Fundamental of Renewable Energy

2 - 3 Febuari 2021

Cawangan Kejuruteraan Elektrik

HARI/MASA	8.00 Pagi - 8.30 Pagi	8.30 Pagi – 10.30 Pagi	10.30- 11.00 Pagi	11.00 Pagi - 12.00 T/hari	1.00 - 2.30 Petang	2.30 Petang - 4.30 Petang
SELASA 2/2/2021	PENDAFTARAN PESERTA	Pre-Test, Climate change & Renewable energy	MINUM PAGI	Solar Photovoltaic (PV) & Solar thermal	MAKAN TENGAHARI	Wind Energy, Biomass
RABU 3/2/2020		Hydro power		i) Geothermal & Wave Energy ii) Energy storage system iii) Exercise		Discussion, Exercise & Post Test

JABATAN KERJA RAYA INVOLVEMENT (Past & Present)

:: Renewable Energy (RE)::






2004

Projek Universal Service Provision (USP)

114 rural ICT center powered by 1 kWp Solar Photovoltaic (PV) stand alone system

.

2006

Projek Solar Schoolnet

5 kWp solar PV stand alone system for computers at 238 rural schools in Semenanjung & Sabah.

Solar Hybrid System
(SK Pulau Omadal, Semporna)

Solar Hybrid System (SHS) for rural schools in Sabah

Phase 1

2007 – 2009
78 rural schools
Total solar PV capacity = 1.5 MWp

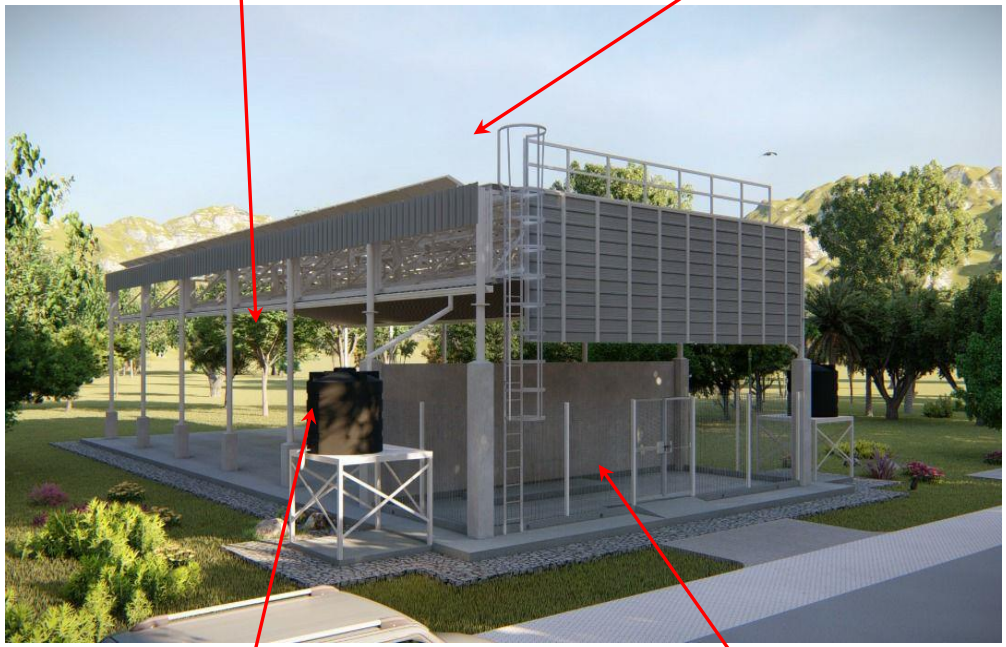
Phase 2

2010 – 2014
84 rural schools
Total solar PV capacity = 2.8 MWp

Konsep Solar Hibrid Untuk Sekolah luar bandar Sarawak

Multipurpose hall untuk kegunaan aktiviti sekolah

Dual purpose Solar PV structure : Penjanaan tenaga elektrik & bumbung untuk ruang bawah



Rain Water Harvesting

Ruang Kuasa (Outdoor type) – Inverter dan bateri

Jumlah Kapasiti Sistem Solar Hibrid

5.02 MW

PROJECT OUTCOME

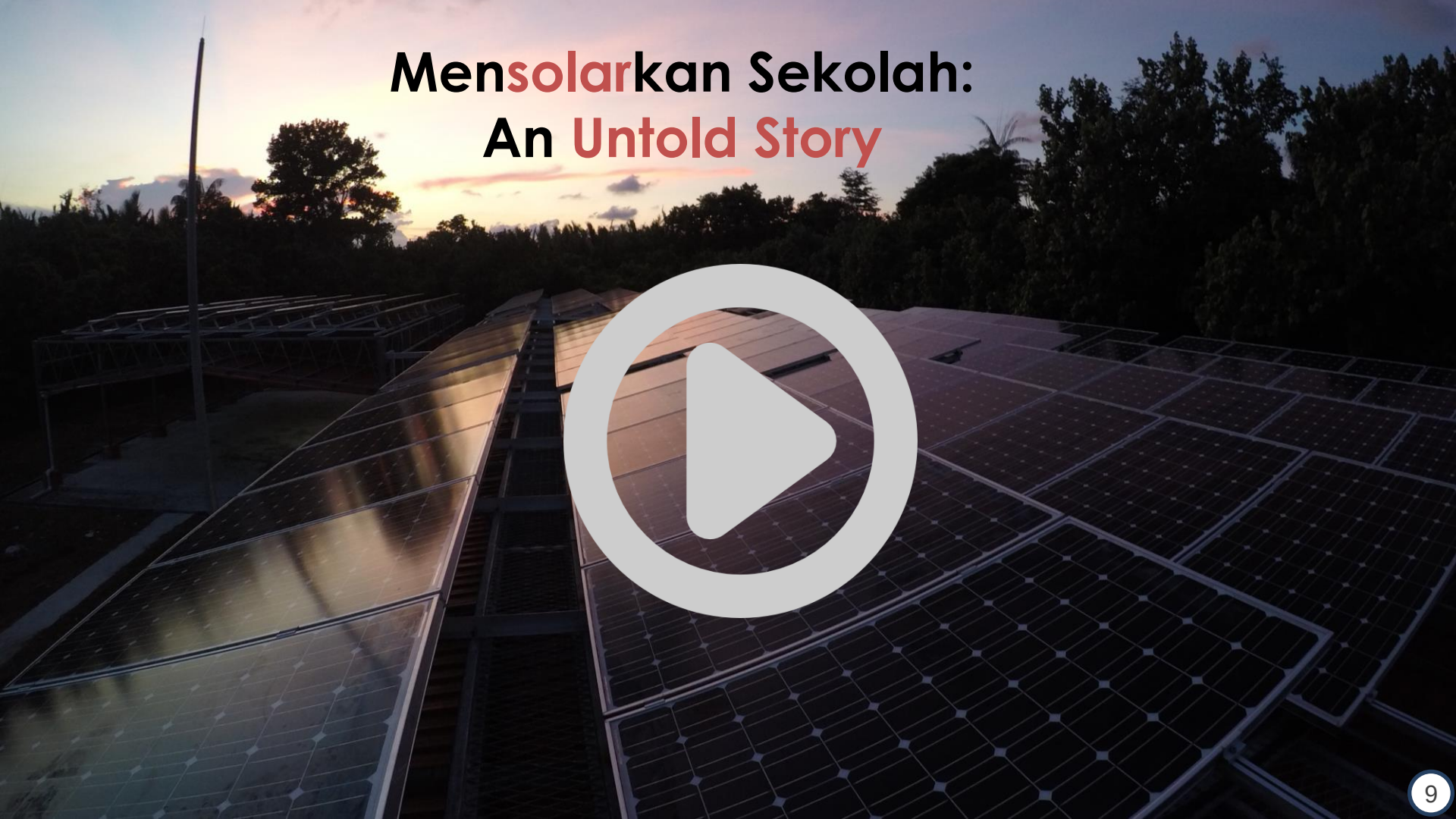
Lebih daripada **10,000** pelajar & **1,300** guru

