INSTITUTION OF ENGINEERS MALAYSIA

POSITION PAPER ON ENERGY EFFICIENCY

(April 2008)

IEM Position Paper on Energy Efficiency (PPEE)

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Abbreviations

Abbreviation	Full text
A/C	Air Conditioners
ASEAN	Association of South East Asian Nations
BAU	Business As Usual
BCR	Benefit – cost ratio
BIPV	Building Integrated Photovoltaic (PV)
CFL	Compact Fluorescent Lamps
DA	Designated Agency
DANIDA	Danish International Development Authority
DANCED	Danish Cooperation for Development & Environment
DEDE	Department of Alternative Energy Development and Efficiency
DSM	Demand Side Management
EE	Energy Efficiency
EE/DSM	Energy Efficiency/Demand Side Management
EER	Energy Efficiency Ratio
EM	Energy Management
ENCON	Energy Conservation Fund, Thailand
ESCO	Energy Service Company
GDP	Gross Domestic Product
GHG	Green House Gas
GoM	Government of Malaysia
GWh	Giga Watt Hours
HEM	High Efficiency Motors
IEM	Institution of Engineers Malaysia
IPP	Independent Power Producer
ITA	Investment Tax Allowance
JKR	Jabatan Kerja Raya
KTAK	Kementerian Tenaga, Air dan Komunikasi
KW	Kilowatt
kWh	Kilo-watt hour
LEO	Low Energy office
MASHRAE	Malaysian (Chapter) American Society of Heating, Refrigeration and Air-conditioning Engineers
MBIPV	Malaysia Building Integrated Photovoltaic
MD	Maximum Demand
MEWC	Ministry of Energy, Water and Communications
MIEIP	Malaysia Industrial Energy Efficiency Improvement Project
mmBtu	Million British Thermal Units
MoF	Ministry of Finance
MVA	Mega Volt Amperes
MW	Mega watt
MWh	Megawatt hour
NEF	New Energy Foundation (Japan)
NEPO	New Energy planning Ofice
NPV	Net Present Value
PPEE	Position Paper on Energy Efficiency
PS	Pioneer Status

Abbreviations

Abbreviation	Full text
PTM	Pusat Tenaga Malaysia
PV	Photovoltaic
REEEF	Renewable Energy & Energy Efficiency Fund
RM	Ringgit Malaysia
SEB	Sarawak Energy Berhad
SESB	Sabah Electricity Sdn. Bhd.
SIRIM	Standards and Industrial Research Institute of Malaysia
SMART	Specific, Measurable, Achievable, Realistic and Time-targeted
SPP	Simple Payback Period
SREP	Small Renewable Energy Power
ST	Suruhanjaya Tenaga
S-T	Sales Tax
T & D	Transmission & Distribution
TNB	Tenaga Nasional Berhad
UNDP/GEF	United Nations Development Programme/Global Environment Facility
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USAID	United States Agency for International Development
VSD	Variable Speed Drives
XMP	X Malaysia Plan
ZEO	Zero Energy Office

IEM Position Paper on Energy Efficiency (PPEE)

Executive Summary

Current Status

Malaysia has announced aspirations to benefit from Energy Efficiency (EE) initiatives from as early as the 7th Malaysia Plan (7MP) but has yet to achieve measurable success. Specific targets were set out in the 9th Malaysia Plan (9MP) and attractive fiscal incentives were provided for the adoption of such EE initiatives.

The lack of success to date appears to have occurred primarily from the absence of any designated agency to drive the implementation of strategies or programmes to meet the policy targets.

Potential Benefits

Effective implementation of EE (or DSM) initiatives is possible and can generate substantial economic benefits through the reduction of power demand and energy savings (including gas subsidy savings), even if on a conservative basis as shown in the table below (based on Section 3.3 of the report).

Potential capital investment savings

Component	Year	2010		2020	
Demand growth reduction from 7.8% to		7.3%	7.3%	6.8%	6.3%
Generation plant (RM billion)		0.67	0.67	13.05	14.37
T & D networks (RM billion)		0.27	0.27	5.22	5.75

Key Issues

Malaysia can successfully achieve the benefits from the desired EE goals if the following institutional issues are addressed:

Reiterating the national commitment to promote effective adoption of EE initiatives by setting SMART (Specific, Measurable, Achievable, Realistic and Time-Targeted) energy saving targets and providing the necessary institutional support through:

Designating a specific agency (such as the ST or PTM) or establishing a new suitable agency to execute the programmes required to achieve the desired energy savings such as the example of DEDE in Thailand), including giving it the authority to define and certify EE products to be exempt from paying import duty and sales tax, and adequate resources to discharge its functions, Establishing a funding mechanism (through an electricity tariff levy as proposed in section 5.0 in the report) to finance the successful promotion EE and RE initiatives according to the targets set,

These fundamental actions need to be supported by related implementation processes such as:

Revising (modifying) the definition of eligible applicants for the import duty and sales tax exemptions to include manufacturers and importers rather than only to end-users,

Expanding the list of materials and products eligible for such import duty and sales tax exemptions, and

Simplifying the application and approval processes for the fiscal incentives made available, and publicising the benefits and processes to the prospective beneficiaries,

Recommendations

The main requirements for Malaysia to successfully ensure adoption of EE initiatives and to derive the associated benefits are:

- Reiterate national commitment to promote the adoption of EE initiatives by energy (especially electricity) users,
- Enforce use of a greater portion of natural gas in Co-Generation mode rather than for power generation in Open Cycle Gas Turbines.
- Set SMART (Specific, Measurable, Achievable, Realistic and Time-Targeted) energy saving targets and provide the necessary institutional support through:
    - Establishing a funding mechanism (through an electricity tariff levy as proposed in section 5.0 in the report) to finance the successful promotion EE and RE initiatives according to the targets set,
    - Designating a specific agency (such as the ST or PTM) or establishing a new suitable agency to execute the programmes required to achieve the desired energy savings such as the example of DEDE in Thailand),
    - Giving it the authority to define and certify EE products to be exempt from paying import duty and sales tax, and adequate resources to discharge its functions (through the fund mentioned above),

IEM Position Paper on Energy Efficiency (PPEE)

1.0 Introduction

Availability of adequate, reliable and affordable energy is a critical component of national industrial and commercial development, as well as an essential feature of basic utility amenity for social needs to ensure a desirable “quality of life” for its residents.

Energy use covers diverse fields but the main distinctions are for transport and non-transport use. This paper only addresses non-transport use of commercial energy but includes energy forms such as electricity and thermal energy for heating and cooling, whether derived from fossil fuels or from renewable energy (RE).

Electricity use for transport in industrial activity is included.

1.1 Scope of Position Paper

This Position Paper on Energy efficiency (PPEE) attempts to cover the various options to ensure efficient energy use for national development and social requirements for commercial energy as mentioned above and in particular addresses the following:

- Projected energy demand over the medium (say 5 years) and long (say 20 years) term periods
- Energy availability and security over the time periods indicated above to meet the projected national energy needs,
- Use of alternative energy resources and supply options that can be credibly considered for sustained national economic development, and
- Recommendations for the government to consider in developing a “long term energy policy” consistent with national economic development aspirations.

The PPEE shall also address the government’s proposal for a 10% energy saving in government facilities as announced in the national Budget for 2006.

2.0 National Energy policies

The national energy policy has been predicated on the following principles:

Supply Objective:

To ensure provision of *adequate, secure and cost-effective energy* supplies by *developing indigenous energy resources, both non-renewable & renewable*, using least-costs options, & diversifying supply resources within & outside the economy;

Utilisation Objective:

To promote the *efficient utilisation* of energy and the elimination of wasteful & non-productive patterns of energy consumption;

Environmental Objective:

To minimise the *negative impacts* of energy production, transportation, conversion, utilisation & consumption *on the environment*

Although national energy policies have evolved to cover fuel diversification to a “Four-Fuel-Policy” (Hydro, gas, coal and oil) and then the “Five-Fuel-Policy” (to include RE sources such as biomass, mini-hydro, solar, etc.) there is no indication of any finite policy for long term fuel availability and security, especially with respect to indigenous fuel security.

In spite of the Five-Fuel-Policy having been enunciated in 2000, there has been little development of RE fuelled power generation since that time.

3.0 Background

3.1 Climate Change and energy efficiency

Malaysia has commitments under the UN Framework Convention on Climate Change [UNFCCC] to curb the rate of growth of its greenhouse gas [GHG] emissions, especially from the combustion of fossil fuels. The latest UN Human Development Report in its Appendix Table 1 clearly shows that Malaysia had the highest growth rate of 221% in emissions from the energy sector over the period 1990 - 2004, among the top 30 emitters of CO_2. We obviously do not wish to be a target for such damaging indictment of our GHG emissions record and must take effective measures to mitigate this rate over the immediate future.

The formation of a Ministerial Committee on Climate Change, after the recent Bali Conference of the Parties of the UNFCCC, as announced by Datuk Seri Azmi Khalid, is an indication of the Government's serious intention and commitment to address this problem.

Adoption of EE initiatives in all energy use sectors can go a long way to demonstrate te national commitment to this noble objective..

3.2 Current Energy Use Status

The escalating use of energy, produced predominantly from fossil fuels, has raised world-wide concern over preserving the environment from pollution caused by the emission of Green House Gases (GHG), which cause global warming from the combustion of fossil fuels.

The Malaysian government has followed the world-wide trend to reduce GHG emissions by incorporating the adoption of energy efficiency (EE) initiatives in the 7th Malaysia Plan (1996 to 2000) and continued to support environmental preservation by supporting the promotion of EE and RE.

The government specifically incorporated both EE and RE as policy options for the electricity supply sector in the 8th Malaysia Plan (2001 to 2006) including the launching of the Small Renewable Energy Power (SREP) programme to promote grid connected RE powered electricity generating plant.

Malaysia’s energy demand growth and projections from the 8th and the 9th Malaysia Plans is shown in Table 1 below.

