Enhancing the Solar Energy Potential in Malaysia using the Concentrated Photovoltaic (CPV) Technology

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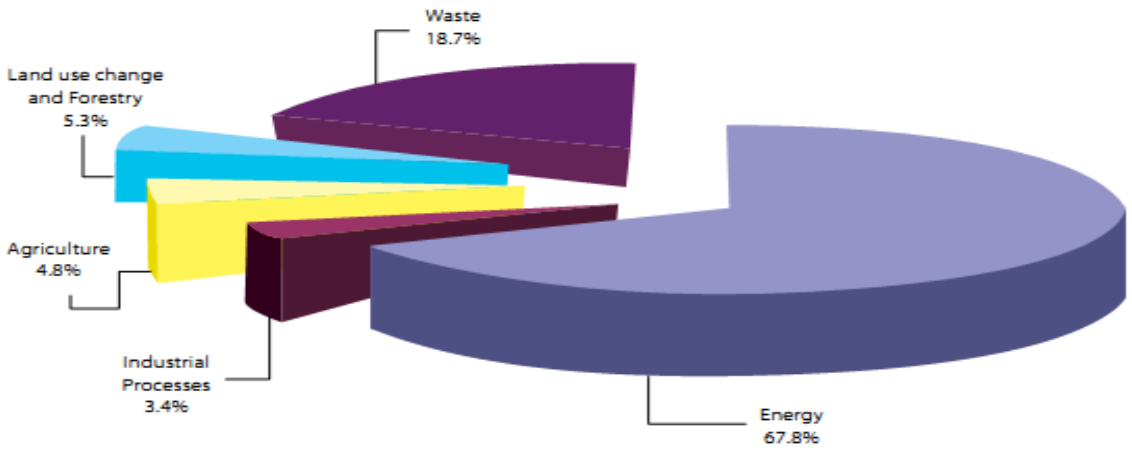
Presentation Outline

- **Introduction**
- **Some Facts and Figures of Malaysia**
- **Renewable Energy Initiatives in Malaysia**
- **RE and Environmental Targets by the Government**
- **Overview of Concentrated Photovoltaic (CPV) Technology**
- **Our Research Project**
- **Concluding Remarks**

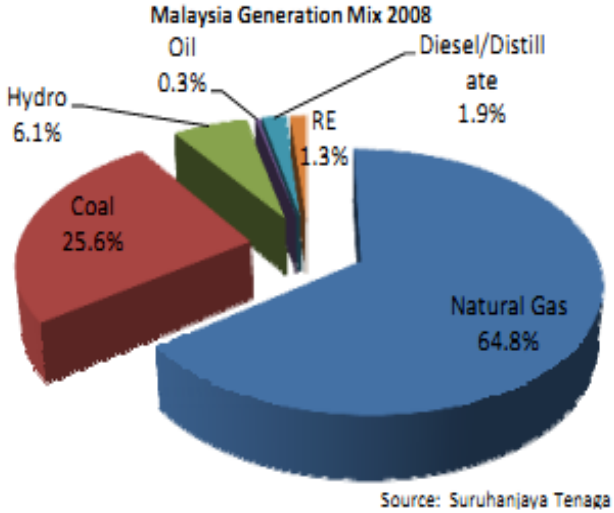
Introduction

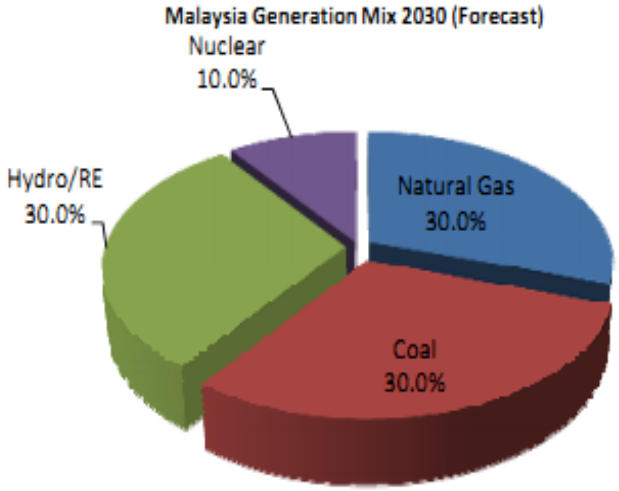
- The significance of electric energy cannot be overemphasised in the contemporary world.
- Research has shown that energy production sector emits the largest amount of GHG emissions – fossil fuels burning.
- To cope with the future energy demand, amid the environmental constraints, there is a need to go for RE.
- Solar energy is one of the most abundant RE resources that could be aggressively harnessed for energy production.
- Malaysia is one of the countries in the world working to facilitate the growth of RE industry.
- One of the newest and most efficient solar technologies in the market today is concentrated photovoltaic (CPV) panels.