51% pelajar lulus **UPSR pada 2017** berbanding 31% pada 2011

40,000 MWh penjanaan tenaga **HIJAU** dalam 8 tahun

21,000 tonnes CO_2 dikurangkan dalam 8 tahun

Mensolarkan Sekolah: An Untold Story



Module Kursus RE tahun 2021

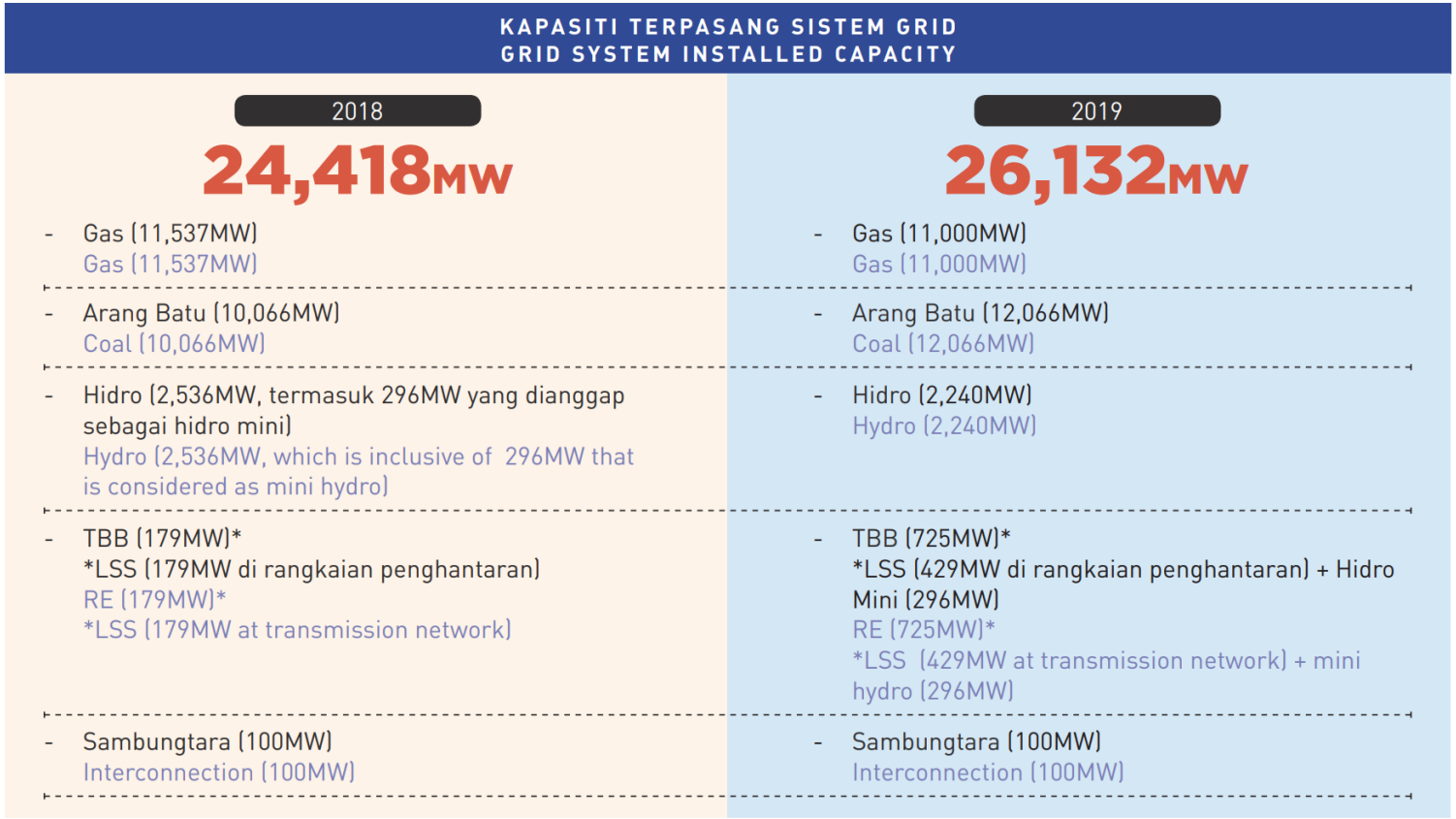
1) *Fundamental of RE*
2) *Designing of Off-Grid Solar PV System*
3) *Designing of Grid Connected Solar PV System*

Climate Change & Renewable Energy

Fundamental of Renewable Energy

Energy Resources

- The world energy demand is still dependent on fossil fuel base energy generation
  - Gas & oil
  - Coal
  - Diesel



Source: ST Annual Report 2019

Energy Resources

	2018		2019	
	Semenanjung Malaysia Peninsular Malaysia	**Sabah dan Labuan** Sabah and Labuan	**Semenanjung Malaysia** Peninsular Malaysia	**Sabah dan Labuan** Sabah and Labuan
Kapasiti Terpasang Installed Capacity	24,418MW	1,277MW	26,132MW	1,277MW
SAIDI SAIDI	48.22 minit /pelanggan/tahun minutes/customer/year	267.87 minit /pelanggan/tahun minutes/customer/year	48.13 minit /pelanggan/tahun minutes/customer/year	205.31 minit /pelanggan/tahun minutes/customer/year
Kapasiti LSS LSS Capacity	179MW	50MW	429MW	50MW
Margin Rizab Reserve Margin	32%	29%	38%	23%
Permintaan Maksimum Maximum Demand	18,338MW	955MW	18,566MW	1,001MW

Source: ST Annual Report 2019

Energy Emission Overview

- Every day we damage our climate by using fossil fuels for energy & transport
- Malaysia emitted 208 mill. tonnes of CO_2 or 7.1 tonnes per capita in 2009
- Projected total emissions – 285.73 mill tonnes CO_2 (2020). Largest emitting sector – electricity generation (43.4%)