Table 1 - Final Commercial Energy Demand by Sectors in Petajoules

	2000	2005	2010	Average Annual Growth Rate (%)	
				8MP	9MP
Industrial	477.6	630.7	859.9	5.7	6.4
Residential & commercial	162	213	284.9	5.6	6.0
Transport	505.5	661.3	911.7	5.5	6.6

Source: Ministry of Energy, Water & Communications and Economic Planning Unit.

The electricity demand and growth for the 9th Malaysia Plan (9MP) period is shown in Table 2 below.

Table 2 – Electricity Demand Growth

Growth based on MD MW

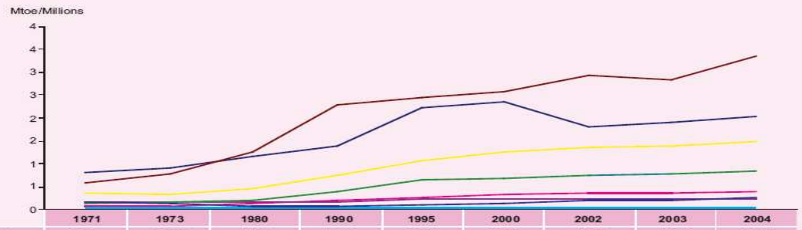
Growth rate	9MP	7.80%	9MP	8.12%	9MP	8.12%		7.83%
Years	TNB		SEB		SESCO		Total Malaysia	
2005	12,493	12,493	543	543	743	743	13,779	13,779
2006		13,467		587		803		14,858
2007		14,518		635		869		16,021
2008		15,650		686		939		17,276
2009		16,871		742		1,015		18,628
2010	18,187	18,187	802	802	1,098	1,098	20,087	20,087
GDP growth	6%		6%		6%		6%	
Elasticity		1.300%		1.353%		1.353%		1.305%

Source: 9th Malaysia Plan ***Table 19 – 4***

However, the energy does not appear to be used efficiently to produce the economic output on a national perspective. Chart 1 below shows the comparative energy use efficiency for Malaysia against some of its ASEAN neighbours. The chart shows that the energy intensity has been higher than for 5 of the other ASEAN members and has been increasing over the years.

Chart 1 – Comparative Energy Intensity

Figure 11: Energy Intensity in ASEAN



	1971	1973	1980	1990	1995	2000	2002	2003	2004
Brunei	0.800	0.900	1.150	1.400	2.233	2.367	1.800	1.900	2.025
Indonesia	0.056	0.064	0.139	0.208	0.264	0.345	0.357	0.347	0.389
Malaysia	0.350	0.326	0.467	0.737	1.061	1.258	1.353	1.382	1.486
Myanmar	0.050	0.038	0.044	0.025	0.039	0.046	0.044	0.053	0.054
Philippines	0.162	0.177	0.164	0.156	0.219	0.232	0.231	0.229	0.230
Singapore	0.600	0.768	1.263	2.280	2.446	2.580	2.919	2.843	3.362
Thailand	0.144	0.173	0.200	0.395	0.638	0.683	0.755	0.792	0.846
Vietnam	0.159	0.152	0.064	0.064	0.109	0.152	0.191	0.209	0.264

Source : Energy Balances of Non-OECD Countries (2002-2003), 2005 Edition, International Energy Agency (IEA)

Source: National energy Balance 2005

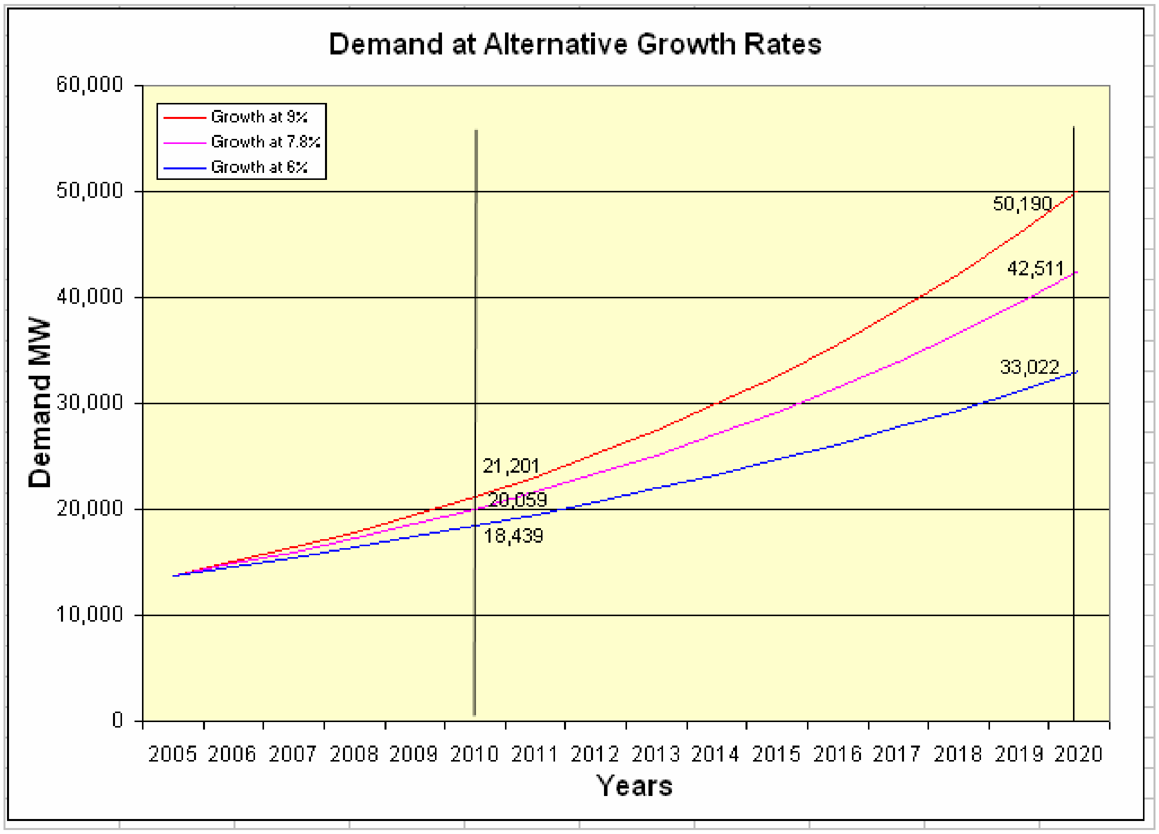
3.3 Efficient Use of Energy – Technical Potential

High demand growth rates resulting from failure to adopt EE practices result in the need for substantial capital investment to develop increasingly higher capacity infrastructure such as for electricity generating plant, and transmission and distribution (T & D) networks. The capital investment involved per MW of power capacity is assumed to be of the order of RM 4 million per MW of generating plant and about RM 1.6 million per MVA for the T & D infrastructure development.

Efficient use of energy can have a significant impact in moderating the demand growth. The change in demand growth will be modest to start with as appropriate EE initiatives begin to take effect but can accelerate as the culture of EE becomes a norm. Moreover, the initial demand reduction can be considered as easily achievable “low hanging fruits” where little investment would be required for the fairly substantial benefits that can be achieved.

Chart 2 below shows the comparative growth trends under varying scenarios. These alternative growth rates are fairly drastic and not necessarily possible to achieve in the short term.

Chart 2 – Alternative Demand Growth Scenarios



Based on total Malaysia demand

The trends show wide, but realistic, differences to illustrate the magnitude of demand variations that can occur if such apparently "extreme" elasticity variances are achieved. It is not possible to achieve such changes in elasticity in a short period or without the investment of substantial resources. Table 3 below shows the magnitude of theoretical potential monetary savings in capital investment possible for the generation and T & D infrastructure development.

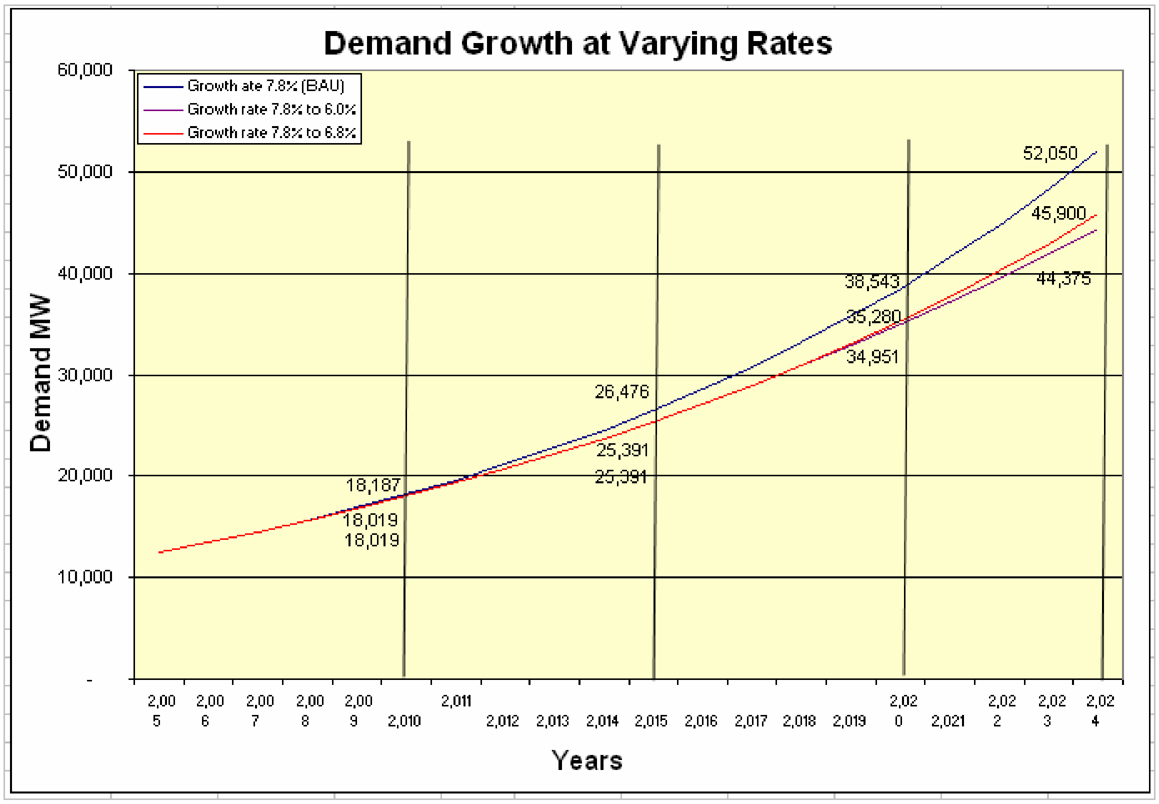
Table 3 - Potential Capital Investment Savings (RM billion)

Component	2010		2020	
Growth reduction from 9% to	7.8%	6.0%	7.8%	6.0%
Generation plant	4.57	11.05	30.72	68.67
T & D networks	2.15	5.20	14.45	32.32

3.4 Efficient Use of Energy – Practical Potential

While the dramatic potential savings are not realistically achievable, more moderate savings can be achieved if adequate resources are allocated, when it would be possible to moderate the elasticity gradually over a suitable period of time. The example shown in Chart 3 below demonstrates the demand variations if the elasticity is gradually moderated to result in demand growth reduction from 7.8% to 6.8% (by 2015) and to 6.0% (by 2023).

