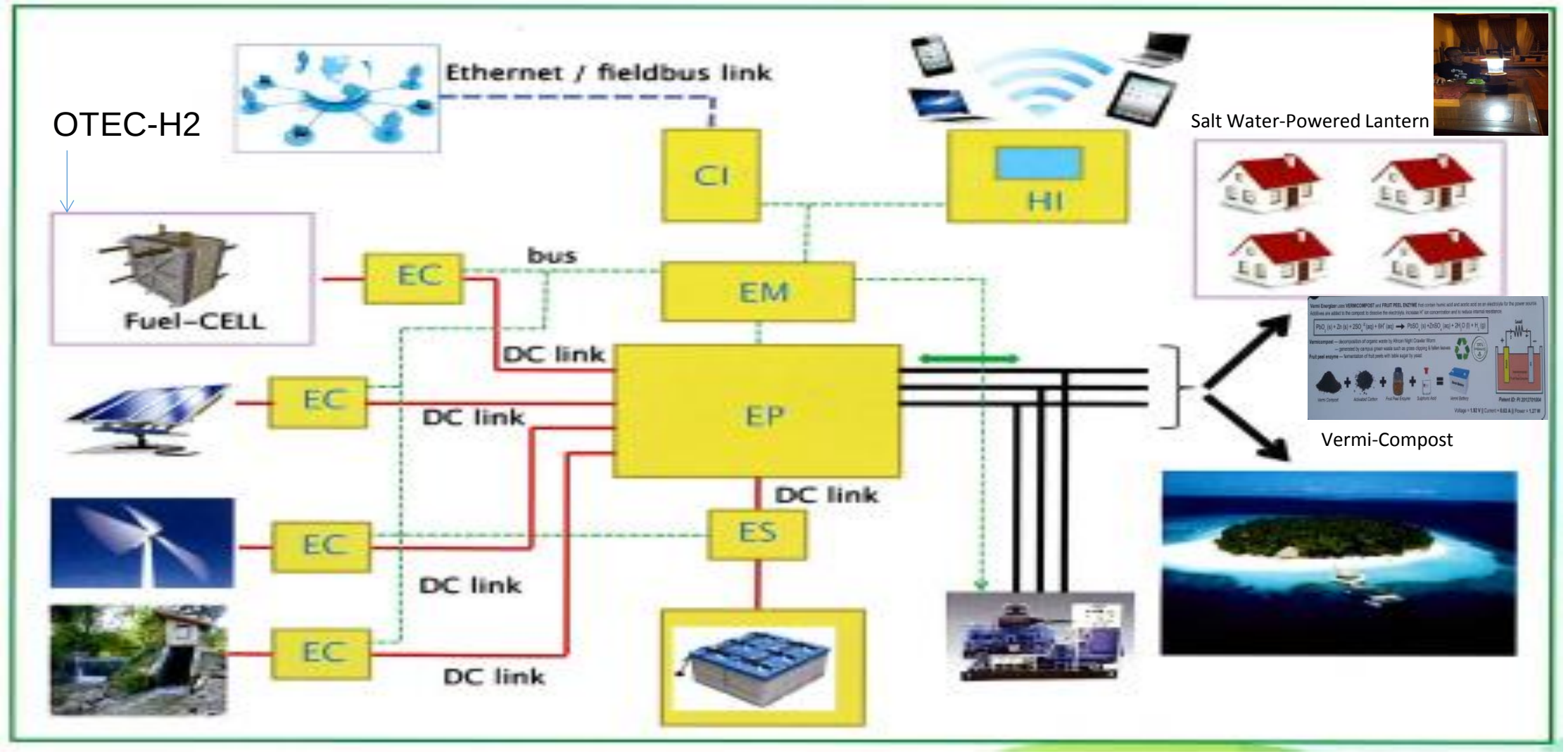
http://apps.unep.org/publications/pmtdocuments/-Global_trends_in_renewable_energy_investment_2015-201515028nefvisual8-mediumres.pdf.pdf
Accessed on 8 December 2015 by bakar.jaafar@gmail.com

NGAP-NGAP THEORY @WORK




Localised Power Utility & Network Communications
Efficient Building Systems
Internet
Renewables
solar
Consumer Portal & Building
Advanced Metering
Control Interface
Dynamic Systems Control
Distribution Operations
Fuel-cell
Data Management
Distributed Generation & Storage
Smart End-Use Devices

6. DISTRIBUTED POWER SYSTEMS WITH RENEWABLES & OFF NATIONAL OR STATE-WIDE GRID



RENEWABLES

OTEC-Hydrogen: H2-FC	Salt-Water: Salinity Gradient	Solar PV: DC & Electrolyzer
Pico-Hydro	Vermi-Compost-Power	Offshore wind

The Washington Post

Salinity Gradient:
The freshwater of Jordan River flowing over the salt water of the Dead Sea