Source : Energy Revolution, Greenpeace

Global Issues

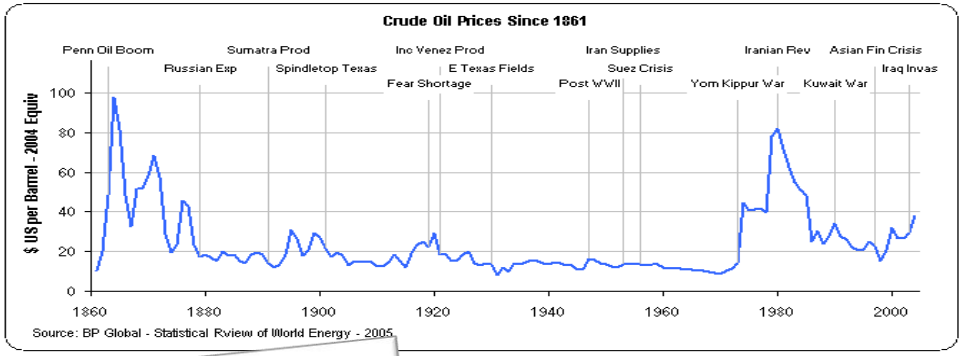
- Fossil fuel based energy will be depleted by time

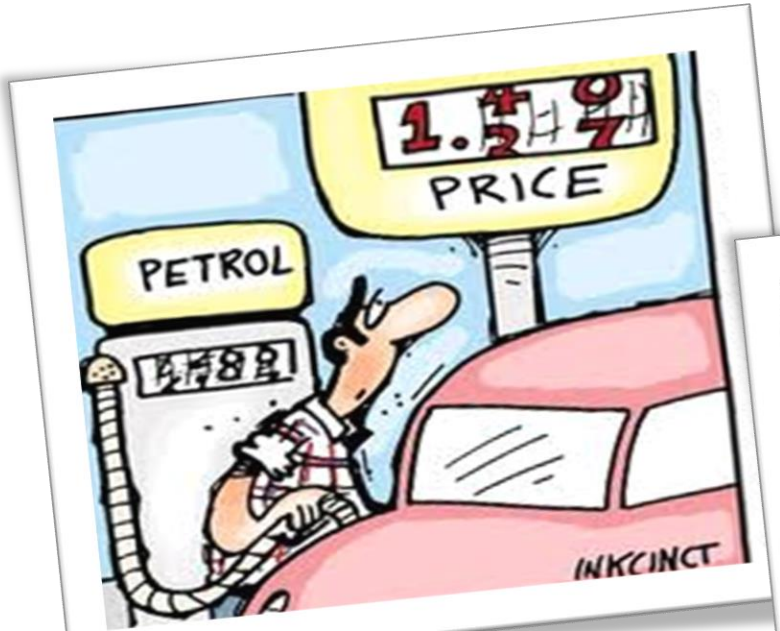
  - **Malaysia's energy reserve**

    - Oil reserve of three billion barrels. Crude oil production 750,000 barrel/day
    - Natural gas produced 80,000 barrels/day, with 2.12 trillion cubic meter reserves
    - The current reserve amount for oil may last for 19 years & natural gas for 33 years

Global Issues

- Fluctuation of global oil price





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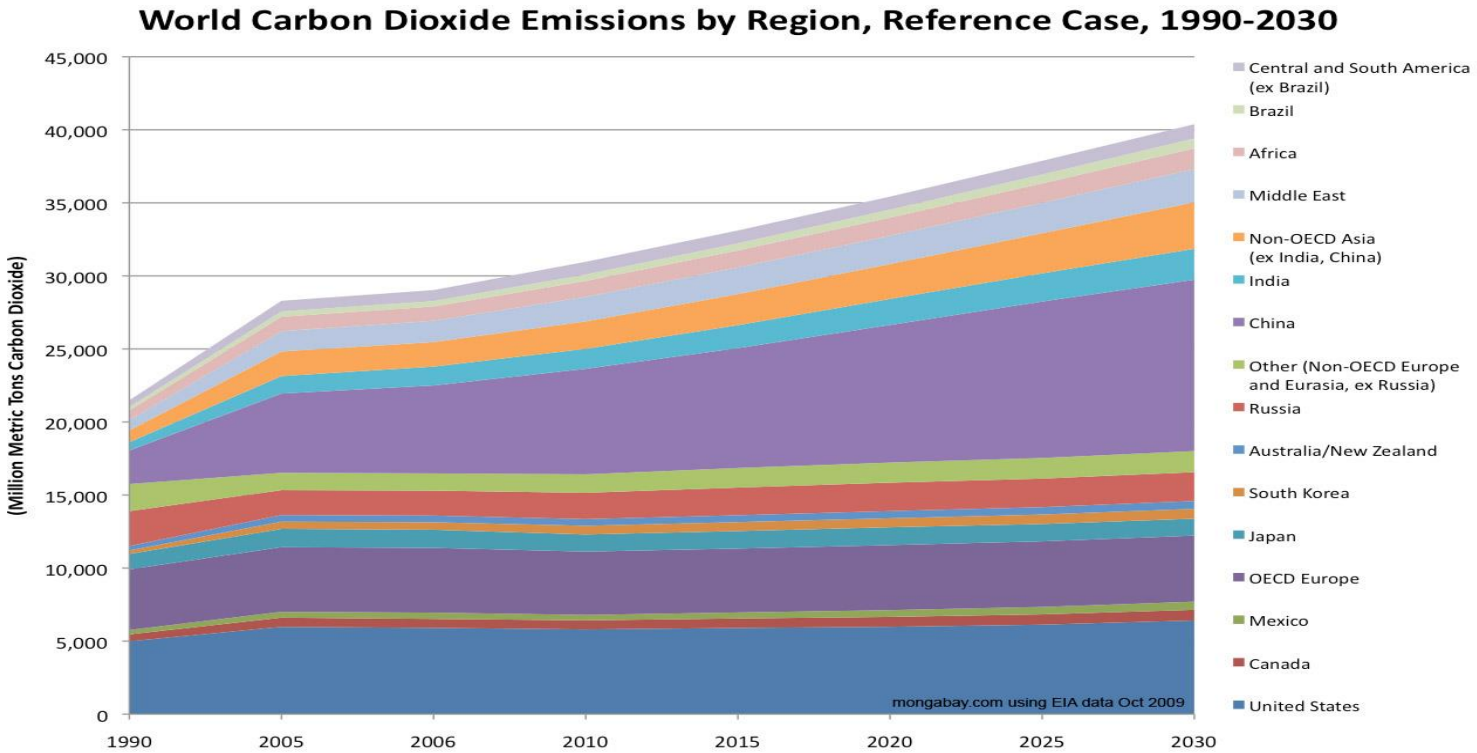
Global Issues

