RENEWABLE ENERGY AS A FIFTH FUEL OPTION FOR POWER GENERATION IN MALAYSIA

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Malaysia formulated a "Five Fuel Policy for Power Generation" in 2000, following a DANCED feasibility study. Subsequently, Renewable Energy was envisaged to provide 5% of the electricity generated in Malaysia by the end of the Eighth Malaysia Plan (8MP), through the Small, Renewable Energy Power (SREP) programme in 2001.

RE was promoted through the efforts of the then Kementerian Tenaga, Komunikasi dan Multimedia (KTKM) and the Suruhanjaya Tenaga (ST), with the establishment of a Special Committee on Renewable Energy (SCORE) as a one-stop agency to facilitate the approval of RE applications under the SREP.

Unfortunately, the development of RE electricity generation seems to have fallen far short of the initial expectations.

This article attempts to address the rationale for the promotion of RE as a Fifth Fuel, and to highlight some specific issues that may warrant deeper consideration before the Five Fuel policy can be realised.

INTRODUCTION

Malaysia is a signatory to the Kyoto Protocol on climate change, which incorporates reduction in the generation of greenhouse gasses (GHG) to preserve the environment. Malaysia ratified the agreement on 4 September 2002. Among our obligations as a signatory is the use of renewable energy (RE) as an alternative to fossil fuel derived energy, which is a depleting resource, and the conservation of fossil fuels through more efficient use of energy.

Exploitation of RE in Malaysia is not a new phenomenon. RE has been used for many decades in different forms such as biomass waste combustion for palm oil mill electricity and steam generation, wood waste for timber complex energy needs, solar energy for product drying, etc.

The Five Fuel Policy however, addresses RE use for electricity generation fed into the local utility grid network. Relevant policy statements on the use of RE for electricity generation envisage such electricity generation to form about 5% of the electricity supply fed via the utility grid by the end of the Eighth Malaysia Plan. This translates to RE generated electricity being about 650MW, in terms of the generating capacity, as the electricity demand is estimated to be about 13,000MW by the end of 2005.

NATIONAL FUEL POLICY FOR POWER GENERATION

Malaysia, like many developing and developed countries, relied on the use of cheap and readily available petroleum products for its energy use, including for electricity generation, until the successive "oil-shocks" in the early 1970s.

Malaysia had a Four Fuel policy, covering hydro, natural gas, coal and oil, for electric power generation from the 1980s when natural gas was discovered and exploited for electricity generation. This policy was changed to a Five Fuel policy, covering hydro, natural gas, coal, oil, and renewable energy and energy efficiency (RE/EE), following the DANCED (Danish Cooperation for Environment and Development) study on the "Strategy for the Development of Renewable Energy (RE) as the Fifth Fuel," in the year 2000.

Among other findings, the DANCED study concluded that there is sufficient biomass waste in Malaysia to generate electricity (valued at over RM6 billion per annum) and to solve the palm oil mills' waste disposal problem in one fell swoop.

The study also indicated that, subject to certain specified premises, RE generated electricity for sale to the local utility could be a viable option for the palm oil millers, if the local utility agreed to purchase the RE generated electricity, if fed into its distribution grid, at a purchase price of between RM0.14 and RM0.17 per kWh. This assessment was based on the premise that the existing oil mills would take the initiative to get their power generating installations

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connected to the nearest electricity distribution grid, and sell surplus electricity they could generate, to the local utility. This would allow them to burn their waste more efficiently and productively to generate surplus electricity to sell to the utility as a viable business proposition, and to dispose of their waste effectively.

The study concluded that new, dedicated RE powered electricity generation plant could be viable business options (at the same purchase price range,) if the development of these generating plants was supported with suitable fiscal and financial incentives. These incentives included "soft-financing" with longer loan tenure (up to the plant life or license duration, of the order of 10 to 15 years or more,) waiver of import duties and local sales tax, and ready availability of waste biomass fuel, at no or nominal cost (on the assumption that existing disposal cost was a burden to the oil millers.)