Some Facts & Figures of Malaysia



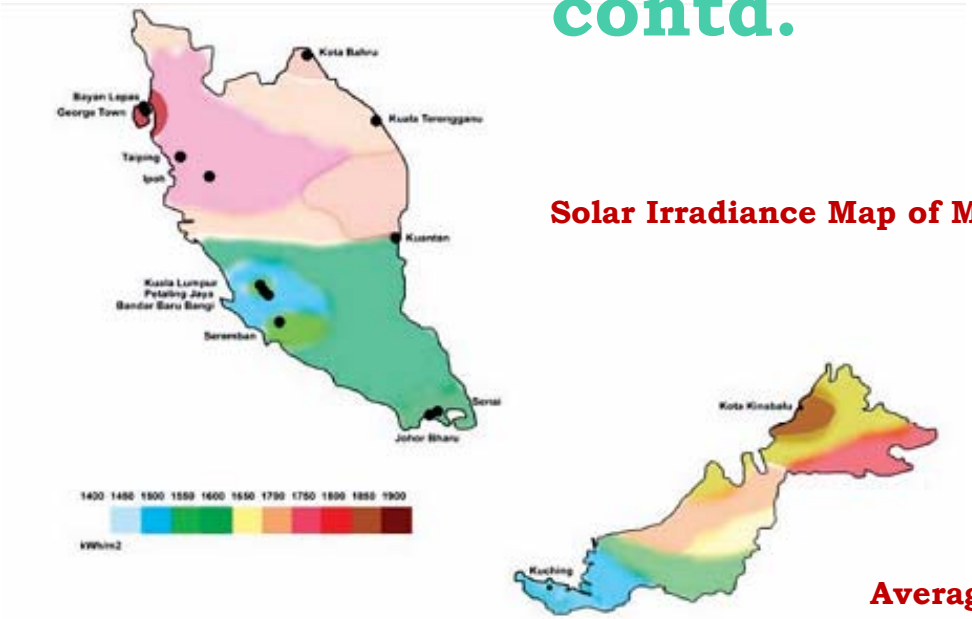
Greenhouse Gas Emissions in Malaysia by Source in 1994 [1]





Malaysia power generation by source

Some Facts & Figures of Malaysia contd.



Solar Irradiance Map of Malaysia

Average Yearly Solar Irradiance, kWh/m^2 per day [2]

Town/Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Alor Setar	5.26	5.86	5.81	5.65	5.05	4.82	4.84	4.69	4.65	4.37	4.23	4.42	4.96
Georgetown	5.62	6.09	5.93	5.69	5.07	4.97	4.92	4.71	4.67	4.53	4.76	5.00	5.15
Kota Baru	5.14	5.95	6.23	6.28	5.54	5.33	5.35	5.30	5.42	4.76	3.98	4.24	5.28
Kuala Lumpur	4.79	5.37	5.42	5.27	5.11	4.98	4.92	4.87	4.88	4.76	4.36	4.17	4.90
Johor Baru	4.48	5.22	5.05	4.87	4.57	4.41	4.30	4.33	4.53	4.57	4.34	4.07	**4.55**
Kota Kinabalu	5.11	5.78	6.43	6.45	5.77	5.33	5.19	5.17	5.31	5.03	4.75	4.65	**5.41**
Kuching	3.96	4.36	4.69	4.99	4.87	4.93	4.84	4.87	4.68	4.59	4.48	4.16	4.62