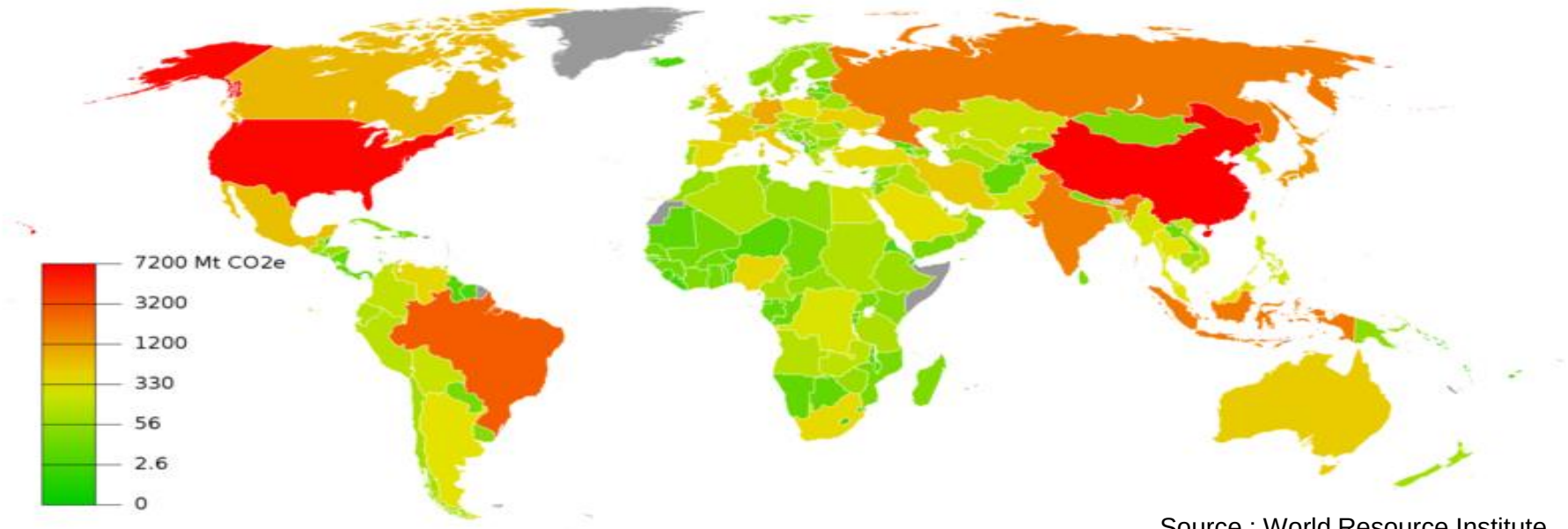
- World population growth requires more energy
- Environmental pollution

Environmental Effect

- Green House Gasses
  - Global warming & climate change



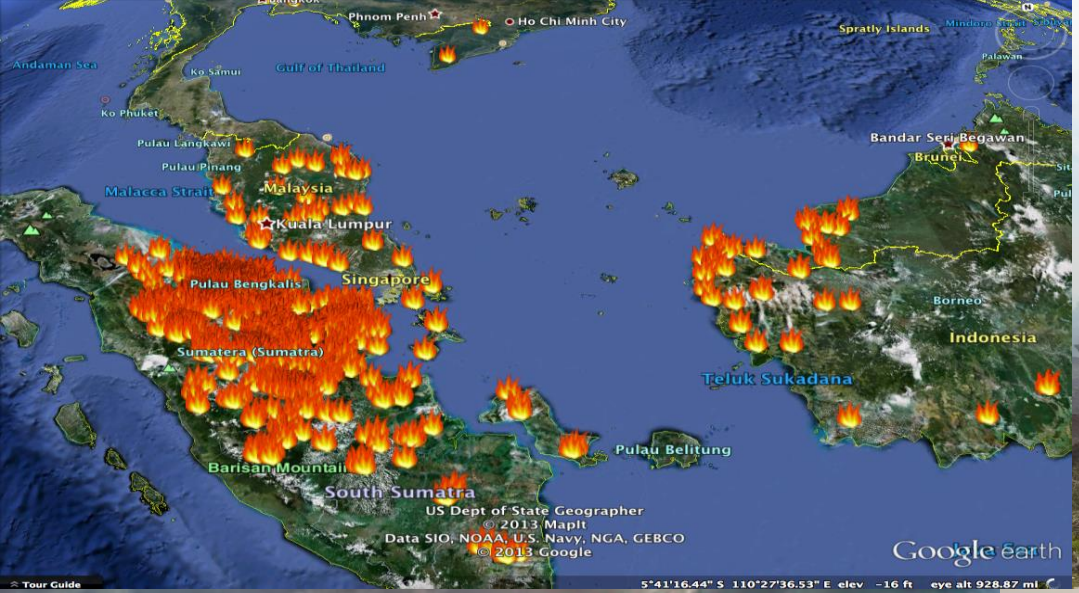
Annual CO_2 emission (2005) including land use



Source : World Resource Institute
World Bank

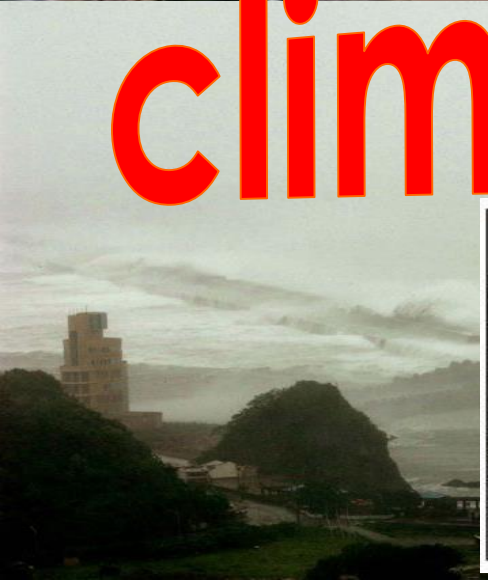
Malaysia

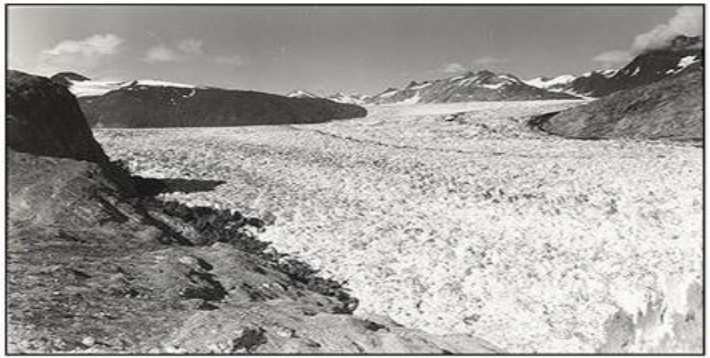
- Annual CO2 emission (2008) = 208,267,000 metric tons (0.7% of world emission)
- Annual CO2 emission per capita (2009) = 7.1 metric tons per capita (not including land use)


Phnom Penh
Ho Chi Minh City
Spratly Islands
Andaman Sea
Ko Samui
Gulf of Thailand
Palawan
Ko Phuket
Bandar Seri Begawan
Brunei
Pulau Langkawi
Pulau Pinang
Malaysia
Malacca Strait
Kuala Lumpur
Singapore
Pulau Bengkalis
Borneo
Indonesia
Sumatera (Sumatra)
Teluk Sukadana
Pulau Belitung
Barisan Mountains
South Sumatra
US Dept of State Geographer
© 2013 MapIt
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2013 Google
Google earth
Tour Guide
5°41'16.44" S 110°27'36.53" E elev -16 ft eye alt 928.87 mi


DIMANAKAH INSAN
DIKALA BUMI DINODAI
FOTO BY SANI996

climate change !!!





