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POWER HUNGER

How energy standardisation is helping fulfill our demand for unlimited energy.

ENERGY SAVING MAINTENANCE

HOW A PROPER MAINTENANCE INITIATIVE CAN SAVE ENERGY BILLS AND CAPITAL EXPENSE

SOLAR PHOTOVOLTAIC STANDARDS

THE MALAYSIAN STANDARD MS 1837 PAVES THE WAY FORWARD FOR LOCAL SOLAR POWER SYSTEMS

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UPDATES

OF INTEREST

POWER HUNGER

Energy is a key concern in all economic activity. These concerns principally revolve around how energy intensive a business's operations are, how dependent the business is on energy, how efficiently energy is used and how secure that supply of energy is. Yet even though a stable and continuous energy supply is imperative for economic development, energy consumption also has an undesirable impact on the environment and climate.

A rising awareness of these factors has led to calls for action to reduce the adverse effects of energy on the environment. In view of this international movement towards greener energy, the Malaysian government has identified three energy initiatives that will be instrumental in guiding the development of its energy sector, which is the backbone of Malaysia's economic and social development. These initiatives are aimed at:

- Ensuring the provision of adequate, secure and cost-effective energy supplies through the development of indigenous energy resources from both non-renewable and renewable energy sources. These will use the latest cost options and will diversify the sources of supply both from within and outside the country.
- Promoting the efficient utilisation of energy and discouraging wasteful and non-productive patterns of energy consumption. Through the implementation of awareness programmes, it is hoped that both the energy industry and consumers will exercise greater efficiency in energy production, transportation, energy conversion, utilisation and consumption.
- Minimising the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment.

At the international level, the International Organization for Standardization (ISO) is already busy with several initiatives that will contribute to the fight against climate change. These include the development of the new ISO 50001 standard on energy management systems, standards on energy efficiency and renewable energy, and transport-related standards such as those for electric vehicles and intelligent transport systems.

In addition to articles related to Malaysia's national energy policy and electrical energy regulations, this edition of Standards and Quality News brings us up to date on the developments of both the ISO 50001 standard and the Malaysian Standard MS 1837 for solar photovoltaic systems. We also talk about energy efficiency testing services for electrical appliances and the Malaysian Energy Efficiency and Labeling Programme, and take an in-depth look how companies can save energy through effective maintenance.

We hope you find the issue enlightening.

Saleha A. Jalil

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POLICIES AND POWER

Malaysia's energy policies have evolved through the years in response to the changing demands of both industry and the environment.

By Azman Zainal Abidin and Radin Diana R. Ahmad
Policy Analysis and Research Management Division, Pusat Tenaga Malaysia

Energy is central to achieving sustainable development goals. It is a vital force powering business, manufacturing, transportation systems and a necessity in the building sector for residential homes, offices, schools and clinics among others. Energy availability and its accessibility is a crucial factor in any economy and can determine and impact the GDP growth of the country either positively or negatively.

The sustainability of energy resources has been strategically planned over the years with energy policies that have been developed after careful evaluation of the current and future energy needs and supply of energy. Malaysia's energy policies can be traced back to as early as the 1970s.

The major energy policies implemented in the country are as follows:

1 1975

NATIONAL PETROLEUM POLICY

In 1975 the National Petroleum Policy was formulated to guide and regulate the fast growing petroleum industry. The policy's goals include:-

- Making good use of the country's petroleum resources and placing the application of oil and gas resources to serve national needs as a first priority by making available adequate supplies at reasonable prices to meet domestic consumption;
- Providing a favourable investment climate in Malaysia, including opening up new opportunities for downstream activities;
- Ensuring that Malaysians are adequately represented in terms of ownership, management and control in all phases of petroleum operations ranging from exploitation, marketing and distribution; and;

Oil rig, by aran, on Flikr.

