

Report on the Energy Audits Carried out by the Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP) on 48 Manufacturing Companies

THE MALAYSIAN INDUSTRIAL ENERGY EFFICIENCY IMPROVEMENT PROJECT

The Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP) was developed to improve energy efficiency in Malaysia's industrial sector by removing barriers to efficient industrial energy use. The project is implemented by Pusat Tenaga Malaysia and co-funded by the Government of Malaysia, United Nations Development Programme, Global Environment Facility and the Malaysian private sector.

The project targets 8 energy intensive industrial sectors namely wood , food, glass, rubber , cement , ceramics, pulp& paper and iron & steel. These sectors were chosen using a selection process based on information derived from the Asian Development Bank Project Report 1994 and a questionnaire prepared and circulated by the project proponents to energy intensive industries. Several other studies were also undertaken by the Ministry of Energy, Water and Communications in collaboration with the Japan External Trade Organisation (JETRO) regarding energy conservation opportunities in some of the energy intensive industrial sectors.

THE EIGHT INDUSTRIES

The manufacturing sector's share of Gross Domestic Product (GDP) in 2000 was 33.4%. The eight industrial segments targeted by the MIEEIP make up 29.7% of the manufacturing sector. The remaining 70.3% is mostly made up of the electronics and chemical industries. Even though the eight industrial segments make up about a third of the manufacturing sector, they consume an estimated 56.4 % of the final commercial energy demand by the entire manufacturing sector which stands at 432.9 million gigajoules (GJ).

Originally, the Terms of Reference (ToR) of the MIEEIP called for six factories from each sector to be chosen for energy audits. However, the team later decided, together with the National Steering Committee of the project, that a sample representative of the actual number of factories operating in the individual industries was more appropriate.

ANALYSIS OF THE DATA

Annual consumption and potential savings

At the writing of this paper, results of the 48 energy audits conducted by the MIEEIP were available for examination. These 48 factories that were audited by the MIEEIP consumed approximately 934 thousand tonnes of oil equivalent (ktoe) of energy a year, or about 9.4 % of final commercial energy demand by the 8 targeted industries. The recommendations put forth by the audit team ranged from improvement in housekeeping for existing equipment, retrofitting or replacing key equipment or process, to the installation of cogeneration plants.

As stated earlier the eight sectors targeted make up 29.7% of the entire manufacturing sector in Malaysia, yet consume an estimated 56.4% of final commercial energy demand of the entire sector.

According to the energy audits conducted by the MIEEIP, comprehensive implementation of purely energy efficiency measures at the 48 factories can reduce electricity usage and fuel demand by 7.0 % if all the measures are implemented regardless of whether they fall into the no cost, low cost and high cost categories. These factories have the saving potential of 2.58 million GJ of energy yearly. This saving works out to be 0.6 % of the final energy demand by the entire manufacturing sector. This figure is commendable considering that these potential savings is only related to 48 factories audited under the programme. Therefore, the potential for the Malaysian industrial sector would be much higher.

The abovementioned result translates into a monetary saving potential of RM 85.2 million a year by the 48 factories audited. The total one-time capital expenditure required for the implementation of all no cost, low cost, and investment grade measures is approximately RM 100.4 million, resulting in a payback period of 1.3 years. The majority of the savings RM 55 million is achieved through investment grade measures. These cost RM 96.3 million to implement, resulting in a payback of 1.9 years.

Table 1 below details the savings potential from all no cost , low cost and high cost measures of the 48 factories. The results are further segregated into electricity usage and fuel demand savings.