The earth needs to be healed….

- Sustainable energy is the answer…

RENEWABLE ENERGY

ENERGY EFFICIENCY

Definition of Renewable Energy

Renewable Energy (RE) is any form of primary energy from recurring and non-depleting indigenous resources such as agricultural produce, hydro-power, solar, wind, solid-waste, etc.

Biomass

Wind Energy

Hydro

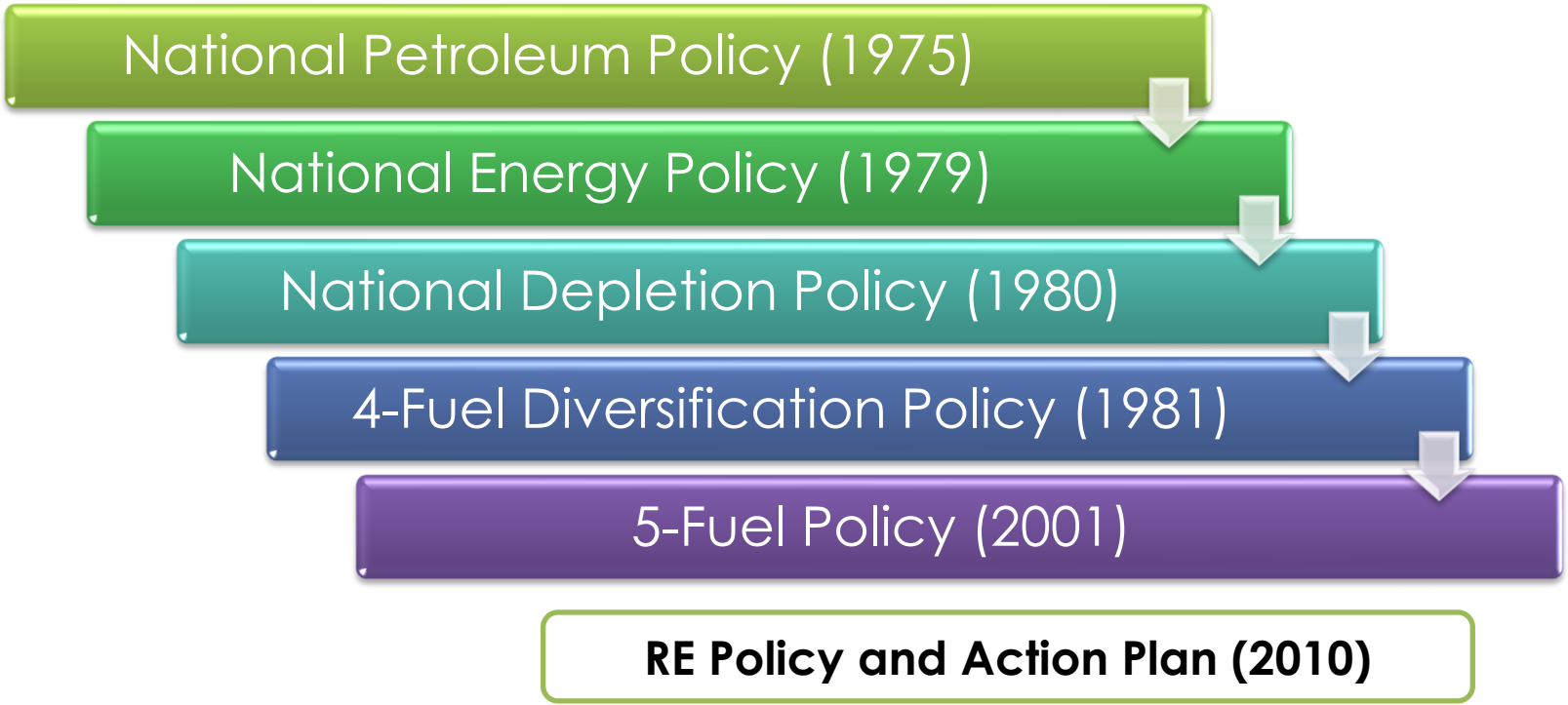
Biogas

Geothermal

Solar PV

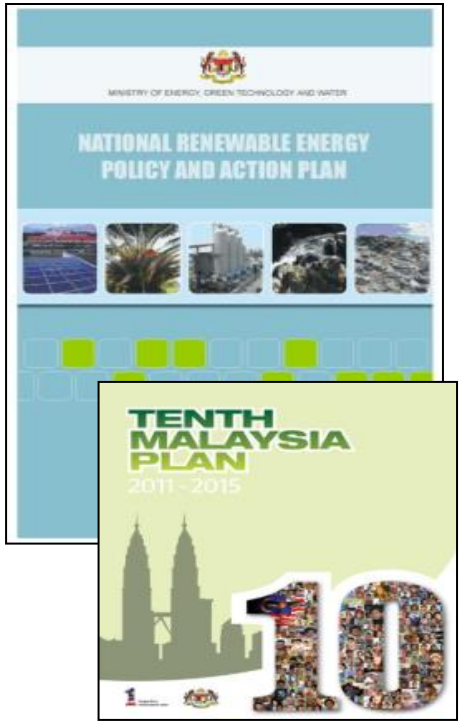
Renewable Energy in Malaysia

Development of Energy Policies in Malaysia



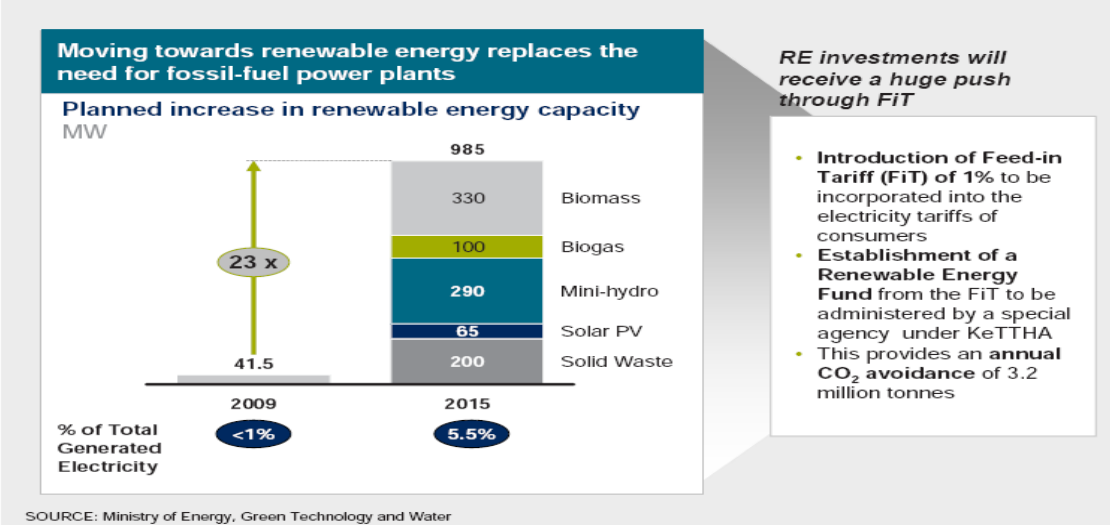
Renewable Energy in Malaysia…cont'd

➢ Renewable Energy: Government Policies



2nd April 2010: National Renewable Energy Policy & Action Plan approved
10th Jun 2010: 10th Malaysia Plan (chapter 6)
15th Oct 2010: National Budget 2011 (paragraph 34)
25th Oct 2010: Economic Transformation Programme (chapter 6)