Chart 3 – Possible Demand Growth Management Through EE



Total Malaysia

Even at such modest and gradual reduction in elasticity, the demand reduction by 2020 would mean substantial investment savings in power generating plant and reinforcement of the T & D infrastructure, at a conservative cost of RM 1.6 per MVA capacity as shown in Table 4 below.

Table 4 - Possible Capital Investment Savings (RM billion)

Component	2010		2020	
Growth reduction from 7.8% to	7.3%	7.3%	6.8%	6.3%
Generation plant (RM billion)	0.67	0.67	13.05	14.37
T & D networks (RM billion)	0.315	0.315	6.14	6.76

The potential demand reductions shown above are achievable if the adequate resources are made available and a dedicated agency (DA) is charged with the responsibility to plan and implement the action plans needed to achieve the results. Such a possibility has been shown by international experience from several countries, including Malaysia's neighbour Thailand (see Appendix 1).

The achievement of the indicated reduction in demand growth is realistic as can be validated by the case studies in Malaysia under the UNDP/GEF (United Nations Development Programme/Global Environmental Facility) supported MIEEIP (Malaysia Industrial Energy Efficiency Improvement Project) as well as from other examples as shown in the attached Appendix 2.

The MIEEIP experience includes examples of energy savings not only for electricity use but also for thermal energy use involving efficient consumption (e.g. adopting "best practice" mechanisms) and fuel substitution through replacing fossil fuels with RE such as biomass.

Additionally, anecdotal evidence indicates that rain in the Klang Valley causes a demand reduction of the order of 3% to 3.5% of the electricity demand in the TNB network in Peninsular Malaysia. This amounts to about 405 to about 475 MW. It also means that effective insulation, especially roof insulation, of air-conditioned commercial and industrial facilities could help reduce the power demand and energy use significantly if such an EE initiative is promoted effectively amongst the respective users.

3.5 Gas Subsidy Savings from Efficient Use of Energy

Efficient use of energy will not only save the need for excessive capital investment in the physical infrastructure but will also save the energy users costs for the energy not consumed (or wasted). In addition, there will be national economic saving from gas not used for power generation at highly subsidised tariff for TNB and the IPPs.

A simple computation of the gas subsidy for power generation is shown in Table 5 below

Table 5 – Gas Subsidy Calculations

"Gas Subsidy" Sensitivity Calculations			
Crude oil price US$/barrel	40.00	60.00	90.00
Crude oil price RM / barrel	152.00	228.00	342.00
Price RM / mmBtu =	27.88	41.83	62.74
Gas price / mmBtu	22.31	33.46	50.19
Gas price RM/mmBtu for power gen =	6.40	6.40	6.40
Price premium RM / mmBtu =	15.91	27.06	43.79
Hence premium / kWh =	0.1810	0.3079	0.4982

Assumptions:							
Exchange rate US$ to RM =			3.8	Gas price =		80%	of oil price
1 mmBtu =	1.055	GJ					
1 barrel =	5.75	GJ =	5.451	mmBtu =	0.479	MWh	
1 MWh =	11.377	mmBtu	at conversion efficiency of 30%				

Since gas fired power generation contributes about 65% of the total electricity generated, the average subsidy for gas used for power generation is of the order of RM 0.2 per kWh, based on a conservative oil price of US $ 60 per barrel. The quantum of gas subsidy savings is shown in Table 6 below.

Table 6 – Potential Gas Subsidy Savings

Growth rate	MW demand at fixed growth rate of 7.8% p.a.	MW demand at declining growth rate from 7.8% to 6%		Reduction in demand growth MW - cumulative	Savings in gas subsidy (RM million)
Year		Declining %			
2,005	**13,779**	13,779	7.80	-	
2,006	14,854	14,854	7.70	-	-
2,007	16,012	15,998	7.60	14.9	16.9
2,008	17,261	17,213	7.50	48.0	54.7
2,009	18,608	18,504	7.40	103.4	117.7
2,010	20,059	19,874	7.30	185.5	211.2
2,011	21,624	21,324	7.20	299.3	340.9
2,012	23,310	22,860	7.10	450.6	513.1
2,013	25,129	24,483	7.00	645.8	735.4
2,014	27,089	26,197	6.90	892.0	1,015.8
2,015	29,202	28,004	6.80	1,197.3	1,363.5
2,016	31,479	29,908	6.70	1,570.8	1,788.8
2,017	33,935	31,912	6.60	2,022.3	2,303.0
2,018	36,582	34,019	6.50	2,563.0	2,918.7
2,019	39,435	36,230	6.40	3,205.1	3,650.0
2,020	42,511	38,548	6.30	3,962.3	4,512.3

Thus the quantum of gas subsidy savings escalates rapidly and accumulates to over RM 4.5 billion by year 2020, unless the world market oil price declines drastically, which is a most unlikely scenario.

4.0 Hurdles to Adoption of EE

4.1 Low, Subsidised Price of Energy

The biggest hurdle to the adoption of EE is the highly subsidised price of energy, both for fossil fuels such as natural gas and petroleum products for industrial and transport use, as well as electricity.

The low price of energy militates against users' willingness to adopt EE initiatives as the financial benefit-cost ratios become unattractive. The fuel subsidies have exploded recently with the oil prices escalating and breeching US$ 100 per barrel compared to an average of about US$ 60 per barrel in the previous year when the gas subsidy for power generation amounted to about RM 18 billion (from THE STAR 26 February 2008).

Heavily subsidised energy prices give a wrong signal to users regarding the need to use it efficiently and to eliminate avoidable waste. Hence, reducing subsidies to reflect a true price of energy is an imperative to encourage efficient use of energy. Such a move need not mean that tariffs for industrial use need to be so high that they lose their competitive edge in the international market.

For electricity tariffs the increase could be differentiated between industrial users (slight increase) and the commercial and residential users (relatively larger proportional tariff increases) to generate greater commitment to use energy efficiently.

Such a proposal can be achieved without handicapping the low income, and thus lower energy using residential customers by adopting increasingly higher block tariffs as shown in the hypothetical example in Table 7 below.

Table 7 – Alternative residential Tariff Proposal

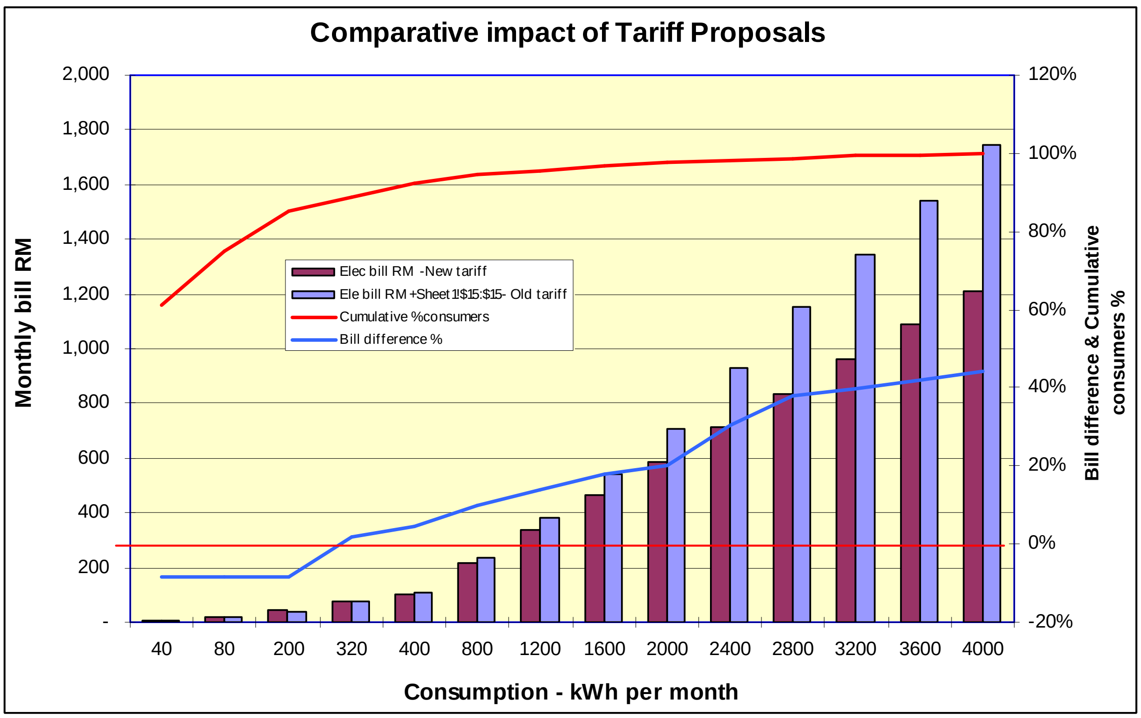
Consumption range kWh/month	Current tariff RM/kWh	Proposed Tariff RM/kWh
<200	0.218	0.200
201- 1000	0.289	0.330
1001 – 2000	0.312	0.400
2001 – 3000	0.312	0.450
3001 & above	0.312	0.500

With residential tariff revised as proposed above, the lower energy using customers would in fact enjoy cost reductions as indicated in Table 8 below. Moreover, electricity users in the higher tariff brackets will be encouraged to adopt EE to reduce their higher electricity bills, thus creating a market for such products and helping to reduce the price premium for EE products as the market volume grows.