Sectors	Subsectors	No Cost Energy Savings			Low Cost Energy savings			High Cost Energy Savings			Total Energy Savings		
		Electrical MWh/r	Thermal G/yr	Total G/yr	Electrical MWh/r	Thermal G/yr	Total G/yr	Electrical MWh/r	Thermal G/yr	Total G/yr	Electrical MWh/r	Thermal G/yr	Total G/yr
Food	Edible Oils Processed Food	296 1,007	6,193 13,478	7,259 17,102	348 537	85,370 22,530	86,624 24,462	669 472	226,420 7,611	228,828 9,311	1,313 2,016	317,983 43,619	322,711 50,876
	Total	1,303	19,671	24,361	885	107,901	111,087	1,141	234,031	238,139	3,329	361,602	373,587
Wood	Particle Board Ply Wood Furniture & Saw Mil	0 466 66	2,345 3,040 698	2,345 4,716 935	40 89 611	1,569 65,037 62,434	1,712 65,357 64,634	0 225 2,241	71,913 140,072 0	71,913 140,883 8,067	40 780 2,918	75,828 208,148 63,132	75,970 210,956 73,635
	Total	532	6,083	7,996	740	129,040	131,702	2,466	211,985	220,063	3,737	347,107	360,561
Ceramic		248	37,673	38,566	382	73,855	75,229	750	38,861	41,561	1,380	150,389	155,356
Cement		324	209	1,375	630	4,598	6,866	72,427	76,529	337,266	73,381	81,336	345,508
Glass		1,035	27,723	31,449	334	12,530	13,732	2,047	51,544	58,913	3,416	91,797	104,095
Rubber	Tyre Glove Others	628 421 147	6,868 25,029 20,812	9,127 26,544 21,339	0 335 1,594	7,524 3,531 3,169	7,524 4,738 8,909	200 1,576 641	14,796 50,257 10,538	15,517 55,929 12,846	828 2,332 2,382	29,188 78,817 34,519	32,168 87,211 43,093
	Total	1,195	52,708	57,010	1,930	14,224	21,171	2,417	75,592	84,292	5,541	142,524	162,472
Pulp & Paper	Integrated Corrugated Cotton Box	149 643	36,627 12,079	37,163 14,395	0 249	39,199 29,006	39,199 29,901	554 243	665,396 22,622	667,391 23,498	703 1,135	741,222 63,706	743,753 67,794
	Total	792	48,706	51,559	249	68,205	69,100	797	688,018	690,889	1,838	804,928	811,547
Iron & Steel	Slag Furnace/Mini Mills Rolling Mill Foundry	1,528 182 152	40,412 17,079 0	45,913 17,733 548	2,910 376 454	43,155 365 0	53,631 1,710 1,635	3,722 1,084 0	98,259 33,315 0	111,658 37,216 0	8,160 1,641 607	181,826 50,758 0	211,202 56,667 2,184
	Total	1,862	57,490	64,194	3,740	43,520	56,985	4,805	131,574	148,874	10,408	232,584	270,053
Total		7,291	250,263	276,516	8,889	453,871	485,872	86,851	1,508,134	1,820,796	103,031	2,212,268	2,583,178

Table 1: Energy Efficiency Saving Measures Identified for the 48 MIEEIP Audited Factories

Another aspect to consider under the MIEEIP is fuel-switching measures. In some cases, the team made the following recommendation of advising the factory to switch over to a less carbon intensive and more environmentally friendly fuel such as natural gas and biomass. While these measures are technically not energy saving measures, they are still considered monetary and CO₂ saving measures, which still help the MIEEIP's target of reducing CO₂ emissions by 10% in accordance with Kyoto Protocol. In addition to the above savings from EE measures, these fuel switching saving measures have an energy saving potential of 4.71 million gigajoules per annum (GJ/yr) which translates into potential monetary savings of RM 22,188,000 per annum. Table 2 below indicates the fuel switching measures recommended by the MIEEIP audit team and its corresponding energy saving potential.

Table 2: MIEEIP Audited Factories with Fuel Saving Potential

Sectors	Subsectors	Fuel Switching Measures	Type of Measure	Energy Saving		CO ₂ Reduction t/yr	Total Energy Savings (GJ/yr)	Total cost Savings (000/yr)
				Electricity MWh/yr	Fuels GJ/yr			
Food	Edible Oils Processed Food	Combustion of Biogas in SNP Boiler	Low Cost	0	3,649	270	3,649	51
		Replacement of diesel fired heater with coconut shell & fired	High Cost	0	8,420	615	8,420	1,700
	Total food			0	12,069	885	12,069	1,751
Wood	Ply Wood Particle Board Furniture	Replacement of oil Heater w/Sawdust-Fired Heater	High Cost	0	21,548	1,573	21,548	537
		Replacement of the dust burner	High Cost	0	64,882	5,060.8	64,882	1,063
		Additional wood fired heater	High Cost	0	11,082.6	2,912.5	11,083	196
	Total Wood			0	97,512	9,546	97,512	1,796
Ceramic	Total Ceramic	PKS Wood-Based Steam Boiler for Dryer	High Cost	0	57,591	4,204	57,591	760
Cement	Factory 1 Factory 2 Factory 3	Use of palm kernel shells	High Cost	0	1,276,686	118,803	1,276,686	2,514
		PKS drying with shale	Low Cost	46	4,230	31	4,396	164
		Savings of coal replaced by PKS	No Cost	0	2,652,827	269,138	2,652,827	13,403
		Drying PKS	High Cost	340	606,599	0	607,823	1,723
	Total-Cement			386	4,540,342	387,972	4,541,732	17,804
Rubber	Others Glove	Change fuel	No Cost	0	0	0	0	6.4
		Change Heating Method from Electricity to Fuel	High Cost	495	0	340	1,782	71
	Total-Rubber			495	0	340	1,782	77
Total				881	4,707,515	402,947	4,710,686	22,188