Renewable energy will increase from <1% in 2009 to 5.5% of Malaysia's total electricity generated by 2015



SOURCE: Ministry of Energy, Green Technology and Water

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Renewable Energy in Malaysia…cont'd

National RE Targets

Year	Cumulative RE Capacity	RE Power Mix	Cumulative CO_2 avoided
2015	985 MW	5.5%	11.1 mt
2020	2,080 MW	11%	42.2 mt
2030	4,000 MW	17%	145.1 mt

Note: RE capacity achievements are dependent on the size of RE fund

- Assumptions:
  - Feed-in Tariff (FiT) implemented

Feed-in Tariff Rates

Technology / Source	FiT Duration	Range of FiT Rates (RM/kWh)	Annual Degression
Biomass (palm oil waste, agro based)	16	0.27 – 0.35	0.5%
Biogas (palm oil waste, agro based, farming)	16	0.28 – 0.35	0.5%
Mini Hydro	21	0.23 – 0.24	0%
Solar PV	21	0.85 – 1.78	8%
Solid waste & Sewage	16	0.37 – 0.45	1.8%

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POLISI TEKNOLOGI HIJAU NEGARA

2011 — Feed In Tariff

- Tarif untuk solar PV
  2013 – RM0.68 – RM1.1316/kWh
  ** Degression rate 8% setahun*

2016 — Net Energy Metering (NEM)

- Konsep *Net billing*
- *Self consumed*, lebihan penjanaan tenaga dijual ke pihak utiliti pada kadar tarif belian tenaga
- Contoh:
  Tarif B = RM0.509/kWh
  ** Rate telah disemak semula tahun 2018*

2018 — Supply Agreement for Renewable Energy (SARE)

- *Self consumed*,
- Tarif penjanaan tenaga daripada solar PV rendah daripada tarif grid utiliti
- Contoh:
  Grid = RM0.509/kWh
  Solar = RM0.43/kWh

POLISI TEKNOLOGI HIJAU NEGARA

EMBARGO SEHINGGA 10.00AM 29 DISEMBER 2020

KEMENTERIAN TENAGA & SUMBER ASLI

MEKANISME PELAKSANAAN *NET ENERGY METERING* 3.0

PERKARA	NEM 3.0		
	NEM RAKYAT	NEM GoMEn	NOVA
	Domestik	Bangunan Kerajaan	Komersial & Industri
Kuota ditawarkan (MW)	100	100	300
Mekanisme (*roll-over*)	NEM 1:1 (12 bulan)	NEM 1:1 (12 bulan)	SELCO+ (1 bulan)
Tarikh mula ditawarkan	1 Februari 2021		1 April 2021
Tempoh tawaran	3 tahun		
Kadar *offset*	Tarif Semasa	Tarif Semasa	*System Marginal Price*
Tempoh *offset*	10 tahun		
Ketetapan selepas 10 tahun	*Self-Consumption (SelCo)*	*Self-Consumption (SelCo)*	*Self-Consumption (SelCo)*
Had Kapasiti Pepasangan	*Single Phase*: 4kWac *Three Phase*: 10kWac	1 MWac/ 1 Akaun	*Nett offset* 1MWac *Net offset +Virtual aggregation* 5MWac
Kelayakan	Pemegang Akaun Domestik	Jabatan/Agensi Kerajaan	Pemegang Akaun Bukan Domestik

LATAR BELAKANG

SARE

Supply Agreement for Renewable Energy

Kesinambungan Net Energy Metering (NEM)

100 MW kuota untuk Bangunan Kerajaan

KONSEP PERLAKSANAAN

Zero Capital Requirement
- Immediate saving with no upfront cost

Multiple Payment Options
- Choose from cash, leasing or energy plan

Billing & Support
- Integrated billing with TNB
- 24 hours hotline support

Warranty
- PV Panel – 25 years performance warranty & 10 years OEM warranty.
- Inverter – 10 years OEM warranty

Maintenance & Monitoring
- Preventive annual scheduled maintenance
- 24 hours continuous performance monitoring
- Inclusive throughout contract period

Ownership
- Full transfer of ownership at the end of contract period at no cost.
- Early contract exit option allowable with exit fee schedule