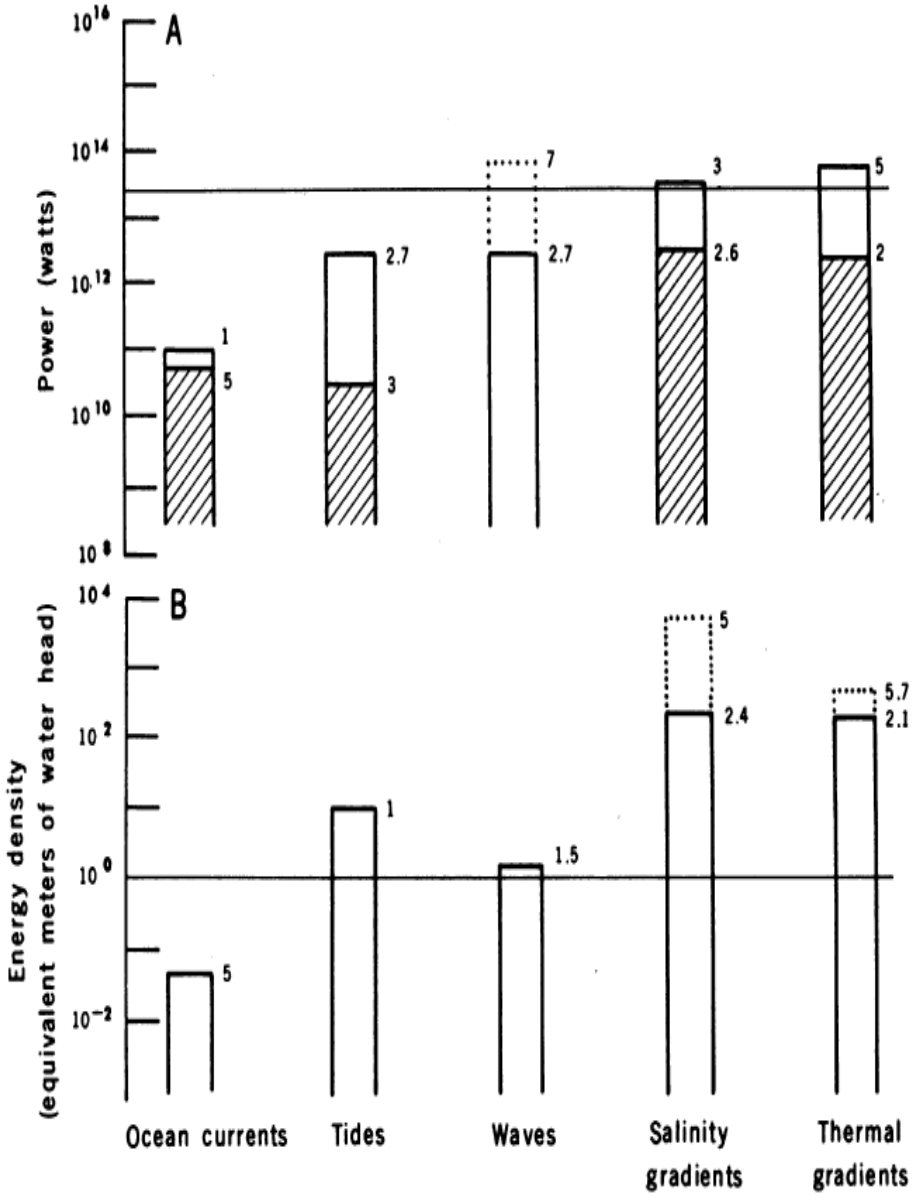


Fig. 1. (A) Power or energy flux for ocean energy. On the "ocean currents" bar, the shading represents the power contained in concentrated currents such as the Gulf Stream. Estimated feasible tidal power is also shaded. The dotted extension on "waves" indicates that wind waves are regenerated as they are cropped. "Salinity gradients" includes all gradients in the ocean; the large ones at river mouths are shown by shading. Not shown is the undoubtedly large power that would result if salt deposits were worked against freshwater or seawater. On "thermal gradients," the shading indicates the unavoidable Carnot-cycle efficiency. The horizontal line at 30×10^{12} watts is a projected global electricity consumption for the year 2000. (B) Intensity or concentration of energy expressed as equivalent head of water. "Ocean currents" shows the velocity head of major currents. For tides, the average head of favorable sites is given. For waves, the head represents a spatial and temporal average. The salinity-gradients head is for freshwater versus seawater, the dotted extension for freshwater versus brine (concentrated solution). The thermal-gradients head is for 12°C; that for 20°C is dotted; both include the Carnot efficiency. [From Wick and Schmitt (22)]

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"But today more than 1 billion people lack access to the most basic energy services."
Bill Gates
30 Nov 2015
[http://www.breakthroughenergycoalition.com/assets/resources/Energy-Innovation-by-Bill-Gates-Nov-30-2015.pdf]

SALINITY GRADIENT @WORK:

40 Watt LED Lantern,
not powered by
battery nor by H2-FuelCell,
but
by salt water with Mg anode

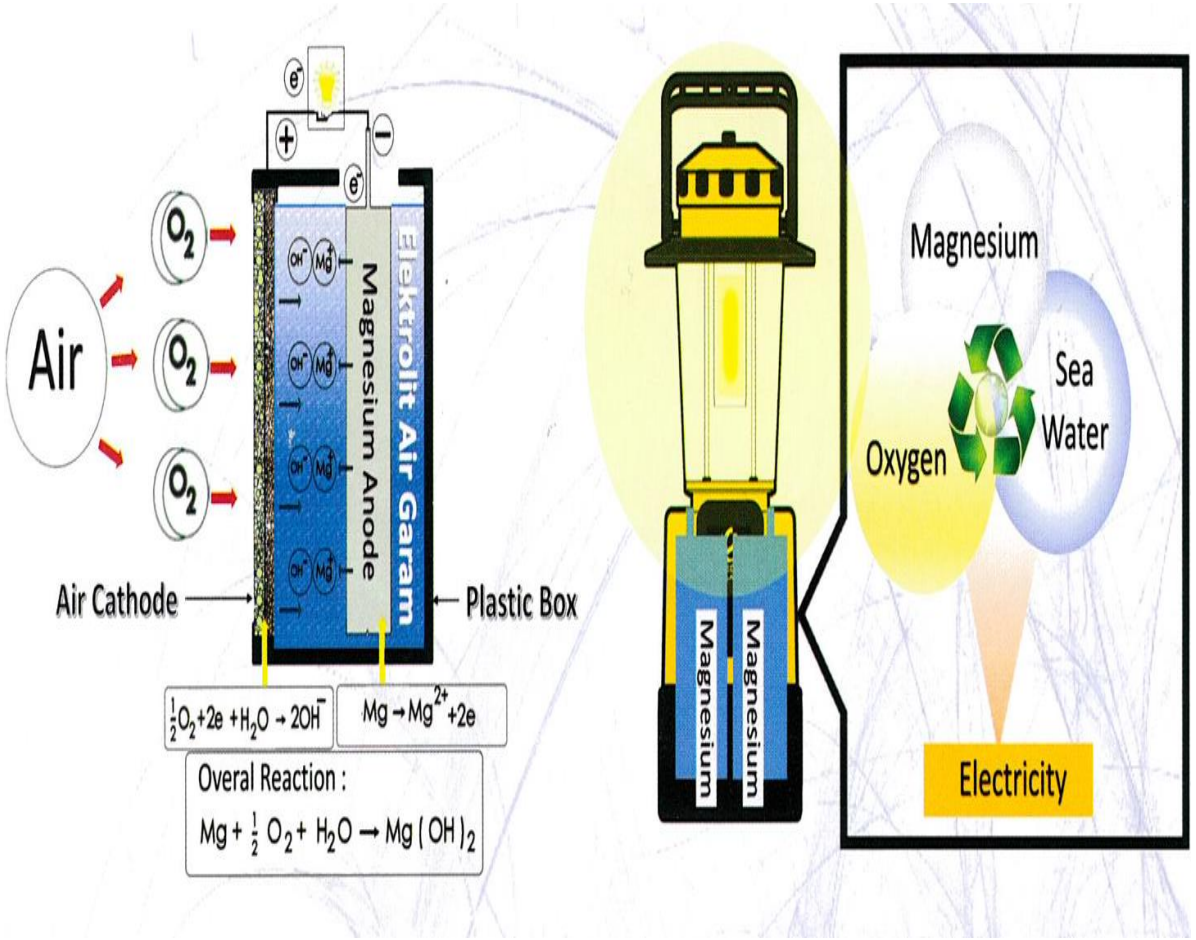
The huge amount of highly saline deep sea water discharged through series of condensers of an OTEC plant could be bottled up to power up such lanterns.

"There are about 1.1 billion of people throughout the world without access to electricity, not even to such a source of light, at least for reading & writing at night, for the sake of humanity and sustainability." World Bank