- Effecting an optimum pace of social and economic exploitation of oil and gas resources and taking into account the need for conservation of these depletable assets and the protection of the environment.

2 1979

NATIONAL ENERGY POLICY

An overall energy policy was formulated in 1979 with broad guidelines on long-term energy objectives and strategies. The aim of the National Energy Policy of 1979 was to ensure an efficient, secure and environmentally sustainable supply of energy in the future. It contained three principal policy objectives as follows:


Oil barrels, by ezioman, on Flikr.

- **The Supply Objective:**
  To ensure adequate, secure and cost-effective energy supply through developing and utilising alternative sources of energy (both non-renewable and renewable) from within or outside the country.
- **The Utilisation Objective:**
  To promote efficient utilisation of energy and discourage wasteful and non-productive patterns of energy consumption.
- **The Environmental Objective:**
  To minimise the negative environmental impacts on the energy supply chain i.e. energy production, conversion, transportation and utilisation.

3 1980

NATIONAL DEPLETION POLICY

The National Depletion Policy (NDP) was introduced in 1980 to manage the exploitation of the natural oil and gas reserves by applying production control on major oil fields. In 1996, under the Seventh Malaysia Plan, the NDP was extended to include gas reserves. The NDP set the limit for the production of oil each day at 650,000 barrels, whilst the consumption of domestic gas in Peninsular Malaysia was limited to about 2,000 million standard cubic feet per day (mmscfd) respectively.


Old oil barrel, by spratmackrel, on Flikr.

The policy was aimed at restricting production at major oil fields of over 400 million barrels of oil initially in place (OIIP) to about 1.75 percent of the OIIP. However, in 1985, the ceiling was raised to 3 percent of OIIP resulting in total production of crude oil being limited to about 650,000 barrels per day (bpd) currently.

THE HISTORY OF NATIONAL ENERGY POLICIES IN BRIEF

1975

National Petroleum Policy

To bring about the efficient utilisation of energy resources for industrial development.

1979

National Energy Policy

A broad policy to ensure the sustainability of the Malaysia's newly found oil and gas resources.

1980

National Depletion Policy

- set a limit on the amount of oil and gas produced (650,000 barrels of oil per day and 2,000 million standard cubic feet per day)
- due to rapid economic development, the production levels of oil and gas have surpassed the set targets
- focused only on the supply side of the energy. The demand side of managing the limited resources was entirely ignored.

1980

Four Fuel Policy

To achieve a more balanced utilisation of four fuels – oil, coal, gas and hydro – in electricity generation so as to reduce overdependence on oil.

2001

Five Fuel Policy

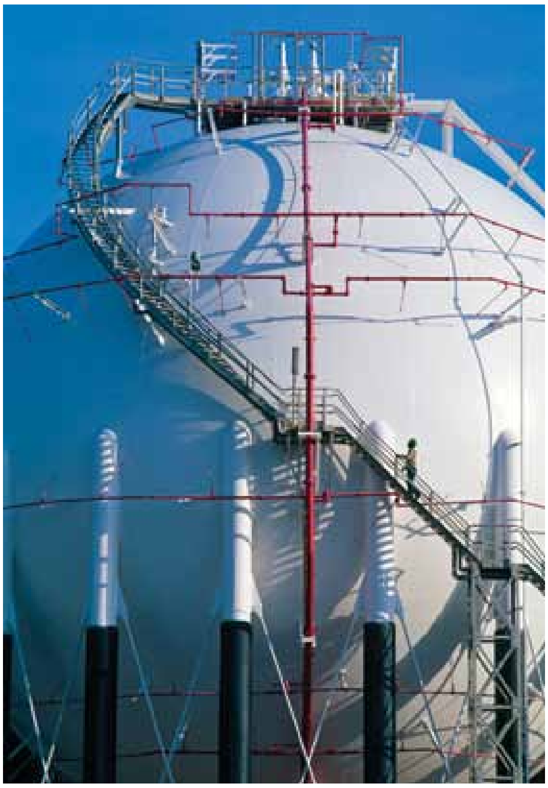
To give greater importance to green energy (renewable sources) and as well as energy efficiency efforts.