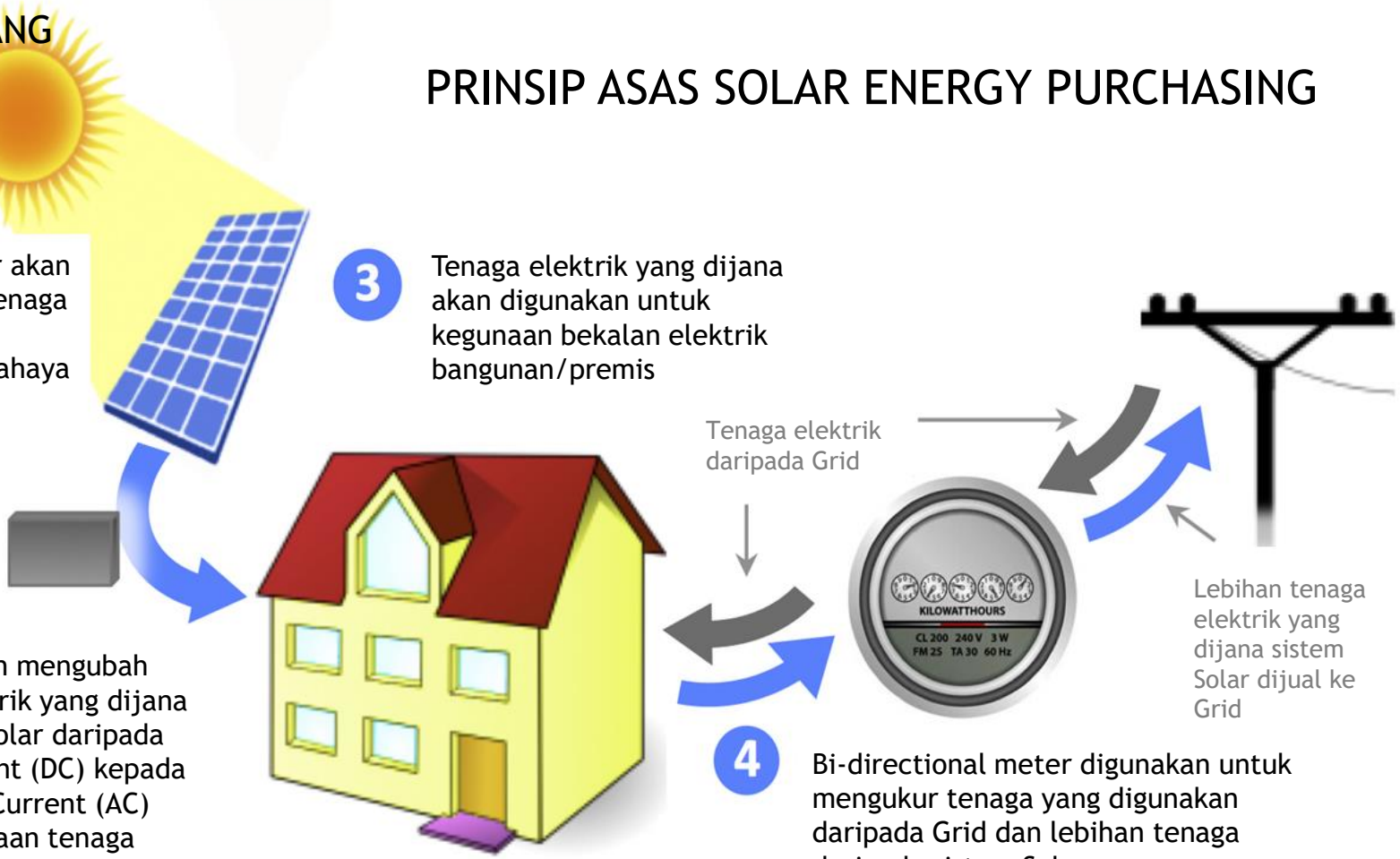
LATAR BELAKANG

PRINSIP ASAS SOLAR ENERGY PURCHASING

1. Panel Solar akan menjana tenaga elektrik daripada cahaya matahari

2. Inverter akan mengubah tenaga elektrik yang dijana oleh panel Solar daripada Direct Current (DC) kepada Alternating Current (AC) untuk kegunaan tenaga bangunan/premis

3. Tenaga elektrik yang dijana akan digunakan untuk kegunaan bekalan elektrik bangunan/premis



4. Bi-directional meter digunakan untuk mengukur tenaga yang digunakan daripada Grid dan lebihan tenaga daripada sistem Solar

Powering a Sustainable Future

Surely we have a **RESPONSIBILITY** to leave for future generations a planet that is **HEALTHY** & **HABITABLE** for all species

– Sir David Attenborough

The **FUTURE** depends on what we do in the **PRESENT**

– Mahatma Gandhi

Powering a Sustainable Future

Solar Energy Purchasing (SEP)

Rooftop solar PV installation for buildings

Integrated Solar PV System (ISPV)

Off-grid power system solution for remote areas

JKR Solar Power Initiatives

Solar PV Integrated Management System (SPV-IMS)

IoT based information management system for solar PV system

Energy Storage System (ESS)

Energy storage as a backup for buildings energy supply

Solar Energy Purchasing

Strategic collaboration between JKR & TNB in *Solar Energy Purchasing* (SEP) program for Government buildings and JKR projects

MoU was signed on 9th Mac 2019

TNB, JKR buat kajian pasang bumbung solar

Jabatan Kerja Raya bakal nikmati faedah bersih elektrik kos sifar modal

***Nirinder Singh (tiga dari kanan) dan Kamaluddin** bertukar dokumen pada majlis memetera di Kuala Lumpur, semalam.*

Oleh Nora Mahpar
noramahpar@bh.com.my

Tenaga Nasional Bhd (TNB), menerusi anak syarikatnya, TNBX Sdn Bhd (TNBX) dan Jabatan Kerja Raya Malaysia (JKR) sedang melaksanakan kajian daya maju untuk memasang bumbung solar di bangunan JKR di bawah Program Pembelian Tenaga Solar TNB.

Kajian berkenaan adalah satu daripada lima bidang kerjasama menerusi memorandum persefahaman (MoU) yang dimeterai antara kedua-dua pihak

TNB pasang PV

MoU itu dimeterai oleh Pengarah Urusan TNBX, Ir Nirinder Singh Johl, manakala JKR diwakili oleh Timbalan Ketua Pengarah (Sektor Pakar), Ir Kamaluddin Abdul Rashid.

Menerusi MoU itu, TNB akan melabur, mereka bentuk, memasang dan menyelenggara sistem fotovoltan solar (PV) di bangunan JKR sepanjang tempoh kontrak selama 20 hingga 25 tahun.

Dengan pemasangan sistem bumbung PV dengan TNBX, JKR akan menikmati faedah bersih elektrik pada kos sifar modal terdahulu.

JKR juga akan dibilkan bagi elektrik yang dijana daripada sistem PV solar pada kadar yang lebih rendah daripada tarif elektrik biasa TNB.

Di samping itu, JKR boleh menjual sebarang tenaga berlebihan yang dijana daripada PV solar kembali ke TNB di bawah Skim Meter Tenaga Bersih (NEM).

Justeru, menerusi Program Pembelian Tenaga Solar TNB ini, JKR akan memperoleh manfaat daripada elektrik bersih untuk memenuhi sasaran pengurangan karbon tanpa membabitkan sebarang modal dan meraih keuntungan daripada penjimatan kos elektrik secara keseluruhan dengan minimum risiko.

Tangani isu tenaga.

Mengulas mengenai MoU berkenaan, Ir Nirinder berkata, kerja-

sama ini sebagai kerj
dua entiti yang ber
menangani isu peng
ga.

"Diharapkan, inisi
meningkatkan kese
keperluan yang lebi
pengurusan tenaga
katanya dalam kery
lam.

Kedua-dua pihak
sama dalam empat
iaitu Promosi Teknol
gara Pintar; Operasi K
Kecemerlangan Peny

JUMLAH KAPASITI SOLAR YANG DICADANGKAN

BANGUNAN KKR **337 kW**
BANGUNAN IBU PEJABAT JKR **143 kW**

Bil	JKR ELEKTRIK	CADANGAN KAPASITI SOLAR (kW)
1	JKR (E) PULAU PINANG	72
2	JKR (E) KEDAH	72
3	JKR (E) PERAK	72
4	JKR (E) KELANTAN	50
5	JKR (E) TERENGGANU	72
6	JKR (E) PAHANG	72
7	JKR (E) JOHOR	126
8	JKR (E) MELAKA	72
9	JKR (E) N9	127
10	JKR (E) PERLIS	150