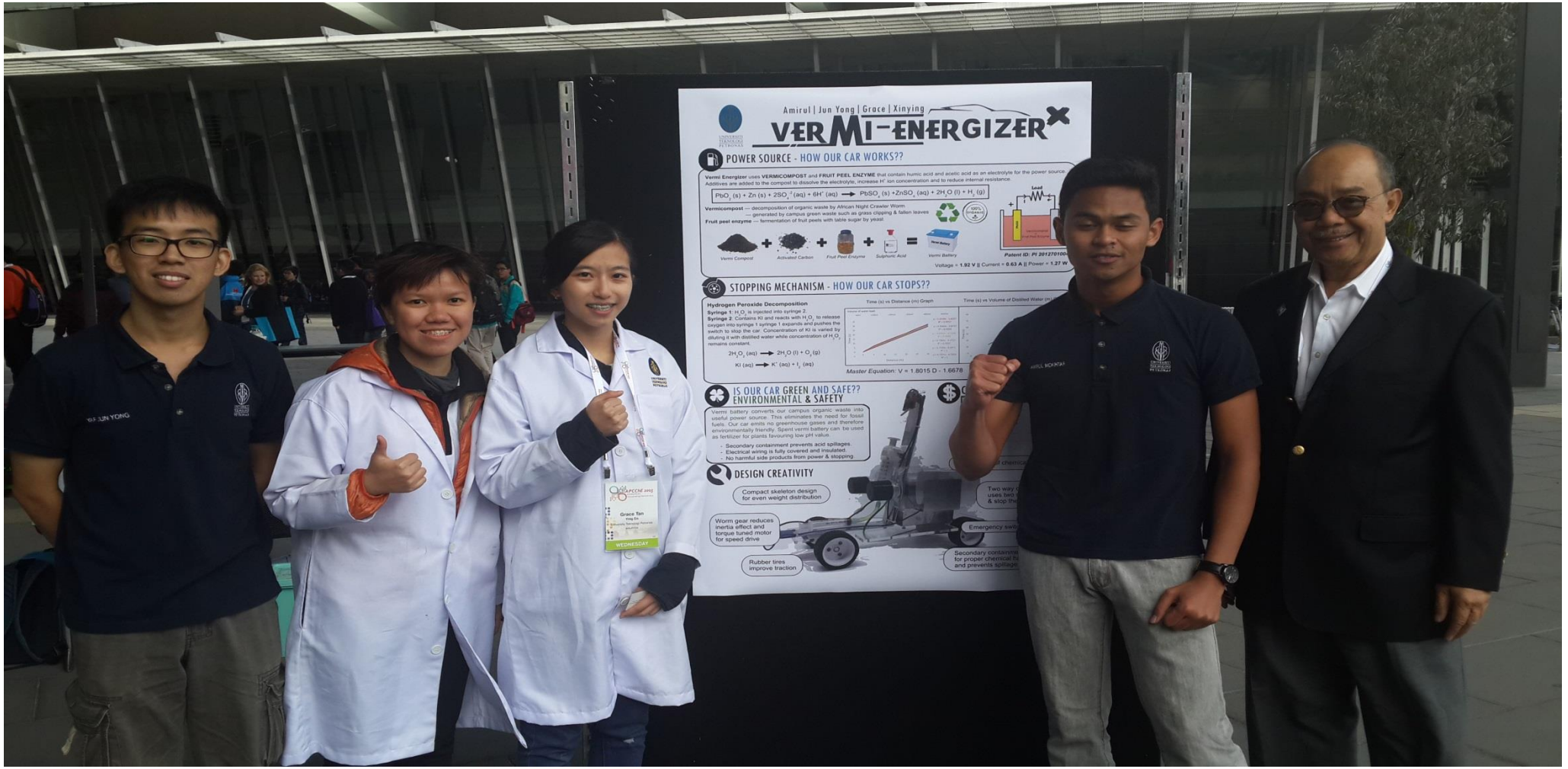
YET, TO ACCOUNT FOR THE POTENTIAL OF UTILIZING SALINITY GRADIENT (SG)

- 380 cc of water containing 18 grams of salt could generate 40 W of power to last for 8 hours;
- Per MW of OTEC, 8500 cubic metres/hour of deep sea water would be put through condensers

=> (8500/hr)(1000/0.38)40W x 8 hrs
=> 6895 MW



UTP Winning Team @APCChE, Melbourne, 1 October 2015



UNIVERSITI TEKNOLOGI PETRONAS

Amirul | Jun Yong | Grace | Xinying

VERMI-ENERGIZER

POWER SOURCE - HOW OUR CAR WORKS??

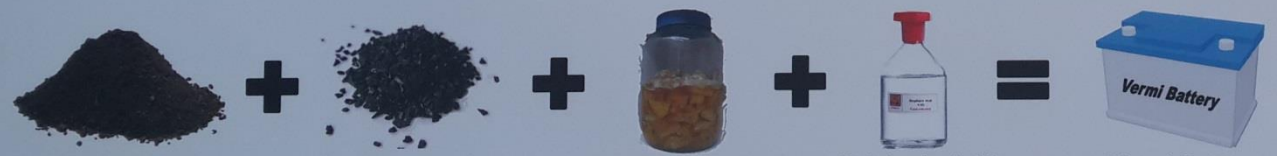
Vermi Energizer uses **VERMICOMPOST** and **FRUIT PEEL ENZYME** that contain humic acid and acetic acid as an electrolyte for the power source. Additives are added to the compost to dissolve the electrolyte, increase H^+ ion concentration and to reduce internal resistance.

$$PbO_2\,(s) + Zn\,(s) + 2SO_4^{-2}\,(aq) + 6H^+\,(aq) \rightarrow PbSO_4\,(s) + ZnSO_4\,(aq) + 2H_2O\,(l) + H_2\,(g)$$

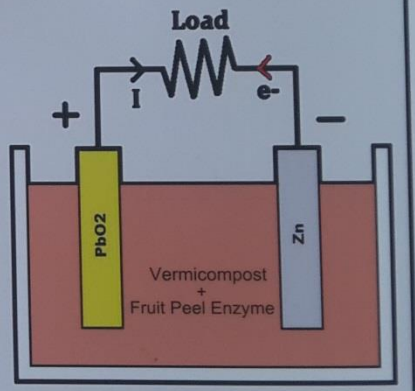
Vermicompost — decomposition of organic waste by African Night Crawler Worm
— generated by campus green waste such as grass clipping & fallen leaves

Fruit peel enzyme — fermentation of fruit peels with table sugar by yeast

100% ORGANIC



Vermi Compost + *Activated Carbon* + *Fruit Peel Enzyme* + *Sulphuric Acid* = *Vermi Battery*



Patent ID: PI 2012701004

Voltage = **1.92 V** || Current = **0.63 A** || Power = **1.27 W**

STOPPING MECHANISM - HOW OUR CAR STOPS??