Renewable Energy Initiatives in Malaysia

- Small Renewable Energy Power (SREP) Program was announced in 2001 by the govt.
- In 2005, MBIPV (a 5 year Programme) was launched to promote use of PV technology in buildings.
- In 2009, Malaysia made a voluntary commitment at the UN Climate Change Conference to reduce 40% of her emission intensity of GDP by the year 2020 compared to 2005 levels.
- Green Technology Policy was launched by the PM in July 2009.
  - To minimise the degradation of the environment.
  - To facilitate the growth of the renewable energy industry.
  - To ensure reasonable RE generation costs.
- As at December 2009, the grid-connected RE power generations in Malaysia totaled 53 MW.
- On Dec 1, 2011, FiT was launched, and 201 proposals for 144 MW worth of PV projects were received by the second day [3].

A few Completed BIPV Project Samples in Malaysia

9.9 kWp Damansara Utama (Selangor) BIPV in 2007

362 kWp PV system Technology Park Malaysia – The largest installation in south-east Asia.

Renewable Energy Capacity Targets by the Government

Year	Cumulative RE Capacity (MW)						
	Biogas	Biomass	Solid Waste	Small Hydro	Solar PV	Solar PP*	Total
2011	20	90	20	60	9	20	219
2012	35	140	50	110	20	55	410
2013	50	200	90	170	33	105	648
2014	75	260	140	230	48	185	938
2015	100	330	200	290	65	295	1,280
2016	125	410	240	350	84	425	1,634
2017	155	500	280	400	105	570	2,010
2018	185	600	310	440	129	725	2,389
2019	215	700	340	470	157	890	2,772
2020	240	800	360	490	190	1,060	3,140

Source: http://www.kettha.gov.my/en

RE & Environmental Targets by the Government Contd.

Year	Cumulative RE Capacity (MW)						
	Biogas	Biomass	Solid Waste	Small Hydro	Solar PV	Solar PP*	Total
2020	240	800	360	490	190	1,060	3,140
2030	410	1,340	378	490	1,370	3,100	7,088
2040	410	1,340	378	490	7,450	5,000	15,068
2050	410	1,340	378	490	18,700	5,000	26,318

Source: http://www.kettha.gov.my/en

- Targeted to avoid **46 million** and **166 million** tonnes of CO_2 from the power generation sector by 2020 and 2030, respectively.

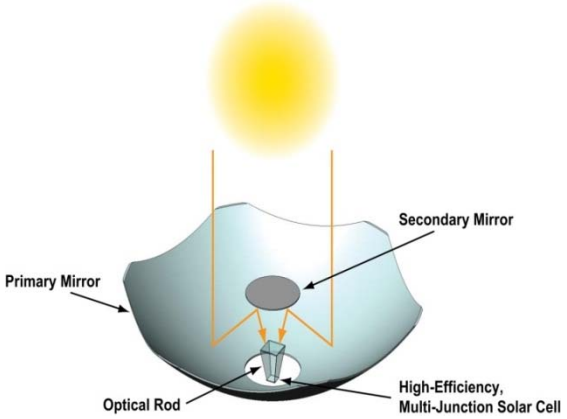
71 % of the total capacity!!!

- This objective may, however, be hampered given the current low efficiency of the conventional PV system, hence the need to source for other solar PV technologies such as CPV with a higher efficiency.

Concentrated Photovoltaic Technology

- CPV systems use lenses or mirrors to concentrate sunlight onto high-efficiency solar cells.
- These solar cells are typically more expensive than conventional cells used for flat-plate pv systems.
- However, the concentration decreases the required cell area while also increasing the cell efficiency.

CPV Array



CPV Cell

Based on the available DNI in an area, different CPV could be chosen:

(i) Low concentration CPV

(ii) Medium concentration CPV

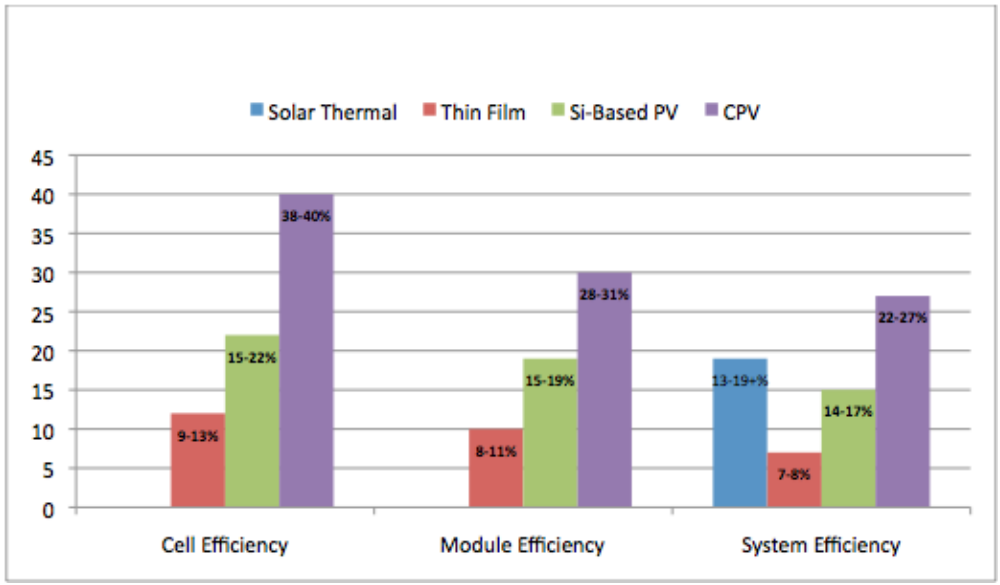
(iii) High concentration CPV

CPV Technology contd.

Advantages:

- Efficiencies are higher than the conventional silicon cells' by a wide margin.
- Can produce same amount of power with 1,775 times less cell surface than standard PV systems [4].
- Consequently, it promotes optimum use of land.
- Short Energy payback.
- Fast response, since no thermal mass.
- Scalable to a range of sizes.

CPV Technology contd.



Output Efficiency Comparison of Different Solar Technologies [5]

- Triple junction CPV cells are expected to reach record efficiencies of 50% by 2015 [2]

Disadvantages:

- It is still relatively costly; perhaps due to small scale of most installation. However, dramatic reduction in costs are expected in the coming years.
- Cell efficiency goes down as operating temperature goes up.

Our Research Project

The Project Site is equipped with the following:

- CPV systems.
- Fixed normal PV panels.
- Normal PV panels with tracking mechanism.
- Grid-tie Inverters.
- Weather station, which monitors the solar irradiance, wind speed, and ambient temperature.
- GPRS system for web-based online data monitoring and management.

KEE Pilot Project Site, UPM,Serdang

Our Research Project contd.

Project Objectives/Expected Results:

- To evaluate and compare the efficiency of CPV technology with that of the conventional PV system.
- To investigate the effect of environmental factors on the performance of CPV systems in Tropical Climates.
- To asses and recommend the most suitable type of CPV system for different parts of Malaysia, based on the Direct Normal Irradiance available in the area.
- To project the capacity of Energy Malaysia could produce from CPV technology.
- To estimate the CO_2 emissions avoidance due to adoption of CPV system, using the Malaysia Feed-in Tariff Mechanism.

Concluding Remarks

1. No doubt, RE has successfully attracted much global attention.

3. Solar energy is one of the most abundant and reliable of environmentally friendly resources for power production.

5. CPV promises to provide cost-effective power generation at high levels of efficiency.

4. Due to low efficiency, conv. PV may be incapable to meet the reqd. energy demand.

2. The need to conserve our environment is a major driver responsible for this development.

Thank You

Questions?

References

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[2] Atmospheric Science Data Center: NASA Surface Meteorology and Solar Energy, retrieved February 2012 from http://eosweb.larc.nasa.gov/cgi-bin/sse/grid

[3] “Malaysia receives flood of applications for solar feed-in tariffs” http://www.renewable-energy-sources.com/2011/12/10/selected-headlines-10-12-2011/

[4] Belén Gallego, “CPV could reach grid parity by 2011” retrieved February 2012 from http://news.pv-insider.com/concentrated-pv/cpv-could-reach-grid-parity-2011

[5] D. Goswami, “Solar Farming Potential in India” retrieved January 4, 2012 from http://www.triplepundit.com/2011/08/solar-farming-potential-india/