The benefit of implementing such fuel switching measures is clearly demonstrated in MIEEIP's Heveaboard demonstration project. This company clustered under the wood sector implemented the Wood Dust Fired Thermal Oil Heater project in 2005 and enjoys a yearly energy cost reduction of RM 720,000/- and an annual fuel saving of 37,385 GJ . Through this project CO₂ emission from Heveaboard has been reduced by approximately 2,916 tonnes.

From the MIEEIP audits also the team concluded that the total annual CO₂ emission from all 48 audited factories amounts to 3.26 million tonnes . Should these companies implement both EE and fuel switching energy saving measures recommended 761,734 tonnes can be reduced annually. Table 3 below highlights the potential CO₂ reduction of the MIEEIP's 48 audited factories. The total percentage savings possible amounts to 23% out of which 11 % can be attributed to renewable energy CO₂ savings and the remaining 12 % to EE related CO₂ savings .

Sectors	Subsectors	CO₂ Emission T/yr	CO₂ Emission Reduction T/Yr	% Of Reduction Potential
Food	Edible Oils	130,960	23,673	18
	Processed Food	17,597	4,315	25
	Total	148,557	27,928	19
Wood	Particle Board	21,756	12,261	56
	Ply Wood	9,074	7,397	82
	Furniture & Saw Mill	14,212	10,719	75
	Total	45,042	30,378	67
Ceramic		56,789	14,463	25
Cement		1,225,166	444,667	36
Glass		149,089	8,069	5
Rubber	Tyre	15,237	2,813	18
	Glove	7,804	11,139	143
	Others	4,213	4,979	118
	Total	59,940	18,931	32
Pulp & Paper	Integrated	923,624	189,156	20
	Corrugated Carton Box	17,465	5,247	30
	Total	941,089	194,403	21

Iron & Steel	Slag Furnace Mini Mills	617,948	18,963	3
	Rolling Mill	13,049	3,456	26
	Foundry	641	417	65
	Total	631,638	22,836	4
Total Related CO ₂ savings		3,257,310	761,734	23
RE Related CO₂ savings			358,786	11
EE Related CO ₂ savings			402,947	12

Table 3: Potential CO₂ Saving of the MIEEIP's 48 Audited Factories.

EFFECTS OF SUCCESSFUL IMPLEMENTATION OF EE MEASURES

The team received feedback from the 48 audited factories on the results of the implemented energy saving measures (ESM) proposed during the audit. The feedback was gathered via follow-up forms. A total of 473 numbers of no, low and high cost ESM were proposed during the audit. Based on the feedback, about 41 percent of the measures have already been implemented by the factories. These factories have invested about RM 5.1 million for the implementation stage and are expected to save their energy cost by more than RM 5 million as well. The result has been discussed in a technical committee formed to evaluate MIEEIP energy audit impact study. The team comprises representatives from Economic Planning Unit (EPU), MEWC, Suruhanjaya Tenaga (ST), UNDP, Federation of Malaysian Manufacturers (FMM) and MIEEIP technical advisors.

It is also encouraging to note that nearly two thirds of the no cost measures recommended were implemented by the factories. The implementation of the no cost category is the most essential as it is the easiest to implement and also the measure that will bring the most immediate impact. Another highlight is that many of the no cost measures were implemented within one year of the audit.

Another interesting observation is the findings of the actual implementation of energy saving measures by the companies audited. The audit team has conducted an intensive follow up programme to gauge the extent and commitment of the audited factories to carry out the recommended measures. So far, the number of companies identified as proactive are Tritex Containers Sdn Bhd, Pan Century Edible Oils Sdn Bhd, JG Containers (M) Sdn Bhd, Jayakuik Sdn Bhd, Malayawata Steel Berhad and Cargill Palm Products Sdn Bhd. The results and figures given by these companies obviously prove that Malaysian companies, with the right backing and support are willing to continuously improve themselves. The energy saving measures executed by JG Containers and Pan Century have been commendable, as they have reduced 5 % and 33 % of the annual energy consumption of their factories respectively. Some companies such as JG Containers have gone far beyond the energy saving measure specified within the report. This is because during the

time of audit, the furnace at JG was operating past its designed lifespan. One of the general recommendations by the team was to rebuild the furnace as soon as possible. Once the furnace was rebuilt, the factory achieved far greater energy savings as compared to its initial energy consumption.