Table 8 – Impact of Proposed Residential Tariff

Consumption kWh/month	Average consumption kWh/month	Current tariff	Proposed tariff	Bill diff %
100	40	8.72	8.00	**-8.26%**
200	80	17.44	16.00	**-8.26%**
300	200	43.60	40.00	**-8.26%**
400	320	78.28	79.60	**1.69%**
500	400	101.40	106.00	**4.54%**
1000	800	217.00	238.00	**9.68%**
1500	1200	337.20	384.00	**13.88%**
2000	1600	462.00	544.00	**17.75%**
2500	2000	586.80	704.00	**19.97%**
3000	2400	711.60	929.00	**30.55%**
3500	2800	836.40	1,154.00	**37.97%**
4000	3200	961.20	1,344.00	**39.83%**
4500	3600	1,086.00	1,544.00	**42.17%**
5000	4000	1,210.80	1,744.00	**44.04%**

Impact of Proposed Alternative Tariffs



Such high energy consuming customers will also be encouraged to replicate the adoption of EE initiatives in their business ventures once they realise the economic benefits of EE. Again, the effective promotion of EE initiatives for commercial and industrial users will also help them reduce their electricity bills even if the tariff rates are increased, as the relative savings can exceed the tariff increases.

4.2 High Cost of EE Products

Adoption of EE practices involves additional "incremental" investment to cover the premium costs of such resources or products. The price premiums can be marginal (say up to 20%) and financially attractive for some cases but can also be substantially heavier (even more than 100%) for other cases that become financially unjustified.

The high cost premium for EE products in Malaysia is a result of the very small market size which does not benefit from any economy of scale. Creation of a sizable market would help to reduce the price premium and thus encourage even greater use of the EE products and make the cost-benefit ratios more attractive.

Such assessment normally ignores social costs such as energy subsidies, costs of mitigating detrimental environmental and health impacts, and perpetuation of unsustainable development practices leading to untenable future energy costs.

4.3 Implementation Mechanisms

Efficient utilisation of energy or energy efficiency (EE) has been enunciated as a national policy initiative from the 7th Malaysia Plan. As a result several projects with international support have been executed in Malaysia to create a culture of efficient utilisation of energy. Amongst them are the following:

- Canadian government supported project for B. C. Hydro to develop a DSM (Demand Side Management) programme with TNB (1999),
- A UNDP/GEF supported MIEEIP programme implemented by Pusat Tenaga Malaysia (PTM) between 2999 and 2007,
- A DANIDA EE/DSM project implemented through ST between 2002 and early 2006.

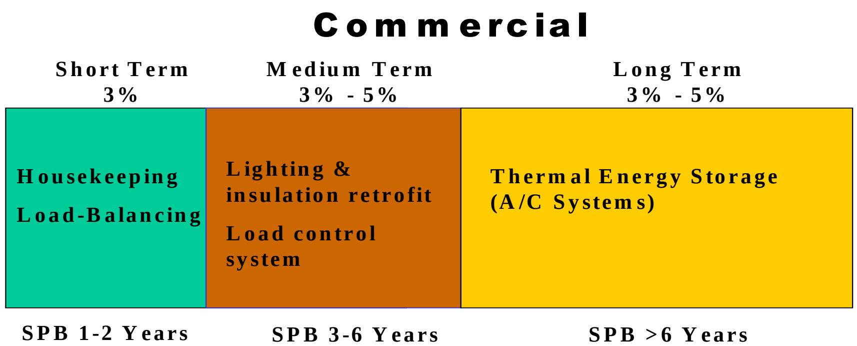
There is little evidence to indicate that the internationally supported initiatives have been sustained with direct or indirect government support to ensure continued benefits from the related EE initiatives. This can be seen from the trend of energy intensity for Malaysia compared with its ASEAN neighbours as shown below[1].

Attempts have also been made to institute Energy Management (EM) Regulations[2] for the largest electricity users in the industrial and commercial sectors to support the national EE policy, but have yet to be implemented.

Normal energy management practices are known to contribute about 3% energy use savings, mainly from "good housekeeping", with virtually no investment, except for the energy management function alone. A summary of the findings on potential energy savings from previous energy audits conducted in Malaysia by various international agencies is shown in Chart 5 below.

[1] Extract from National Energy Balance 2005
[2] By Jabatan Bekalan Elektrik & Gas (JBEG) the precursor of the ST.

Chart 5 – Energy Saving Potential in Commercial Premises



Source: DANCED EE Policy Study

4.4 Incentives for Adoption of EE Initiatives

The Malaysian government has generously provided fiscal incentives to promote the adoption of EE initiatives but has not put in place institutional support to effectively promote the adoption of such EE initiatives. Neither has Malaysia provided any financial commitment to attract potential users to adopt such initiatives. In spite of the generous fiscal incentives provided the take-up rate is low for the following reasons:

- Public dissemination of the incentives available is inadequate,
- The application and approval procedures are cumbersome, and
- There is no dedicated agency to conduct the promotion activities.

Malaysia has been unable to avail the economic benefits from adopting sustained EE initiatives mainly due to the lack of commitment of any finite resources to achieve the respective Malaysia Plan policy targets.

4.5 Efficient Use of Primary Energy

All the above statements have addressed the demand side (user side) of energy consumption. It is as important to also address the supply side of energy efficiency where use of primary energy such as from fossil fuels and RE has a significant impact on overall energy efficiency, whether used directly or converted to a secondary energy form such as electricity, heating or cooling.

Efficient conversion of primary energy in power plants generating electricity is never as efficient as using it in a co-generation (co-gen) form to generate electricity and heat (or electricity, heat and cooling, i.e. tri-generation).

Even the most efficient gas fired combined cycle plant achieve only about 50% conversion efficiency (overall efficiency of perhaps 40%) while co-gen and tri-gen plant could achieve efficiencies of over 85%. Even a conservative efficiency improvement from say, 40% to 75% would mean an improvement of 50% in the primary energy conversion.

The need for more efficient use of natural gas for power generation and industrial purposes is critical in the current situation where there appears to be a shortage of gas supply for industries as a result of the inefficient combustion for power generation.

The economic impact of greater use of gas in co-gen and tri-gen mode instead of combustion in open-cycle and combined-cycle power plants could be substantial as the example below shows.

TNB revenue (for 2007)	RM 23 billion
Assuming fuel cost (including by IPP) is about 35% -	RM 8.05 billion
About 65% of total electricity generation is from gas-	RM 5.23 billion

Assuming 20% of NG is used for co-generation, with efficiency improvement from 40% to 75%, the NG saving would be 15%, (20% of 75% improvement) which amounts to RM 1.05 billion a year.

Sale of RM 1.05 billion worth of NG (at RM 6.40 per mmBtu) to the export market (at say, even RM 24 mmBtu), would generate additional revenue of about RM 3.9 billion, or make available additional gas supplies for industrial use.

Again, no agency attempts to ensure efficient utilisation of natural resources, although perhaps the Ministry of Energy, Water and Communications or the Energy Regulator, Suruhanjaya Tenaga, may be the correct authorities to do so.

This indicates the importance of having a dedicated agency to plan and execute the specific programmes that can achieve the demand reductions desired.

The use of gas for co-generation by industrial users also faces some institutional constraints. Co-generation normally optimises output capacity on thermal energy use with electricity generation as a secondary output.

Industrial users who choose to adopt gas fired co-generation need back-up electricity supply (“stand-by”) from the local utility (TNB in Peninsular Malaysia) for emergency use as well as possible “top-up” if their electricity use demand exceeds the capacity they can generate themselves under co-gen configuration. If the electricity generation exceeds the co-generator’s own consumption, the utility would only buy back the surplus electricity generated from co-gen at a very low (avoided fuel cost) tariff, which penalises the co-generator.

This arrangement imposes heavy financial penalties on the co-generators as the charges imposed by TNB for "stand-by" supply are rather heavy, being considered unrealistic and "exorbitant".

The "top-up" charge depends on the tariff concerned, capacity requested and the actual demand from the utility.

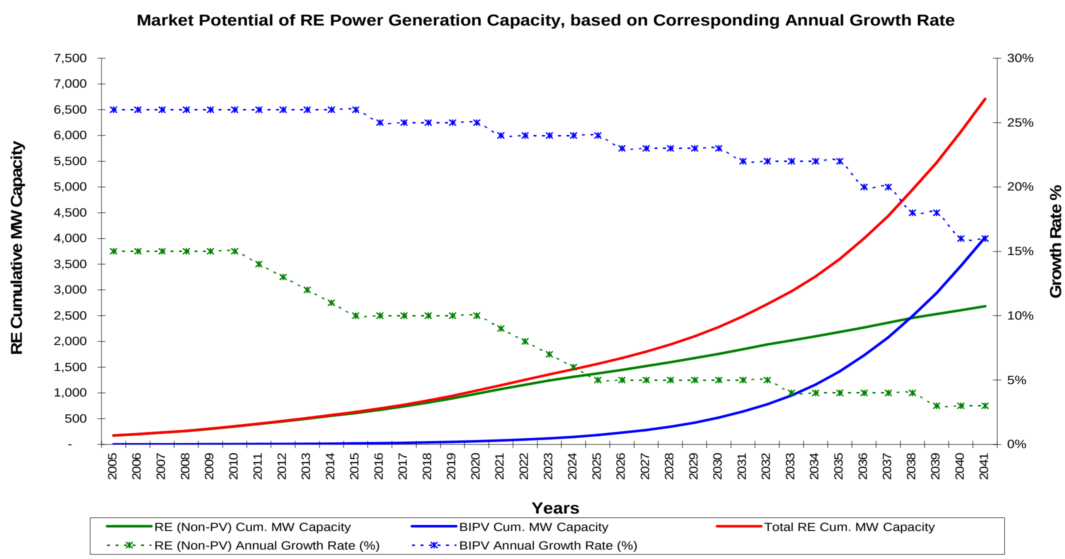
4.5 Primary Energy Security

Malaysia depends on imported energy such as coal to supplement its own internal primary energy resources for power generation, while being a net oil and natural gas exporter. This situation is not expected to last too long as Malaysia is expected to become a net oil importer within the next decade, while gas supplies may last for a few more decades at current utilisation rates.