4 1981

FOUR-FUEL DIVERSIFICATION POLICY

The Four-Fuel Diversification Policy was formulated to reduce the country's over dependence on oil as an energy source and to increase the use of gas as an alternative, particularly in the power sector. Its aim was to ensure reliability and security of energy supply through a mix of oil, gas, hydro and coal sources.

Figure 1 (next page) illustrates the success of the Four-Fuel Diversification Policy whereby the share of fuel oil and diesel in electricity generation decreased while the share of natural gas increased. Prior to 1985, most oil-alternative efforts centred around hydroelectric projects. However, with the completion of the gas pipeline infrastructure through the Peninsular Gas Utilisation (PGU) Project, readily available domestic gas was a good reason to justify its increased utilisation in electricity generation. Efficient and relatively cheap gas-based technologies proved to be very popular among Independent Power Producers (IPPs) entering the electricity generation business in the 1990s.



5 2000

FIVE-FUEL POLICY

In 2001, about 20 years after the Four-Fuel Diversification Policy saw the country's energy mix being driven by oil, natural gas, coal and hydro, the government initiated the Five-Fuel Policy whereby the fifth fuel was renewable energy (RE). This policy was formulated under the Eighth Malaysia Plan (Year 2000 – 2005) to encourage the utilisation of renewable sources such as biomass, solar, mini hydro and wind as additional fuel resources for the power sector.

A target of 350MW renewable energy electricity supply was set in the Ninth Malaysia Plan (2006-2010). To further encourage and intensify the use of RE, the Small Renewable Energy Programme (SREP) was initiated in 2001. Its aims are:

- Promoting the growth of small power generation plants that utilise renewable energy;
- Facilitating the expeditious implementation of grid-connected renewable energy whereby small power producers using RE as energy sources are allowed to sell their excess electricity to utilities distributed through the national grid; and
- Promoting and encouraging the development of more efficient RE technologies.


Windfarm, by Hammer51012., on Flikr.

SREP's program focuses on biomass waste as the key renewable energy resource, especially biomass residue from the oil palm industry as Malaysia is the world's biggest exporter of oil palm products and produces huge amounts of oil palm waste. Small power generation plants which utilise RE can apply to sell electricity to the Utility through the Distribution Grid System.