Government policy statements following the DANCED study envisaged that up to 5% of the electricity generated in Malaysia could be generated from renewable fuels, such as biomass waste from palm oil mills or wood waste from timber complexes, by the end of the Eighth Malaysia Plan period. The 5% target amounts to about 650MW in capacity, out of an estimated demand of about 13,000MW in 2005. Electricity demand in mid-2004 has already exceeded 12,000MW.

Towards this end the government provided for certain fiscal incentives such as Pioneer Status, waiver of import duties and local taxes to promote the development of RE powered electricity generation plants, initially for plants using waste biomass from palm oil mills and the timber industry.

EXISTING RE ELECTRICITY GENERATION

General

A large number of palm oil mills and wood industry complexes generate electricity for their own use from their waste products such as wood chips, palm fibre and shells. The estimated 330 palm oil mills have electricity generating plants in the capacity range of 650kW to about 2,000kW each (usually from more than one gen-set,) although they may only need about 500kW to 1,200kW to meet their own electricity demand, with the additional gen-set retained as a spare to provide firm supply.

These palm oil mills deliberately burn their waste products inefficiently (claimed to be below 5% thermal efficiency,) mainly to dispose of the surplus waste generated from the palm oil milling process. At the same time, they regularly exhaust surplus steam generated in an effort to burn the waste in the boilers, as incineration of the waste is prohibited.

The SREP programme has so far failed to generate the successful implementation of sufficient RE projects, and has also failed to achieve the targeted RE generated electricity by these palm oil mills for connection to the local utilities' distribution grids.

TNB (Tenaga Nasional Berhad), the largest of the local electricity supply utilities, supports SREP and has committed itself to purchase RE generated electricity at RM0.14 to RM0.17 per kWh. TNBD (Tenaga Nasional Berhad Distribution) reiterated at the Co-Generation & Energy Efficiency Seminar (6 to 8 August 2003) its support for the government's SREP programme, and its willingness to purchase RE generated electricity at the stated SREP rates.

Palm oil mill owners have not attempted to take advantage of the opportunity of generating surplus electricity for sale to local utilities. The focus of potential biomass electricity generators has been to develop maximum capacity RE power plants as new business opportunities (i.e., to sell up to 10MW of electric power capacity to the utilities.)

POSSIBLE POTENTIAL

If each of the 330 palm oil mills has a spare gen-set of a minimum capacity of 650 kW, and if these gen-sets were operated to generate surplus electricity for sale to the local distribution grids, then a potential 200MW of RE power generation capacity (which is approximately *one-third* of the target RE capacity,) could be connected to the local distribution grids almost immediately. At the same time, it would double the total RE generating capacity available for their own use and for connection to the distribution grid.

Generating capacity under these circumstances, operated at its maximum (or optimum) value, would exceed the actual demand for the mills themselves. Thus a total of more than about 400MW of RE powered electricity generation could be achieved. This is significant, although it is still short of the 5% target set for RE generated electricity.

It must be recognised that not all existing palm oil mills would be so conveniently located as to easily or economically connect to the nearest distribution grid. Nevertheless some of the palm oil mills' generators could be connected to the grid, to satisfy the Five Fuel policy and go some way towards meeting the RE generated electricity target, and enable the millers to realise the commercial benefits.

A CETREE-produced booklet "Renewable Energy for the Public Sector" showed that the sale of RE generated electricity from existing

palm oil mills is a viable option for an energy price of RM0.17 per kWh, and the simple pay back time can be quite attractive.

In spite of the incentives provided, none of these mills are currently connected to local electricity supply distribution systems to sell their surplus electricity generation capacity to the electricity supply utilities. This issue shall be addressed later.

IMPLEMENTATION STRATEGIES

The Malaysian government has attempted to expedite the development of RE power generation to meet its self-imposed target by encouraging local utilities to purchase RE generated electricity from producers by feeding it into the utility distribution grids at 11kV or 33kV.