STOPPING MECHANISM - HOW OUR CAR STOPS??

Hydrogen Peroxide Decomposition

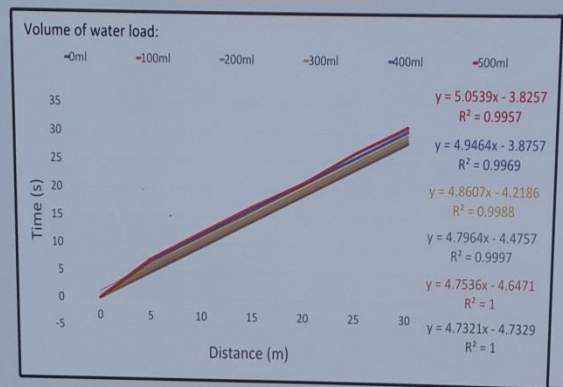
Syringe 1: H_2O_2 is injected into syringe 2.

Syringe 2: Contains KI and reacts with H_2O_2 to release oxygen into syringe 1 syringe 1 expands and pushes the switch to stop the car. Concentration of KI is varied by diluting it with distilled water while concentration of H_2O_2 remains constant.

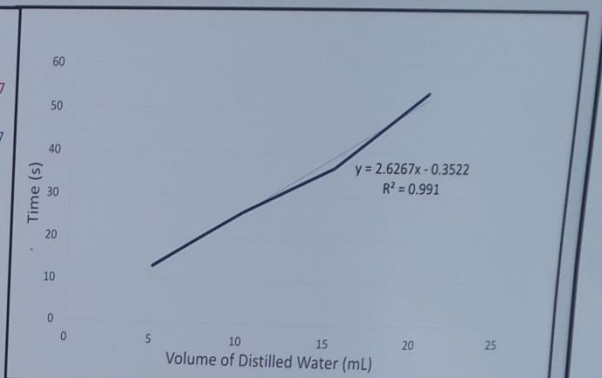
$$2H_2O_2\,(aq) \rightarrow 2H_2O\,(l) + O_2\,(g)$$

$$KI\,(aq) \rightarrow K^+\,(aq) + I_2\,(aq)$$

Time (s) vs Distance (m) Graph



Time (s) vs Volume of Distilled Water (m) Graph



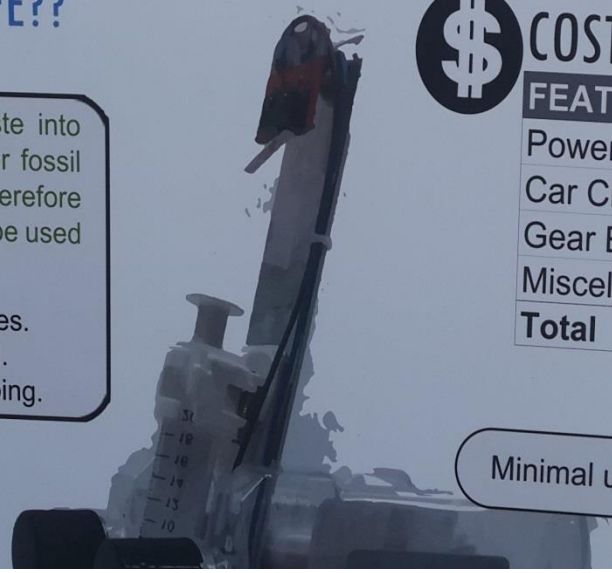
Master Equation: $V = 1.8015\,D - 1.6678$

V = volume of distilled water (ml)
D = distance (m)

IS OUR CAR GREEN AND SAFE??
ENVIRONMENTAL & SAFETY

Vermi battery converts our campus organic waste into useful power source. This eliminates the need for fossil fuels. Our car emits no greenhouse gases and therefore environmentally friendly. Spent vermi battery can be used as fertilizer for plants favouring low pH value.

- Secondary containment prevents acid spillages.
- Electrical wiring is fully covered and insulated.
- No harmful side products from power & stopping.



COST

FEATURES	COST (AUD)
Power Source	2
Car Chassis	40
Gear Box + Tyres	30
Miscelaneous	30
Total	102

DESIGN CREATIVITY

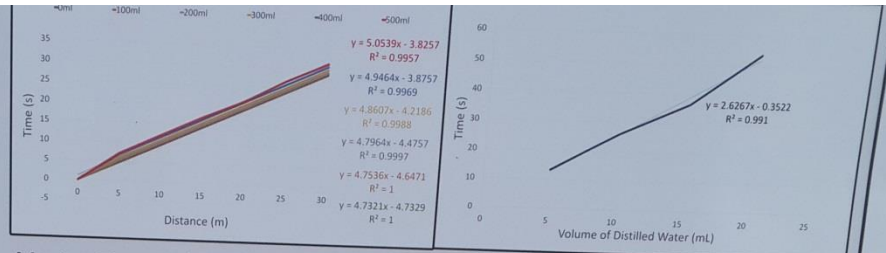
Minimal use of chemical (2)