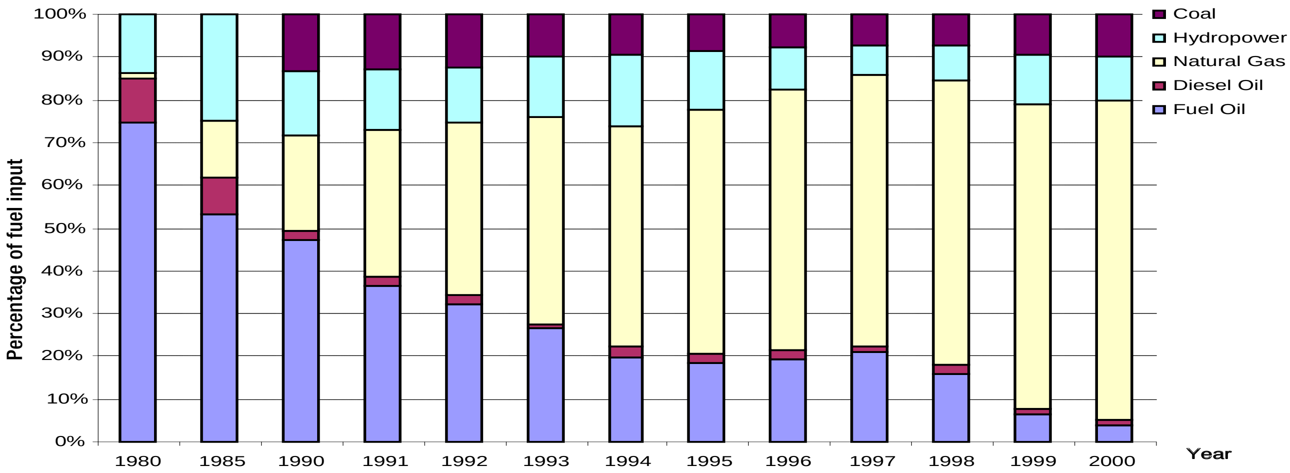


Figure 1: Fuel Input at Power Stations (1980-2000)

(FROM PAGE 4)

While we have been successful in fulfilling Malaysia's energy needs in the past, as our economy grows and incomes rise, per capita energy use will inevitably rise. History shows that demand for energy never remains at current rates and steadily increases over time. It is therefore vital to reconcile the demand for energy.

Meeting and containing this higher demand will pose many challenges and will require (amongst others) initiatives for boosting energy efficiency, developing alternative energy resources and managing environmental risks. Undoubtedly, the task of providing energy will become even more challenging and demanding in the future.

The greatest task ahead is to take cognisance and examine the constraints of energy resource availability, the volatile swings in energy resource prices such as oil, gas and coal prices and also the negative impact of power generation on the environment. The challenge is to draw up an energy roadmap that can guarantee the provision of clean and affordable energy necessary for rapid economic growth and rising standards of living. This may require a combination of strategies including increasing conservation, expanding and diversifying our energy supply. This will mean increasing the share of renewable energy in the energy mix and improving energy efficiency and also addressing issues like climate change and energy security.

MALAYSIA'S GREEN TECHNOLOGY POLICY LAUNCHED

On the 24th of July 2009, the Malaysian Prime Minister Datuk Seri Najib Tun Razak launched the National Green Technology Policy which seeks to promote low-carbon technology and ensure sustainable development while conserving the natural environment and resources.

Datuk Seri Najib Tun Razak.

The first strategic thrust of this Policy was to establish a green technology council for high-level coordination among ministries, agencies, the private sector and key stakeholders for the effective implementation of green technology policies.

The second strategic thrust aims to provide a conducive environment for Green Technology development. This includes the introduction and implementation of innovative economic instruments, as well as the establishment of effective fiscal and financial mechanisms to support the growth of green industries.

The third strategic thrust seeks to intensify human capital development by providing training and education programmes and by introducing financial packages and incentives for students embarking on green technology-related subjects.

The fourth strategic thrust is to intensify Green Technology research and innovation towards commercialisation with incentives to be offered and announced in due course.

The final thrust for green technology to move forward is based on strong promotion and public awareness since it is a new sector in the country. The government would lead by example by adopting green technology in government facilities. It will also promote, educate and disseminate information to gain the buy-in of the public to support the "green economy" and adopt "green practices" as part of their life.

THE LAW OF ENERGY

An overview of The Efficient Management of Electrical Energy Regulations 2008.

by Ir. Francis Xavier Jacob (francis@st.gov.my)
Chairman of the Technical Committee on Energy Management

Energy efficiency laws in the country are, at present, restricted only to electrical energy. This appears to be necessary because there is no overall energy Act. There is an Electricity Supply Act 1990 (Act 447) and even this Act was only amended as recently as in September 2001 to include the efficient use of electricity in its scope.