The actual percentage savings achieved by the audited factories maybe much higher, and will take some time to verify. In fact, one of the biggest difficulties the audited companies face is just to verify and quantify the extent of cost reduction made. This is why nearly 81.2% of the factories audited requested for some form of technical and financial assistance in implementing the measures.

It should be noted that low energy tariffs as well as the low priority given by certain factories towards energy efficiency due to lack of finance , expertise and management commitment makes it difficult for EE efforts to be pursued effectively in Malaysia .

During the audit, the team also encountered some factories who were disinterested in the audit. The lack of interest was due to: -

- Previous disappointment with foreign agencies, which failed to follow up their energy audit program done in collaboration with local partners
- Previous experience with local companies who were not capable of carrying out the required work. Some of these companies claimed to be Energy Service Companies (ESCO) although they are only involved in selling equipment.
- Internal conflict within the association/factory management
- Level of competency /knowledge regarding energy efficiency within industry was assessed by the association members to be high
- Fear of disclosure of industry and technology secrets although it was made clear that there would be a contractual agreement between PTM and audited company to prevent disclosure of company technology

Implementation of energy efficiency measures across the eight industries will reduce the proportion of final commercial energy consumed by them. The eight industries' share of energy consumption could be reduced to 48.9% instead of the current 56.4 %.

The monetary value of the energy savings derived from the need to purchase less fuel and electricity illustrates the extent of which substantial savings can be made without enormous capital investments in new equipment. This saving directly results in lower cost of materials allowing companies to improve profit margins and/or compete more effectively in the global marketplace. With intense competition resulting from the development of economies in the region, any opportunity to reduce production cost, and thus enhance competitiveness, must be seized.

Research and experience in other parts of the world like Europe and Japan demonstrates that the deployment of energy efficiency technology with proper monitoring is an assured way of reducing costs.

Cost management through energy efficiency will provide a buffer when prices of raw materials rise. Saving through energy efficiency can also prevent or postpone job losses when companies seek ways to manage their costs.

In cases where waste products are converted to energy through the installation of new boilers or implementation of cogeneration, there is the added savings from the reduced need for transport and disposal of waste products besides the reduction in demand for purchased energy. The value of implementing energy efficiency measures extends beyond the savings from reduced fuel and electricity purchases. Other benefits include plant, equipment and process modernization, the improvement of plant efficiency, advancement in product quality, and therefore enhanced productivity.

These indirect benefits only add to, if not exceed, the direct savings already generated by the efficient use of energy.

BENEFITS BEYOND TARGETED SECTORS

In net-fuel-importing economies, the beneficiary of the effort to implement energy efficiency policy is mainly the targeted sector, whether it is the manufacturing, transport, or residential users. For example, Korea as a net-fuel-importer uses various energy efficiency & conservation tools to control the growth rate of energy consumption caused by the rapid development of heavy industries to prevent unnecessary dependence on imported fuel. As a result, they expect that total energy demand will increase by only 0.2% annually against an economic growth rate of approximately 6%. In comparison, Malaysia expects a 7.8% annual growth in energy demand against an economic growth rate of 4- 4.5%. When conventional and non-conventional energy resources are combined, the industrial sector represents the largest sectoral consumer of energy in Malaysia.

Malaysia's political and economic stability, productive workforce and developed infrastructure and strategic location in the heart of South East Asia, makes her the ideal springboard for manufacturers to launch into the Asia Pacific region.

The government has gone to great lengths in subsidizing the price of petrol, diesel and other fuels including electricity, to ensure that consumers are not burdened with high fuel prices and industries can remain competitive in the international market. At present, the prices of petrol, diesel and liquefied petroleum gas as well as electricity in Malaysia are among the lowest in the ASEAN region. The situation cannot continue forever and Malaysian energy consumers must be prepared to see some increase in energy prices in the future. Efficient energy usage is an option that consumers must consider to offset this future increase in fuel prices.