Compact skeleton design

oxygen into syringe 1 syringe 1 expands and pushes the switch to stop the car. Concentration of KI is varied by diluting it with distilled water while concentration of H_2O_2 remains constant.

$$2H_2O_2\,(aq) \rightarrow 2H_2O\,(l) + O_2\,(g)$$

$$KI\,(aq) \rightarrow K^+\,(aq) + I_2\,(aq)$$



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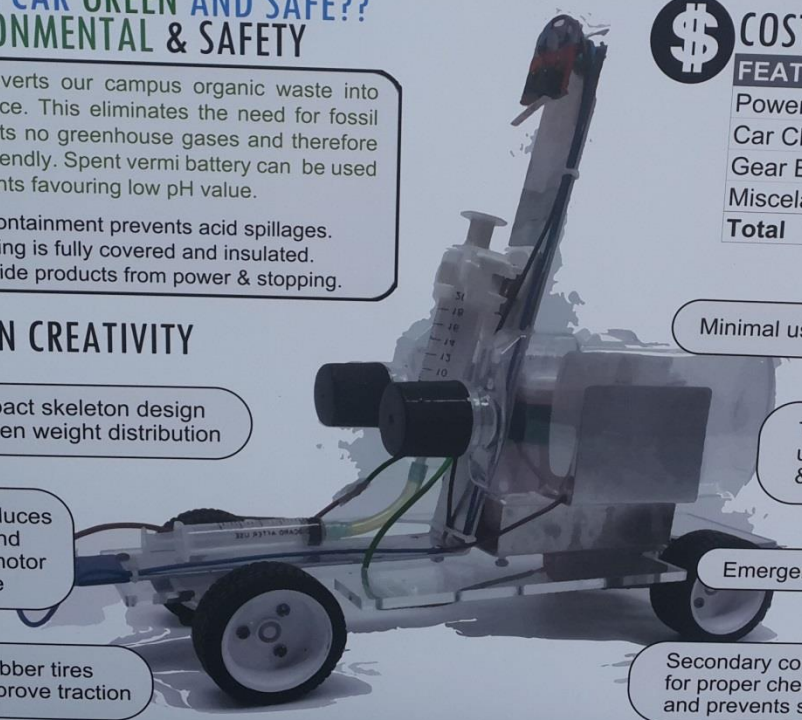


Minimal use of chemical (2)

Compact skeleton design for even weight distribution

Two way circuit system uses two syringe to start & stop the car

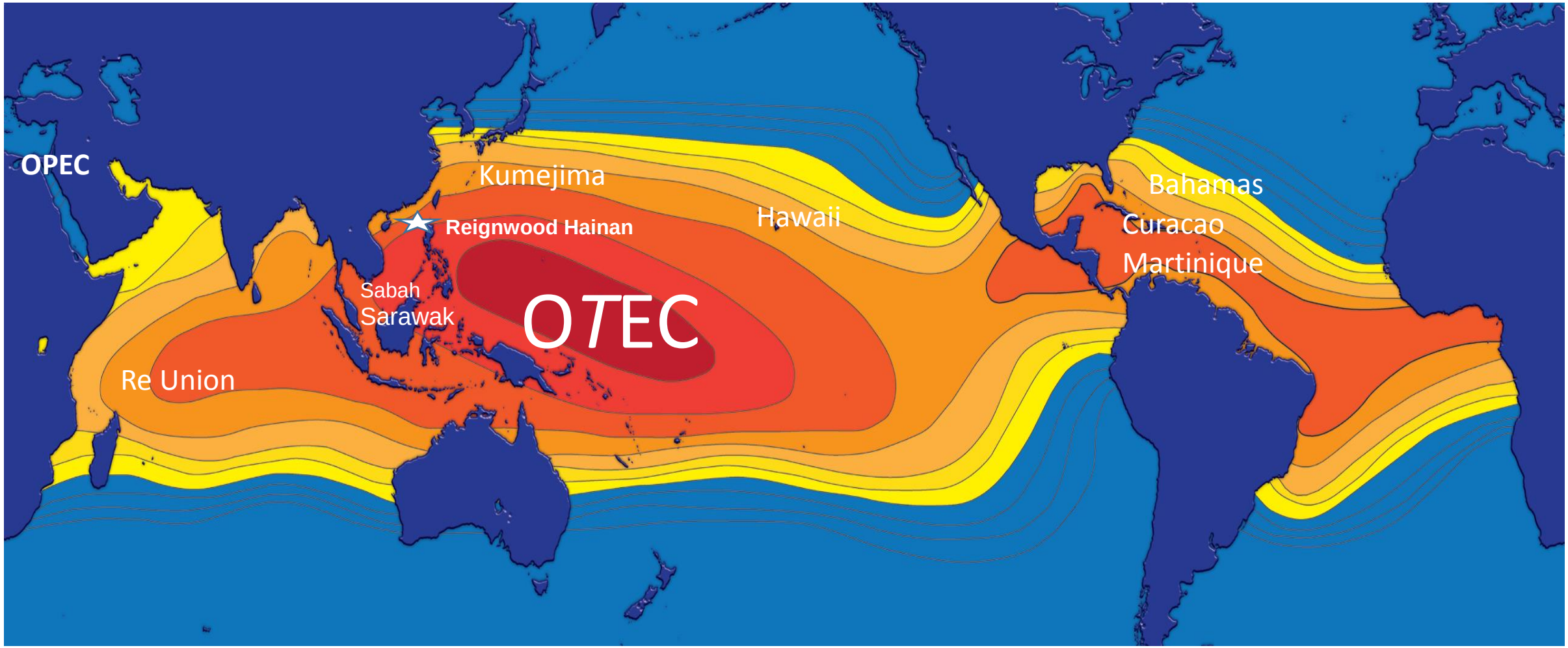
Worm gear reduces inertia effect and torque tuned motor for speed drive