Hydro electric power generation capacity is largely found in Sarawak while the consumption is predominantly in Peninsular Malaysia. Hence large scale use of hydro electric power would require substantial transmission of electricity generated in Sarawak to the Peninsula. Alternatively, it could mean the transfer of highly energy intensive industries from the Peninsula to Sarawak.

Another alternative would be to exploit RE more aggressively especially in the Peninsula. The realistic RE sources available for easy exploitation would be biomass and biogas from the oil palm industry and solar photovoltaic electricity particularly in urban areas i.e. at the point of use. Chart 6 below indicates the potential magnitude of RE power in the form of biomass and solar PV generation capacity that can be exploited in the long term.

Chart 6 – Potential RE development in Malaysia



In this respect it must be remembered that solar thermal energy also constitutes a precious and virtually inexhaustible source of renewable primary energy for low grade heat or as pre-heating for higher grade thermal energy.

5.0 Programme Funding

It is obvious that Malaysia's efforts to promote EE have been far from successful, in spite of repeated (and financially substantial) international assistance programmes through a variety of support mechanisms such as under the Danish government's DANCED and DANIDA programmes and UNDP/GEF programmes.

Lack of sustenance of these programmes through failure to provide the necessary financial resources to encourage users to embrace an EE culture for future economic development and energy security has virtually "wasted" the resources invested in the above-mentioned programmes.

Non-availability of federal government funds to continue the EE programmes mentioned can be excused if such funds could not be allocated due to other higher priorities. However, it is not necessary that such funds should come only from government coffers. The funds should in fact come from the energy users themselves who would stand to gain the most benefits form effective promotion and adoption of EE initiatives.

Most countries used as examples above manage to source such funds (including for the promotion of RE) from the energy users themselves through some form of "energy tax" or levy (e.g. Thailand's ENCON Fund).

A similar mechanism can be employed in Malaysia by imposing a marginal levy of say 1% on the electricity tariffs for all users. Based on TNB's recent statement of its overall revenue of about RM 23 billion for its 2006/07 financial year, a 1% (or about RM 0.26 per kWh) levy would generate a recurring fund of over RM 200 million a year growing at the same rate as electricity growth rate of about 6% per annum.

Such a levy derived fund could finance ALL the EE initiatives that could be realistically implemented and build up a buffer sum in the short term. Such a fund could also fund additional RE programmes that may not be sufficiently attractive under current RE tariffs, or the net-metering tariff for the Malaysia Building Integrated Photovoltaic (MBIPV) project, by funding the incremental costs of a more attractive "enhanced Feed-In-Tariff (FIT) for such RE projects.

Surplus revenue from such a REEEF could also be utilised to benefit the low income population by facilitating improvement in their living conditions by "social development initiatives". One such initiative could be partly financing effective insulation of their premises' roofs to reduce the health hazards of "heat stress" as the lower cost residential premises are not conducive for comfortable living unless they use mechanical cooling and ventilation, something most such users cannot afford.

Table 9 below shows the prospective value of such a levy fund (say, RE and EE Fund, or REEEF) based on the demand growth shown in chart 3, with electricity energy use at a load factor of 65% and a levy of RM 0.0026 per kWh.

Table 9 – Potential Value of RE & EE Fund from Electricity Tariff Levy

Year	MW demand at declining growth rate from 7.8% to 6%		Energy Growth GWh at LF of 0.65	Levy value RM million
	MW MD	Declining %		
2,005	13,779	-		
2,006	13,779	7.70		
2,007	14,840	7.60	91,090	237
2,008	15,968	7.50	98,013	255
2,009	17,165	7.40	105,364	274
2,010	18,436	7.30	113,160	294
2,011	19,781	7.20	121,421	316
2,012	21,206	7.10	130,163	338
2,013	22,711	7.00	139,405	362
2,014	24,301	6.90	149,163	388
2,015	25,978	6.80	159,456	415
2,016	27,744	6.70	170,299	443
2,017	29,603	6.60	181,709	472
2,018	31,557	6.50	193,701	504
2,019	33,608	6.40	206,292	536
2,020	35,759	6.30	219,495	571

This mode of funding will mean that electricity users themselves pay for the fund which is then used to help them save their electricity use and derive net savings as the reduction in their consumption can far exceed the 1% levy imposed.

6.0 Conclusions for Successful Adoption of EE

Effective implementation of EE (or DSM) initiatives is possible and can generate substantial economic benefits through the reduction of power demand and energy savings, even on a conservative basis as shown in section 3.3 and Table 4.

Malaysia has instituted adequate fiscal incentives to enable successful adoption of EE to derive significant economic benefits which have yet to be achieved.

Malaysia can achieve the desired benefits if the following hurdles are effectively addressed.

- Reiterating its commitment to promote effective adoption of EE initiatives and support it by setting SMART (Specific, Measurable, Achievable, Realistic and Time-Targeted) energy saving targets,
- Designating a specific agency (such as the ST or PTM) or establish a new suitable agency to execute the programmes required to achieve the desired energy savings such as the example of DEDE in Thailand),
- Establishing a funding mechanism (through an electricity tariff levy as proposed in section 5.0 above) to finance the successful promotion EE and RE initiatives according to the targets set,
- Consuming a greater portion of natural gas in Co-Generation mode rather than for power generation in open Cycle Gas Turbines.
- Revising (modifying) the definition of eligible applicants for the import duty and sales tax exemptions to include manufacturers and importers rather than only to end-users,
- Expanding the list of materials and products eligible for such import duty and sales tax exemptions, and
- Simplifying the application and approval processes for the fiscal incentives made available, and publicising the benefits and processes to the prospective beneficiaries,

7.0 Recommendations

Malaysia can successfully achieve the benefits from the desired EE goals if the following institutional issues are addressed

Reiterating the national commitment to promote effective adoption of EE initiatives by setting SMART (Specific, Measurable, Achievable, Realistic and Time-Targeted) energy saving targets and providing the necessary institutional support through:

- Designating a specific agency (such as the ST or PTM) or establishing a new suitable agency to execute the programmes required to achieve the desired energy savings such as the example of DEDE in Thailand), including giving it the authority to define and certify EE products to be exempt from paying import duty and sales tax, and adequate resources to discharge its functions,
- Establishing a funding mechanism (through an electricity tariff levy as proposed in section 5.0 in the report) to finance the successful promotion EE and RE initiatives according to the targets set,
- Enforcing use of a greater portion of natural gas in Co-Generation mode rather than for power generation in Open Cycle Gas Turbines.
- These fundamental actions need to be supported by related implementation processes such as:
    - Revising (modifying) the definition of eligible applicants for the import duty and sales tax exemptions to include manufacturers and importers rather than only to end-users,
    - Expanding the list of materials and products eligible for such import duty and sales tax exemptions, and
    - Simplifying the application and approval processes for the fiscal incentives made available, and publicising the benefits and processes to the prospective beneficiaries,

Appendix 1

Extract from:

USAID | ASIA
FROM THE AMERICAN PEOPLE

ANNEX 5

THAILAND COUNTRY REPORT

FROM IDEAS TO ACTION: CLEAN ENERGY SOLUTIONS FOR ASIA TO ADDRESS CLIMATE CHANGE

June 2007

This report was produced for the United States Agency for International Development (USAID). The authors' views expressed in this report do not necessarily reflect the views of USAID or the United States Government. International Resources Group (IRG) prepared this report for USAID under the ECO-Asia Clean Development and Climate Program; Contract No. EPP-I-00-03-00013-00 Task Order 9.

4.1.4 ENERGY EFFICIENCY

Since the establishment of the ENCON Act 1992 and the ENCON Fund, hundreds of energy-efficiency activities and programs in Thailand have been developed and implemented. Considerable progress has been made and there have been some outstanding program achievements. The ENCON Fund is the main driver providing financial support for most energy efficiency and renewable energy programs, as well as for R&D and public relations campaigns. Some of the successful programs are as follows:

- **The Demand Side Management Program:** EGAT established the DSM Office in 1993 with support from the World Bank, GEF, Australian and Japanese governments and through a fuel adjustment mechanism in the tariff called the "Ft". The EGAT DSM Program has focused mainly on EE labeling schemes, including thin fluorescent tubes, refrigerators, air-conditioners, compact fluorescent lamps (CFLs), electric fans, low loss magnetic ballasts, rice cookers, and lighting reflectors. Cumulative power demand and energy savings as of March 2006 were 1,304 MW and 7,172 GWh respectively.
- **The 30 percent Subsidy Program:** This was one of the most successful DEDE programs. The objective is to help designated factories and buildings implement EE projects. During 2002 and 2003, DEDE shouldered 30 percent of the investment cost and the designated facilities paid 70 percent. Lifetime energy cost savings were about 15.6:1 per Baht of DEDE subsidy.
- **Energy Efficiency Revolving Fund:** The EERF was established in January 2003 to stimulate financial sector involvement in EE projects, and simplify project evaluation and financing procedures. ENCON Fund provided 2,000 million Baht (US$50 million) for each of the two phases (2003-2005 and 2006-present). The funds are managed by commercial banks and supervised by DEDE. Lending banks have provided additional funds, which could reach 12,000 million Baht in Phase 2. The total estimated energy cost savings were about US$20.13 million per year as of May 2005.