Jumlah keseluruhan kapasiti Solar PV

1.4 MW

Jumlah keseluruhan penjimatan dalam 21 tahun

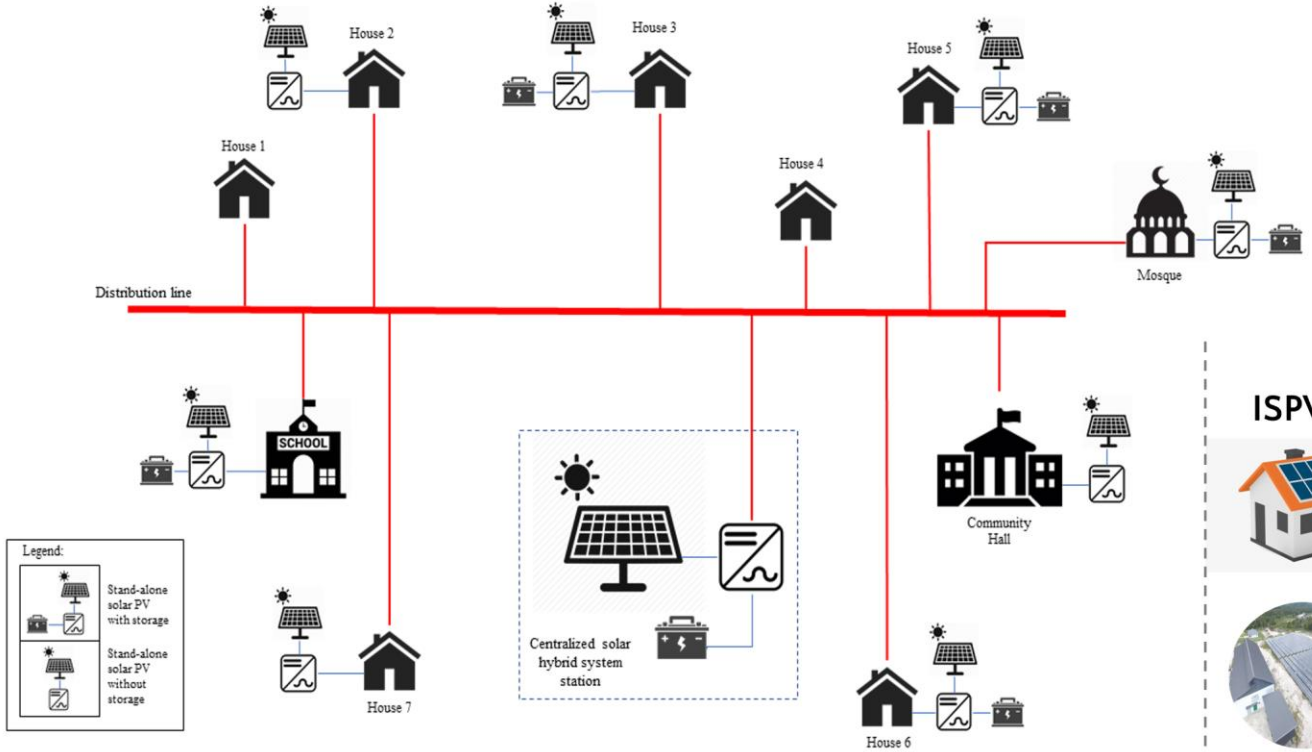
RM8.76 juta

1,400 MWh /setahun
tenaga elektrik dijana daripada sumber tenaga
HIJAU

326 tonnes CO_2
akan dikurangkan dalam setahun

JKR PROPOSAL ON RURAL ELECTRIFICATION PROGRAM (REP)

INTEGRATED SOLAR PV SYSTEM (ISPV)



Definition of ISPV:

"Integrating the concept of hybrid systems and stand-alone systems in one generation network to ensure efficient energy generation & distribution and highly reliable power generation at an effective lifetime cost"

ISPV key features:

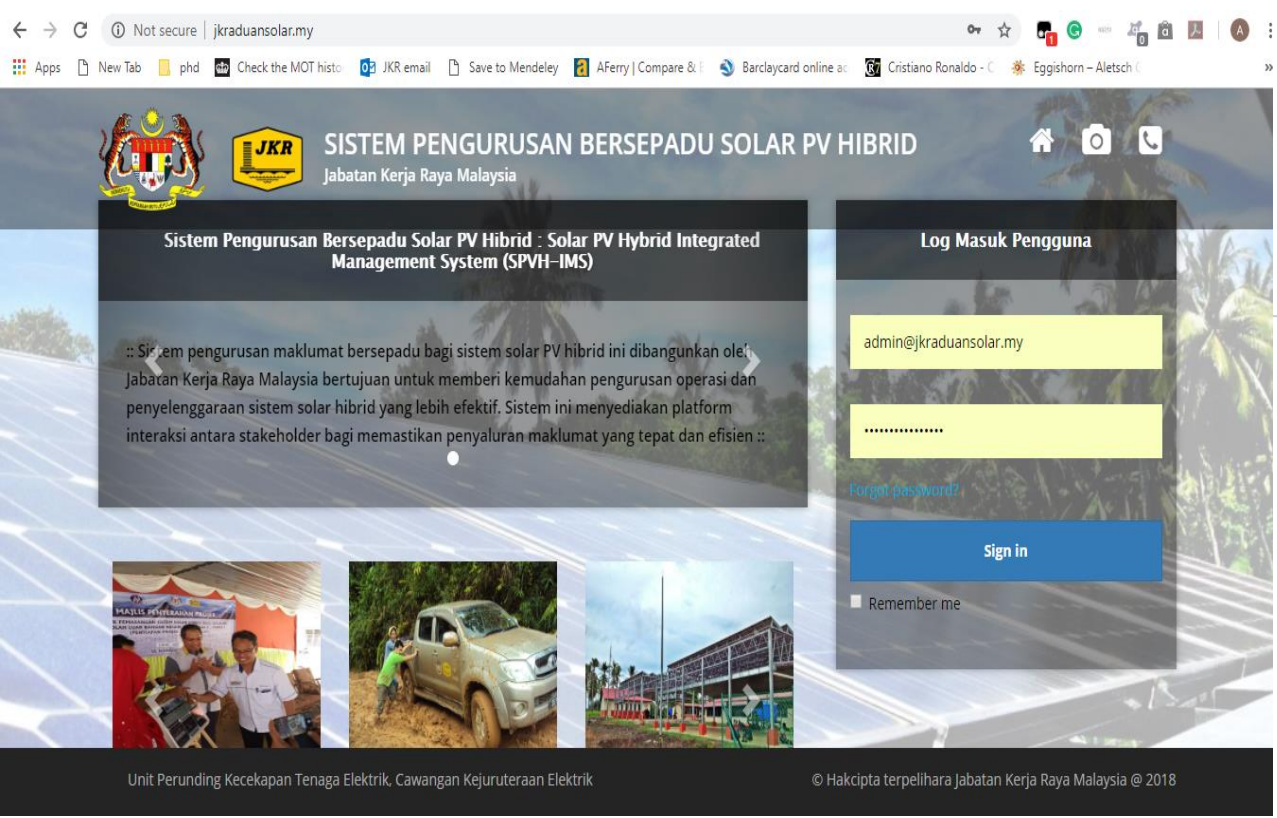
Each household to have **small solar PV system** for base-load demand

A centralized system integrates in the same distribution network at **50% capacity** of total system required

Menaiktaraf Stesen Solar Hibrid Pulau Kapas, Terengganu

220 kW, konsep Integrated Solar PV (ISPV) system

3 Solar PV Hybrid Integrated Management System (SPVH-IMS)



SITE ASSESSMENT

SYSTEM DESIGN

ADUAN

SYSTEM PERFORMANCE

End of 1st session….