TNB has agreed to purchase RE generated electricity fed into its distribution grid at a purchase price of RM0.14 to RM0.17 per kWh, with the electricity producers paying for the interconnection to the distribution grid.

The Malaysian government also provided special incentives such as Pioneer Status for the participating enterprises, as well as waiver of import duties (or waiver of sales tax for locally-produced equipment) to encourage potential RE power plant developers to venture into the RE power generation industry, so as to meet the proposed target.

The government's promotion efforts included the formulation of a SREP (Small, Renewable Energy Power) programme, which set out the principal elements of the grid interconnection criteria as well as a pro-forma REPA (Renewable Energy Purchase Agreement), covering the related commercial considerations, to facilitate the programme implementation.

The government also established a special, "one-stop" mechanism called SCORE (Special Committee on Renewable Energy), chaired by the Ministry of Energy, Communications and Multimedia (MECM, now the Ministry of Energy, Water and Communications, or MEWC,) with the ST as its secretariat, to expedite the processing of the applications for the development of RE projects, and the issuance of the necessary generation licenses. SCORE was charged with the responsibility for facilitating the approvals for RE power generation schemes, including the issuance of the necessary power generation licenses.

The statistics of the number of SREP applications received, approved, licensed, and under construction give a rather poor picture of the success, or rather the lack of it, of the SREP programme as indicated in Table 1.

It appears that all the government initiatives to promote RE have not succeeded in the development of grid connected RE electricity generation (Fifth Fuel) at the rate that had been envisaged.

TABLE 1: STATISTICS OF SREP PROJECTS

ITEM	STATUS
Applications received	Almost 100 (including mini-hydro)
SREP applications approved by ST	56
Licenses issued	6
In operation	1 (LFG, in Selangor)
Under construction	1 (biomass, in Sabah)

CURRENT STATUS OF SREP PROJECTS

The Chairman of the Suruhanjaya Tenaga in his address at the BCSDM/MIDA Forum on 29 April 2004 reported the current status of SREP projects (Table 1).

Only one RE plant, the Land Fill Gas (LFG) plant in Selangor has been commissioned and is feeding LFG fired power to the local grid. One biomass plant is under construction in Sabah, while the remaining projects are still at "planning and negotiation" stage.

There is no record of any existing palm oil mill applying to sell its surplus electricity generation capacity to the local grid, although this could be considered an obvious choice for millers who face waste disposal problems.

The bulk of the SREP applications refer to the installation of new, large RE plants (up to 10MW) to take advantage of the concessions granted under the SREP programme, as there seems to be no effort by millers to try to connect their installations to the local distribution grids.

The general perception is that the successful implementation of RE power plants is handicapped by the developers' and the utilities' inability to agree on an "equitable sale price" (notwithstanding the agreed SREP

TABLE 2: COMPARATIVE GENERATION COSTS OF POWER GENERATING PLANT

Levelised generation cost		Coal fired	CC - GT	OC - GT
sen/kWh	Min	13	19	31
	Max	17	22	36

Source: IRP, Second Senior Managers Workshop – 2 May 2002

TABLE 3: WEIGHTED AVERAGE COST OF AVOIDED GENERATION					
MR/Pk share* (%/%)	**50/50**	**60/40**	**70/30**	**80/20**	**90/10**
Min (sen/kWh)	25.00	23.80	22.60	21.40	20.20
Max (sen/kWh)	29.00	27.60	26.20	24.80	23.40

** MR = Mid-range period, Pk = Peak period*

price range of RM0.14 to RM0.17 per kWh,) for the electricity generated from an RE plant. This implies that the so-called agreed sale price range is not really attractive or viable for project financing from financial institutions.

There is no way that the oft-stated target of 5% of electric power being generated from RE by the end of the Eighth Malaysia Plan can be achieved. The target will remain unachievable so long as the purchase price anomaly is not resolved.