Despite these successes, many government EE programs were neither cost-effective nor successful and had to be modified or discontinued. One example is the compulsory energy audit program for designated factories and buildings. The designated facilities were supposed to submit energy audit reports every three years. However, 10 years after the Ministerial Regulations went into effect, fewer than 60 percent of the total facilities (about 4,500) had submitted reports, even though the ENCON Fund provided substantial subsidies. Therefore, in early 2005 DEDE revised the regulations by making the requirements simpler, and cancelled the subsidies for energy audits.

4.2 COMPARISON OF ECONOMIC POTENTIAL AND COST EFFECTIVENESS

Table 4.2 shows the generating costs of several renewable energy sources (DEDE 2006c). The generating costs of mixed conventional energy, DSM, some EE programs, and CDM projects are also included for comparison. The DSM and EE programs are quite cost effective.

TABLE 4.2: COST EFFECTIVENESS OF VARIOUS ENERGY RESOURCES

Program/Technology	Capital Cost (US$/kW)	Generating Cost (Baht/kWh)	Generating Cost (US cents/kWh)[1]
The 30 percent Subsidy Program[2]		0.14	0.34
DSM		0.52	1.30
EE Revolving Fund[2]		0.40	1.00
Biogas electricity generation	1,491	1.77	4.43
Mixed conventional energy (70 percent NG)	1,200	2.11	5.28
Mini hydro, 200 kW-6 MW	1,630	2.44	6.10
Biomass condensing, 20 MW	1,892	2.51	6.28
Micro hydro, < 50 kW	1,924	2.78	6.95
Biomass condensing, 10 MW	1,415	3.24	8.10
Wind farm, 20,000 kW	1,336	3.39	8.48
Biomass condensing, 5 MW	1,667	3.51	8.78
MSW incineration, 3,000 kW	5,736	7	17.50
Solar PV, large scale, 460 kW	4,084	11.88	29.70

[1] Exchange rate: US$1 = 40 Baht. [2] Total investments divided by average lifetime (seven years) energy savings.
Source: DEDE, 2006c.

Appendix 2 - 1

Extracts from MIEEIP

An example of the financial benefits resultant from a reduction in energy demand is summarised in **Tables II and III** below.

Table IV: Example of industrial sectors involved:

No	No. of factories	Sector	No of recommended measures in energy audit				No of actual measures carried out & in progress				% Success	No. of companies that need/ require	Investment incurred	Actual annual energy savings achieved	
			No Cost	Low Cost	High Cost	Total	No Cost	Low Cost	High Cost	Total			Th.RM/yr	kToE/yr	Th.RM/yr
1	3	Cement	7	5	8	20	6	2	0	8	40.0	3	20	N.A	150
2	3	Glass	8	4	11	23	5	1	4	10	43.5	3	450	3.0	913
3	10	Food	29	62	14	105	26	16	1	43	41.0	6	2,095	0.8	680
4	9	Rubber	38	41	24	103	31	16	4	51	49.5	8	83	NA	135
5	7	Wood	15	17	14	46	10	13	1	24	52.2	6	7	0.4	510
6	6	Ceramic	14	26	9	49	10	8	2	20	40.8	6	48	NA	2,432
7	4	Iron&Steel	24	26	13	63	6	0	3	9	14.3	2	408	0.1	97
8	6	Pulp&Paper	21	31	12	64	10	20	0	30	46.9	5	30	0.2	134
	48	0	156	212	105	473	104	76	15	195	41.2	39	3,141	4.5	5,051

Electricity cost savings for the 48 industries in the sectors shown above are shown in the Tables V below.

Tables V: Total Energy Savings implemented by audited Factories from 2001 – 2004 : 4. 5 kToE/yr (189,459 GJ/yr)

Energy cost savings ("social cost")	RM million per year	Lifetime Savings (RM million at disc. rate of 6% p.a.)
Saved electricity generation and supply	2.6	25.56
Saved gas subsidy for power generation Assumptions: Oil barrel price : Gas subsidy of RM 0.31/kWh at oil price of US$ 60/ barrel (with Gas share for power generation of 70 %	2.3	22.18
Total	4.9	47.7

If these savings are replicated across the sectors, then these savings would equal life-time savings of over RM 732 million as shown in the **Tables VI** below (information not available for some sectors).

Tables VI

Sector	**Straight Line Extrapolated Electricity Savings (50%) (MWh/yr)**	Saved electricity generation and supply (Million/Yr)	Saved gas subsidy for power generation (Million/Yr)	Total Saved in Millions over a 15 Year life span
Cement	N/A	N/A	N/A	N/A
Glass	20,877	101.4	87.4	188.8
Food	45,496	220.9	190.5	411.4
Rubber	**N/A**	N/A	N/A	N/A
Wood	4,875	23.7	20.4	44.1
Ceramic	**N/A**	N/A	N/A	N/A
I & S	4,187	20.3	17.5	37.9
P & P	5,565	27.0	23.3	50.3
Total	**80,999**	393.3	339.1	732.5

Appendix 2 - 2

Savings from Retro-fit Initiatives and EE Appliances

Further, retrofitting of EE features such as additional roof insulation, building shading, improved window glazing, and use of more efficient lighting as well as replacement of EE consumer products such as refrigerators, air-conditioners, washing machines, etc. is also easily encouraged as these products have shorter replacement cycles. Such products also have relatively high energy efficiency improvement opportunities as shown by international experience.

Sample cases are shown below (extracted from sources shown or calculated)

Example 1

<u>Roof Insulation</u>

Cost Savings

potential when insulation the roof

Payback time					
	28℃	26℃	24℃	22℃	
Annual saving, air con	22,2	30,0	39,4	50,0	kWh/m² ceiling
Annual saving	5,6	7,5	9,9	12,5	RM/m² ceiling
Insulation cost	25,0	25,0	25,0	25,0	RM/m² ceiling
Payback, simple	4,0	3,0	2,3	1,8	years

<u>Assumptions:</u>
Electricity = 0.25 RM/kWh

ROCKWOOL®
FIRESAFE INSULATION

Example 2

<u>Savings from EE lighting</u>

Lamp type	Lamp life hours	Lamp load (watts)	Lamp cost RM	Lifetime energy cost/unit	Total lifetime cost RM	Lifetime savings RM
Incandescent	1,000	60	1.70	156.00	173.00	0
CFL	10,000	16	17	41.6	58.60	114.40

Example 3

EE Fridges

A 5-Star fridge uses about 25% less electricity than a normal (3-Star) model. The energy use difference under test conditions for a fridge of 200 to 250 litres is about 150 kWh per year (the difference is much greater for normal use due to the frequent opening and closing of the fridge). This translates to electricity cost saving of at least RM 43 a year (at the residential electricity tariff of 28.9 sen / kWh). A simple calculation gives the following results.

Price difference RM	Electricity saving / year RM	Payback period years (for higher cost)	Net saving for 10 years use (simple payback basis)
200.0	43.35	4.6 years	233.50

The net saving takes into account the higher cost of the EE fridge. As fridges last for more than 10 years this gives an attractive saving potential especially when it is certain that the electricity tariffs will increase over the time period concerned.

Associated gas subsidy saving would amount to about RM 30 to RM 45 per annum.

Appendix 2 - 3

Savings from EE/DSM Plan (DANIDA Project at Suruhanjaya Tenaga)

An Energy Efficiency/Demand Side Management (EE/DSM) plan developed under a DANIDA (Danish International Development Agency) project at the Suruhanjaya Tenaga (ST) during the period 2002 to 2005 evaluated potential benefits from adopting a series of EE/DSM initiatives under an “EE Plan for 2003 – 2006” as summarised below.

Plan period	Public sector Investment (RM million)	Private Sector Investment (RM million)	Potential Electricity Savings GWh	NPV Savings RM million
2003 - 2006	33	74	1,400	237

The Plan was not implemented as the financial resources required were not available. However, 2 specific programmes to promote High Efficiency Motors (HEM) and Energy Efficient Refrigerators (EE Fridges) were implemented from 2004 to 2006 with moderate success.

In addition, the Plan foresaw gas subsidy savings of RM 81.4 million over the lifetime of the plan initiatives as detailed below.

Suruhanjaya Tenaga

ENERGY EFFICIENCY

ENERGY SAVING BENEFITS

Primary Energy Savings from EE/DSM				
Energy saved	Eq. In mmBtu	Cost RM per mmBtu		Extra Rev - RM
MWh		Power gen	Oil Eq. At US$ 20.0 per	
		6.40	13.22	
1,400,000	11,942,000	76,428,800	157,873,240	81,444,440
Calculations based on MIEEIP Paper for Energy Business Fund				

14 May 2004 Composite file EE/DSM/RE/Co-gen

Appendix 2 – 4

Extracts from High Efficiency Motors Case Study

Suruhanjaya Tenaga

Energy & Cost Savings - Summary

Description	Oleochemical Factory, 55-kW		Jebco, 18.5-kW		Evergreen, 37-kW	
	Standard	HEM	Standard	HEM	Standard	HEM
Loading, %	79%		62% (motor is oversized)		106%* (motor is overloaded)	
Demand, kW	48.58	45.2	12.37	12.16	41.80	40.21
Demand Savings, kW		3.4		0.21		1.59
Percentage of Savings		6.9%		1.7%		3.8%
Annual Energy Savings, kWh		29,573		916		6,933
Annual Cost Savings, RM		RM 6,210		RM192		RM1,456

ST - IEM Seminar August 2005

Suruhanjaya Tenaga

C/S: Impact of Tax Incentives on Net HEM Motor Prices

Details	Oleochemical Factory, 55-kW		Rubber Factory, 18.5-kW		Wood Factory, 37-kW	
	Standard	HEM	Standard (Local)	HEM (Local)	Standard	HEM
Actual Motor Market Price	RM11,300	RM 24,000	RM1,848	RM2,775	RM6,750	RM13,500
Price after deduction of 10% Sales Tax (on Local & Imported HEM)	No change	RM21,818	No change	RM2,523	No change	RM12,273
Price after deduction of 15% Import Duty (on Imported Motor)	No change	RM18,972	No change	NA (local motor)	No change	RM10,672
Incremental Cost Without Tax Exemption		RM12,700		RM925		RM6,750
Incremental Cost With Tax Exemption		RM7,672		RM673		RM3,922

ST - IEM Seminar August 2005

Suruhanjaya Tenaga

C/S: Tax Incentive & Financial Analysis

Description	Oleochemical Factory, 55-kW		Rubber Factory, 18.5-kW		Wood (MDF) Factory, 37-kW	
	Without Gov. Tax Incentive	With Gov. Tax Incentive	Without Gov. Tax Incentive	With Gov. Tax Incentive	Without Gov. Tax Incentive	With Gov. Tax Incentive
Price Premium	RM12,700	RM7672	RM 925	RM 673	RM 6,750	RM 3,922
Annual Savings	RM 4,998		RM 192		RM 1,456	
Running Hour	7,000		4,380		4,380	
Payback Period	2.5 yrs	1.5 yrs	4.81 yrs	3.5 yrs	4.6 yrs	2.7 yrs
Return On Investment (15 years lifetime)	33%	58%	14%	22%	15%	31%

ST - IEM Seminar August 2005

Appendix 2 - 5

Energy Efficient Design of Buildings

Extract from "Design Strategies for Energy Efficiency in New Buildings (non-Domestic)" KTAK/JKR/Danida book on Energy Efficiency in Buildings 2004.