Emergency switch for safety halt

Rubber tires improve traction

Secondary containment for proper chemical handling and prevents spillage

Global OTEC Potential, Development & Transition: "*From OPEC to OTEC* …" [Clarence Zener (1973)]



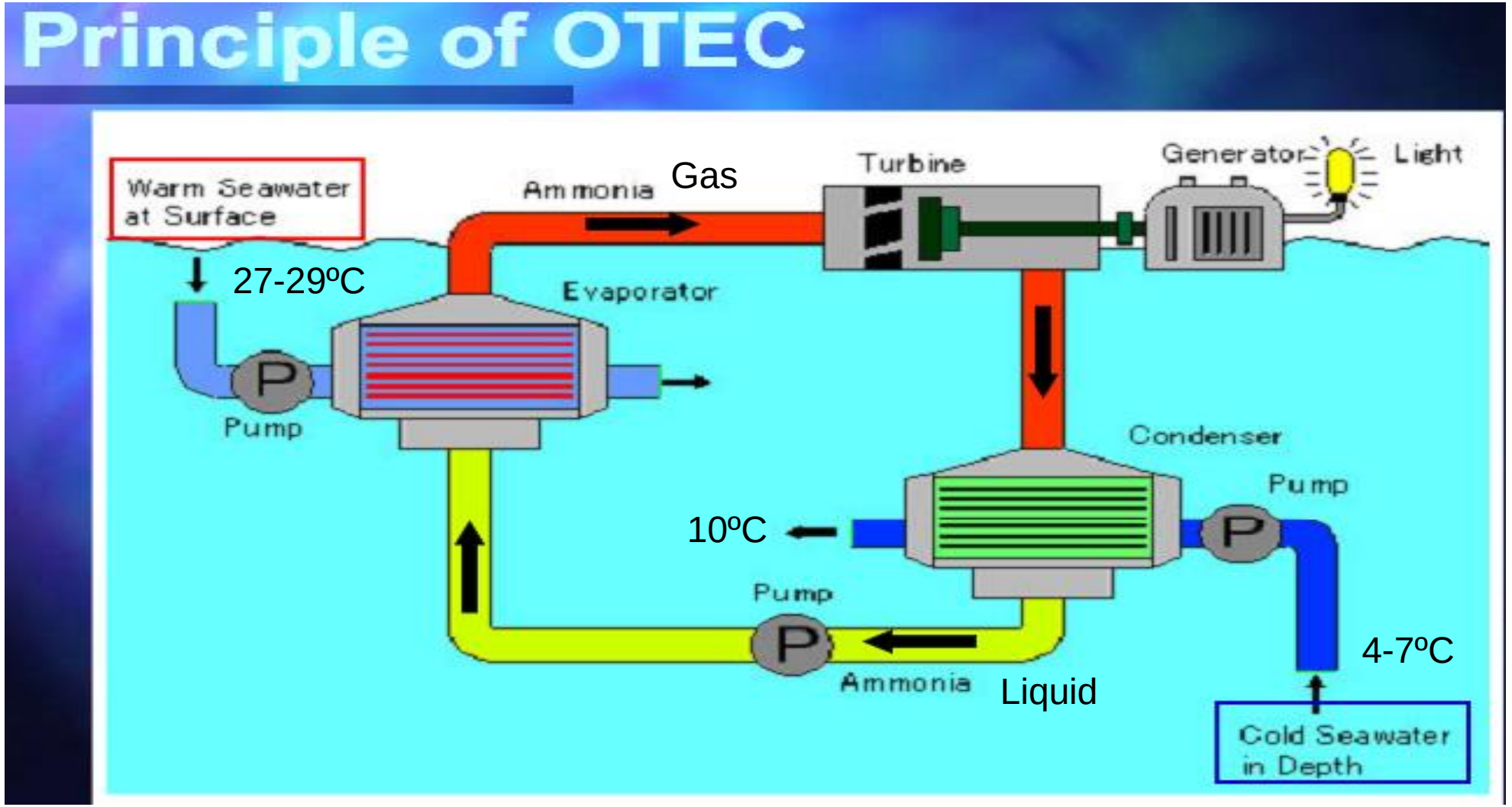
OTEC Legal Definition:

"OCEAN THERMAL ENERGY CONVERSION"

"... a method of converting part of the heat from the Sun which is stored in the surface layers of a body of water into electrical energy or energy product equivalent";

[Pub. L. 96-310, Sec. 9, July 17, 1980, 94 Stat. 946.]