HYPOTHETICAL ANALYSIS OF AVOIDED COST

The IRP (Integrated Resource Planning) presentation of its analysis on SREP power tariff at the Second Senior Managers Workshop on 2 May 2002 gave the range of TNB generation costs as shown in Table 2.

These costs can be reasonably interpreted to cover "base load" (coal fired steam plant), "mid-range" (CC-GT, or Combined Cycle–Gas Turbine), and "peak-period" (OC-GT, or Open Cycle–Gas Turbine) generation costs, respectively.

At the same time, the IRP group assessed the "avoided cost" to be 14.7 sen per kWh.

SREP plant power generation is tantamount to "energy harvesting" whenever it is available, and thus results in avoidance of peak energy generation (highest cost). Avoided generation is mainly from peak period and partly mid-range generation plants. Base load generation is not avoided, as there is always some amount of mid-range generation to meet the normal demand.

If the RE energy harvest replaces peak and mid-range energy in the proportions shown in Table 3, the weighted average of avoided cost ranges from 20.2 to 29.0 sen per kWh.

This hypothetical assessment indicates that the highest avoided cost of system generated energy replaced by RE generated electricity (energy harvested) is almost twice the avoided cost stated by IRP (29 sen against the claimed 14.7 sen), if the mid-range and peak energy avoided is equally shared. Even if the peak period share is only 10%, the lowest avoided cost is still 20.2 sen per kWh.

NATURAL GAS SUBSIDY

The avoided cost shown above is based on the existing natural gas (NG) price for power generation, i.e. RM6.40 per mmBtu. This price is a subsidised price as the market price, based on an oil price of USD20.0 per barrel, is equal to RM13.22 per mmBtu (the current oil price is in the region of USD40.0 per barrel.) The subsidy element thus amounts to between 5.8 sen to 7.8 sen per kWh (at an oil price of USD20.00 per barrel) depending on the assumed thermal efficiency of gas

TABLE 4: CALCULATION OF NATURAL GAS SUBSIDY

1.000 MWh =	10.910 GJ	at thermal efficiency of	33%
1.000 mmBtu =	1.055 GJ		
1.000 MWh =	10.341 mmBtu	at thermal efficiency of	33%

Loading proportion	0.80 pu
Share of total generation sold	0.50 pu
Mill gen-set capacity	1,000 kW

Average Operating hours	Electricity Sold (kWh)	Equivalent mmBtu	Cost of NG at RM6.40 per mmBtu	Extra NG revenue at RM13.22 per mmBtu	Extra Revenue (RM/KWh)	Generation efficiency of replaced Electricity (%)
6,000	2,400,000	27,301	174,725	360,917	***0.0776***	30
6,000	2,400,000	24,819	158,841	328,107	***0.0705***	33
6,000	2,400,000	20,476	131,044	270,688	***0.0582***	40

combustion in different power plants, as shown in Table 4.

The real price of avoided cost for electricity generation is therefore considerably higher than the IRP (and TNBD) claimed price of 14.7 sen per kWh.

REALISING THE FIVE FUEL POLICY

Since the above analysis shows significant differences in the assessment of what can be considered an equitable avoided cost for RE generated electricity, the solution of this anomaly is crucial to ensuring that the stated five fuels are used to generate electricity in Malaysia.

The target of achieving a 5% share of RE generated electricity (especially if considered to be for electricity supplied to the grid) in Malaysia is a national goal. The government, perhaps through SCORE, should therefore evaluate the current impasse in the implementation of the SREP programme and determine the institutional changes necessary to help achieve the policy target. This could involve changes to the computation of the avoided cost principle (e.g., by transferring the gas price subsidy to the SREP price) to reflect the real life situation that exists now.

If the present concept of leaving the RE generated electricity tariff to be decided on a "willing buyer, willing seller" basis between the SREP developers and the utilities is maintained, then the proposed Five Fuel Policy, incorporating the stated goal of 5% of electricity generation from RE will not materialise, perhaps even up to the end of the Ninth Malaysia Plan. ■

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