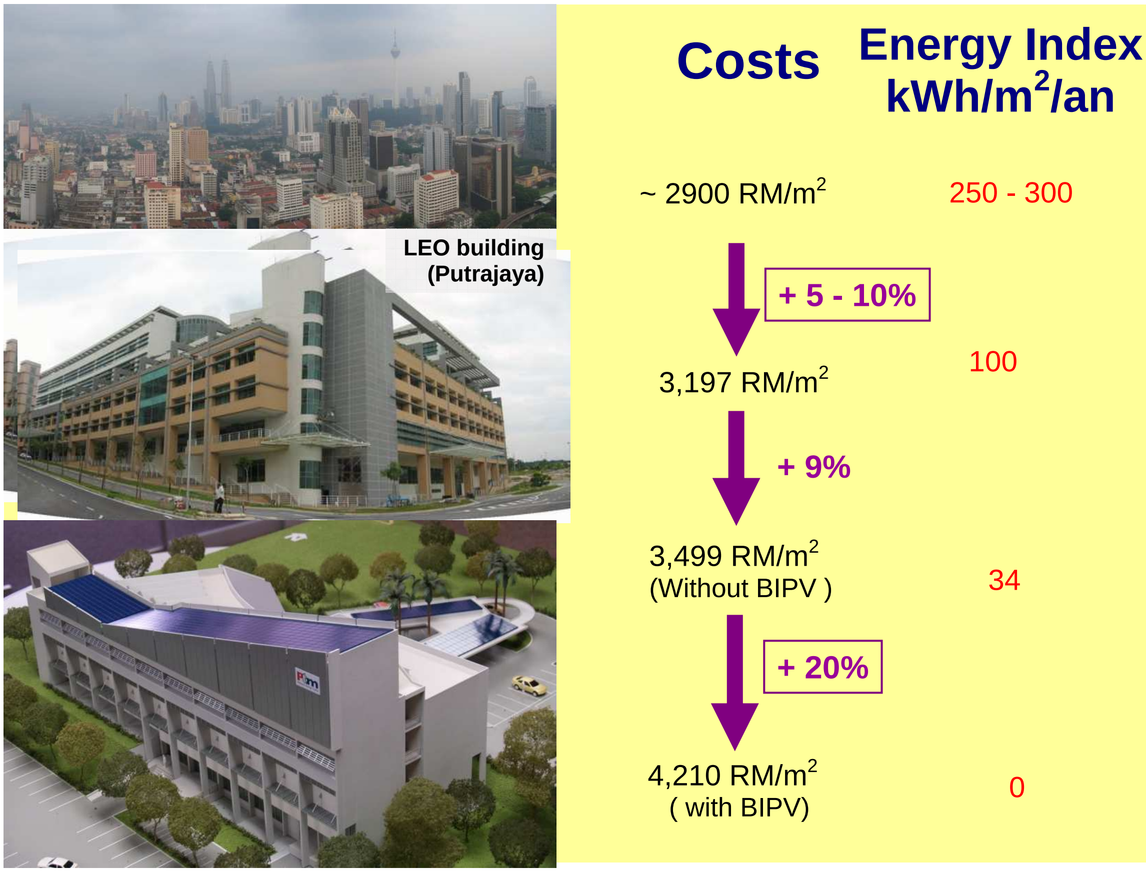
A forecast of savings that could be derived by implementing selected EE initiatives reveals there is much scope in extending the present incentives to non-machinery products and materials. See Table **VIII** below.

Table VIII: Possible Savings from Selected EE Initiatives in Malaysia

Measure	Base case	Improved case	Savings kWh/m^2-yr	Savings RM/m^2-yr	Investment RM/m^2	Pay back (yrs)
Roof insulation	Al sheet + 40 mm insulation	+100 mm mineral wool	13	4	32	8
Wall insulation	115 mm bricks	200mm aerated concrete bricks	5.1	1.5	13	9
Cooling and Vent	Conventional	Zoning with Variable Air Volume, CO_2 controls and variable speed drives	40	12	65	5
Lighting	500 lux	Designed for 350 lux, and zoning of lighting (separate light circuits)	19.5	5	24	4
Overall (excluding Cooling & Vent)			38	10.5	69	7
Energy consumption without Energy Saving Measures ~ 229 kWh/m^2						
Energy consumption with Energy Saving Measures ~ 152 kWh/m^2						

Source: "Design Strategies for Energy Efficiency in New Buildings (non-Domestic)" KTAK/JKR/Danida book on Energy Efficiency in Buildings 2004.

A more dramatic example is that for the PTM's ZEO (Zero Energy Office) building, where incorporation of extensive EE Features help reduce electricity consumption drastically as shown in the chart below. This shows that a cost premium of about 20% in EE features can reduce the electricity consumption by about 80% compared to that of a typical building in Malaysia.



Source: PTM ZEO Building presentation

Appendix 2 - 6

EE savings from large A/C installations

Introduction

Air-conditioners generally form the largest consumers of electricity for commercial buildings and industrial processes requiring a cool, low humidity environment.

Electricity users are reluctant to invest in EE initiatives as the perceived benefits are inadequate due to the low electricity tariffs, notwithstanding the recent tariff review which increased tariff by 12% for the industrial and commercial consumers as well as the bulk of the residential users.

Current status:

Most A/C chillers now profess to have energy ratings of between about 0.5 kW/R-T (refrigeration-tonne) to over 0.7 kW/R-T with the more energy efficient options being more costly. In the light of relatively low (subsidised) electricity tariffs, users tend to consider up-front purchase cost over the operating energy cost in deciding the chillers to install.

A conservative demand saving of say, 0.2 kW per R-T of chiller capacity (replacing a 0.8 kW/R-T unit with a 0.6 kW/R-T unit) will mean a potential infrastructure capacity development saving of about RM 800 for each R-T of chiller capacity (at RM 4,000 per kW of generating capacity), besides giving energy consumption savings for the user.

An assessment of TNB sales statistics from the ST's statistics report for 2004 gives the information tabulated below:

Customer category	Industrial	Commercial
GWh sales for 2004	35732	19967
A/C share GWh	20%	40%
A/C cons GWh	7,146	7986.8
Load factor	50%	30%
MD at above LF – MW	1,632	3,039
Tot MD MW		4,671
Tot kW of A/C load		4,670,715
A/C R-T at average of 0.7kW/R-T * =		6,672,451

* The average capacity rating is taken as 0.7 kW/R-T, as existing chillers in service include old and new units.

The potential demand saving from changing, say 10% of the existing old chillers would amount to about 133 MW. This saving could be achieved through adequate promotion of the fiscal incentives under Budget 2008 available for users to invest in EE A/C plant.

kW saving/RT **0.20** **Tariff RM/kWh** **0.30**

Payback calculations on total investment for Hi-Eff chillers			
A/C operating hours/an	**Energy savings kWh/an**	**Energy cost savings RM/an**	**SPP on total cost – years (at RM 1,300 per RT capacity)**
2000	400	120	10.8
3000	600	180	7.2
4000	800	240	5.4
5000	1000	300	4.3

Large A/C chillers often operate for more than 15 to 20 years and for between 2,500 to over 6,000 hours per annum. The overall energy savings could therefore be from RM 120 to RM 288 per annum per R-T of A/C chiller capacity.

Energy savings also result in gas price subsidy reductions. At current oil price of over US$ 80 per barrel, the gas subsidy can be over RM 0.3 per kWh, which is about the same as the cost of electricity to the consumer.

A/C chiller replacement, if coupled with adequate roof and overall envelope insulation, could require a smaller capacity of A/C plant to achieve the same cooling effect, or to improve the conditions in places where the existing environment is not sufficiently comfortable for optimal productivity.

The energy saving from insulation of the facility would be proportionately higher for low rise facilities where the roof area is proportionately larger and contributes to higher heat gain.