Ref:
http://uscode.house.gov/download/pls/42C98.txt



Al-Quran 24:40 (610-632)

Rankine (1851)
D'Arsonval (1881)
Claude (1930)

"As energy insiders are starting to say, if solar was evolution, storage is revolution. Storage technologies plus internet-enabled computing are the killer app in the war against fossil fuels and climate chaos. The emerging internet of energy allows millions of 'prosumers' (producer-consumers) to be making, storing, trading and exporting power to the grid, 24/7. This continuously balancing, decentralised, **smart grid** is the 21st century's answer to the old paradigm of baseload."

By Ben Oquist

[http://www.abc.net.au/news/2015-12-07/oquist-how-does-coal-fit-in-with-this-'innovation'-agenda/7007536. Accessed on 8 December 2015]

7. Conclusions: “Energy, Just around Us” with Renewables! The Game Changer

- Distributed Power Systems with Renewables would be the Future; &
- The main Grid is only to complement?!

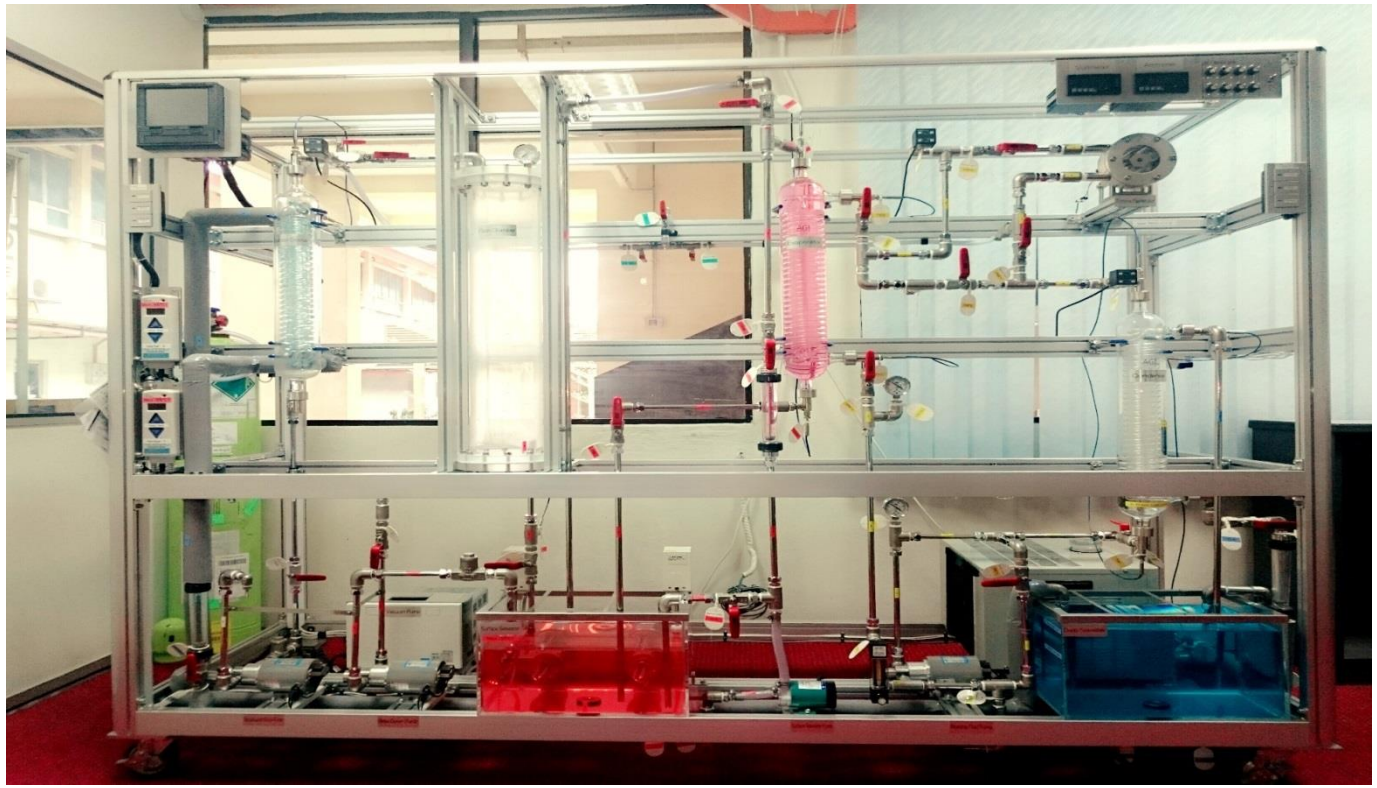
=> “Ngap-Ngap” Theory is to work

=>Less pressure on urban development with costly housing and expensive living conditions

TERIMA KASIH

GRACIAS
MERCI
SPASBO
SYUKRAN
THANK YOU
XIE-XIE

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



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