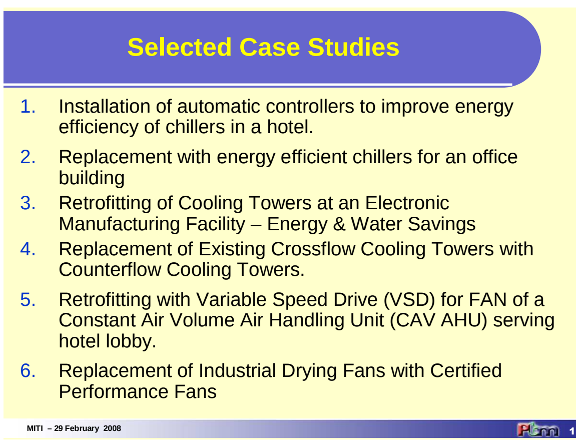
Appendix 2 - 7

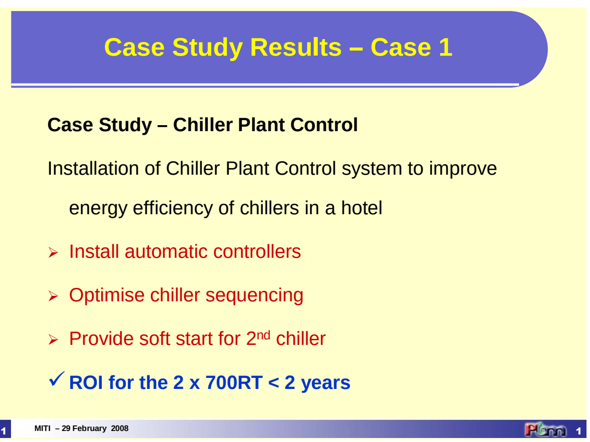
Case Study Results

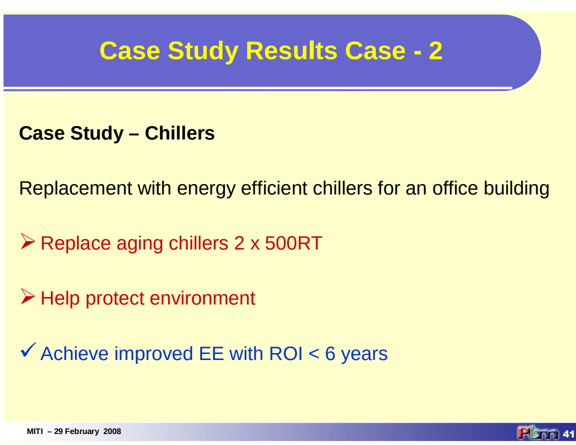
The following data is from a series of case studies conducted under a joint effort between Suruhanjaya Tenaga (ST), Pusat Tenaga Malaysia (PTM) and the Malaysian Chapter of the American Society of Heating, Refrigeration and Air-conditioning Engineers (MASHRAE).

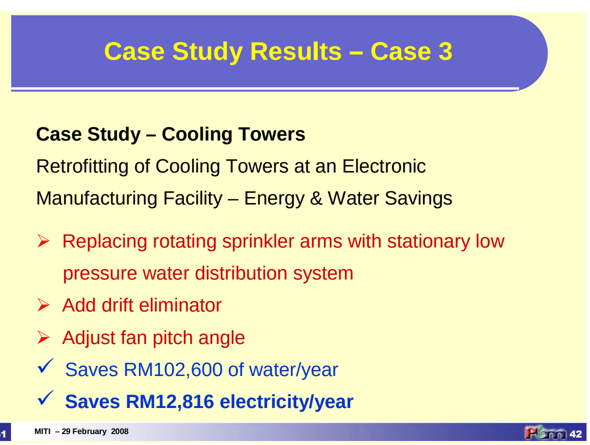
These results were presented at a Seminar on Building Energy Efficiency and Energy Conservation in Efforts in Offices on 22 November 2007 at the Cyberview Lodge in Cyberjaya.

These results show that EE initiatives have attractive benefits in terms of the relatively short "Simple Payback Period (SPP)" indicated for the respective cases. It must be noted that these SPP returns are exclusive of the government's fiscal incentives provided under Budget 2008 in September 2007. Hence, such EE initiatives become even more financially attractive when the fiscal incentives available are taken into account.









Case Study Results – Case 4 (1)

Case Study – Cooling Towers

Replacement of Existing 4-Cell Crossflow Cooling Towers with 2-Cell Counterflow Cooling Towers

- 3000 HRT tower
- Added VSD for fan motors
- ✓ **Fan motors reduced from 84 to 32.4 kW**

Case Study Results – Case 4 (2)

Cooling Towers: Best Practice

Suggested methods of energy savings in cooling towers

1. Reduce motor kW with VSD or 2-speed motors or HE motors or install velocity recovery fan stack
2. Reduce ECWT by replacing infill, HE fans, improve water treatment quality
3. Reduce water loss by installing drift eliminator

Case Study Results – Case 5

Case Study - Fans

Energy Savings by retrofitting VSD to an AHU FAN serving a hotel lobby

1. To vary fan speed in accordance with load demand for 24 hour operation
2. Savings of RM 9,600/year
3. **ROI < 2 years**

Case Study Results – Case 6

- **Case Study – Certified Performance Fans**
- Replacement of Industrial Drying fans with Certified Performance Fans

- Replace unrated fans with performance certified fans
- for 24 nos 18.5 kW centrifugal fans
- Drying time reduced from 26 hours to 16 hours
- Savings of RM136,500/year
- **ROI < 1 year**

Case Study Results – Case 6

Fans: Best Practice

Suggested methods of energy savings that will reduce Fan loads

1. Reduce air flow needs by eliminating leakage losses from ducts, dampers; apply duty cycling operation
2. Reduce pressure loss by using better filters and flow meters
3. Modify or select fan to meet exact duty

Fan and its Ventilation System

- Best Practice for the design of a particular fan and its best selection to achieve EE is insufficient
- Selecting a fan with high efficiency motor and high fan total efficiency at 90% but then operating the whole ventilation system at 50% efficiency is a sheer waste of $$$

  - you might as well pay less for a fan with 75% total efficiency and operate the whole ventilation system at 75% to be more cost effective

Appendix 2 - 8

Government Electricity Consumption & Potential savings

The government consumption of electricity is stated to be about RM 1.2 billion to RM 1.5 billion per annum. This would amount to about 6% to 7.7% of the total TNB sales. On a pro-rate basis the electricity demand due to government consumption could therefore be of the order of 800 MW to 1000 MW.

Air-conditioning load for air-conditioned facilities is normally about 50% to 60% of the total load. Thus A/C load for government facilities could be between 400 MW to 600 MW. A 10% saving of government electricity consumption would amount to a saving of RM 120 million to RM 150 million, with a demand reduction of the order of 80 MW to 100 MW.

Appendix 2 - 9

Effect of Rain on Power System Demand

Anecdotal evidence indicates that rain in the Klang Valley causes the electrical system demand in P. Malaysia (TNB system) to drop by about 3%. The rain lowers the ambient temperature and thus reduces the air-conditioning load.

A 3% demand reduction on a system demand of about 13,500 MW is over 400 MW. This means that retro-fitting of roof and physical envelope insulation for air-conditioned facilities in the Klang Valley could help reduce the TNB demand by a portion of the 400 MW reduction mentioned above (say 50% or 200 MW).

The Klang Valley demand is assumed to be approximately half the TNB demand. Thus effective roof and physical envelope insulation of air-conditioned facilities throughout the country could help reduce electricity demand by up to about 400 MW.

Similar insulation of new facilities which are designed to be air-conditioned could also help reduce the power demand for the new facilities, thus helping to reduce the elasticity between electricity demand and GDP growth rates.

The degree of electricity savings possible from EE design of air-conditioned buildings can be immense when the EE potential of the KTAK LEO building and PTM's ZEO building are considered for adoption, even if only cost-effective measures (e.g. those giving a cost recovery from electricity cost savings over a period of up to 10 years) are implemented.

Additionally, Appendix 2-5 showing the simulated electricity demand variations for insulation of the case study facility validates this deduction.

Summary of Potential Savings

Table 6 shows that the practical savings anticipated from the adoption of EE measures may start with minimal savings but could accelerate rapidly if effective measures are adopted on a sustained basis. An extract of the data shows the following potential savings on the assumptions considered.

Potential Savings from EE

	2008	2009	2010	2011	2012	2013	2014	2015
Year	1	2	3	4	5	6	7	8
Demand BAU* MW	17,261	18,608	20,059	21,624	23,310	25,129	27,089	29,202
Reduced demand MW	17,261	18,590	20,003	21,504	23,095	24,781	26,565	28,451
Savings MW	0	18	56	120	215	348	524	751

* BAU – Business as Usual

Are these savings realistically possible? A review of the data and information given in Appendices 2-6 to 2-9 show that such savings are achievable when the following impacts are considered.

1) Appendix 2-6

Changing of 10% of the old A/C chillers can save 133 MW in demand. If the savings are more conservative to start with and increase gradually, the potential savings could be as follows:

Year	1	2	3	4	5	6
Saving %	2	4	6	8	10	10
Saving MW	26	53	79	106	133	133
Cumulative MW	26	79	158	264	399	532

2) Appendix 2-8

Reducing government electricity consumption by 10% over a period of 5 years could help achieve demand savings as tabled below (assume maximum saving is 100 MW).

Year	1	2	3	4	5	6
Saving, increasing at 2% pa	2%	4%	6%	8%	10%	10%
Saving MW (Cumulative)	20	40	60	80	100	100

3) Appendix 2-9

Reducing demand through passive insulation of air-conditioned facilities has the potential for a demand reduction of up to 400 MW. If this reduction is achieved through a gradual implementation of such facilities, the demand saving could be as follows.

Year	1	2	3	4	5	6
Insulation of facilities increasing at 2% pa	2%	4%	6%	8%	10%	10%
Saving MW	8	16	24	32	40	40
Cumulative MW	8	24	48	80	120	160

Summing up the conservative potential from the three initiatives indicated above gives a cumulative saving potential as shown below.

Year	1	2	3	4	5	6
A/C chiller replacement MW	26	79	158	264	399	532
Passive insulation MW	8	24	48	80	120	160
Government facilities savings MW	20	40	60	80	100	100
Total potential savings MW	54	143	266	424	519	792
Desired demand reduction MW	**18**	**56**	**120**	**215**	**348**	**524**

The comparison shows that even on a conservative basis, the possible demand savings can exceed the desired savings to match the projections forecast in Table 6 of this paper.

This can be achieved even without other credible EE saving initiatives such as those indicated in Appendix 2-7 which shows the results of case studies conducted by PTM and MASHRAE.