The first set of electrical energy efficiency regulations under the Electricity Supply Act 1990 – The Efficient Management of Electrical Energy Regulations 2008 – was formulated and came into effect on 15 December 2008. The following installations are affected by these Regulations: -

- Any installation which receives electrical energy from a licensee or supply authority with a total electricity consumption equal to or exceeding 3,000,000 kWh as measured at one metering point or more over any period of six consecutive months; or

- Any installation used, worked or operated by a private installation licensee with a total net electrical energy generation equal to or exceeding 3,000,000 kWh over any period of six consecutive months;

The Regulations empower the Energy Commission, by written notice, to direct the owners of the effected installation to:

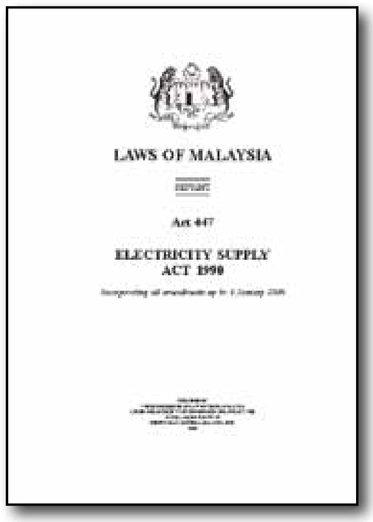
a) appoint or designate a registered Electrical Energy Manager;

b) submit a written confirmation of such appointment or designation (name, particulars, date of expiry of registration);

c) submit information on its policy, objectives and the accounts and documents pertaining to the efficient electrical energy management of the installation; and

d) to submit periodical reports on the efficient electrical energy management of the installation

A licensee or supply authority who supplies electrical energy to any installation shall submit to the Commission information or documents regarding the names and particulars of consumers whose total electrical energy consumption over any period of six consecutive months equals or exceeds 3,000,000 kWh not later than one month after the expiry of the period of six consecutive months from the effective date. The Regulations state similar obligations to private installation licensees to inform the Commission on the net electrical energy generation over six months period within the time frame.


LAWS OF MALAYSIA
Act 447
ELECTRICITY SUPPLY ACT 1990

Electricity Supply Act 1990 (Act 447)

The licensees have to ensure that the information and documents provided to the Commission are true, accurate and complete.

The Regulations further state that in order to be registered as an Electrical Energy Manager with the Commission the candidate must: -

- be a Malaysian citizen aged 23 years and above
- be a Professional Engineer and possess at least six months working experience in the efficient management of electrical energy, or
- hold a degree in Science, Engineering, Architecture or its equivalent and possess at least one year working experience in the efficient management of electrical energy; or
- hold a certificate of competency as an Electrical Services Engineer or as a Competent Electrical Engineer as in the Electricity Regulations 1994 and possess at least nine months working experience in the efficient management of electrical energy; and
- demonstrate knowledge of the requirements of the Act and the Regulations

The Commission may require the person to attend an interview before being registered. The functions and duties of Registered Electrical Energy Managers are to: -

- audit and analyse the total electrical energy consumption/ generation of the installation
- advise in developing and implementing measures to ensure efficient management of electrical energy at the installation
- monitor the effective implementation of the measures
- supervise the keeping of records on efficient management of electrical energy at the installation and verify its accuracy; and
- ensure the timely submission of information and reports under the Regulations.

The Regulations state that an Electrical Energy Manager may have his or her registration cancelled if any of the following happen:-

- the Manager contravenes or fails to comply with provisions of the Electricity Supply Act or the Regulations;
- the Manager's certificate of registration has been obtained by false or fraudulent declaration, certification or representation;
- the Manager's certificate of registration has been used for a purpose that differs from that for which it was issued or in a manner that is intended to mislead or deceive the public; or
- there has been failure to carry out the functions and duties as specified in the Regulations

Other provisions of the Efficient Management of Electrical Energy Regulations 2008 include: -

- the Commission will maintain a register of registered Electrical Energy Managers
- Procedures for replacing certificates of registration
- Procedures for certifying true copies of certificates of registration
- Procedures for submitting requests for Extensions of Time
- Procedures for serving notice, either in person or by registered post

In the event that there is a failure to comply with these regulations, the Regulations state that any person who commits an offence under the Regulations shall, on conviction, be liable to a fine not exceeding five thousand ringgit or to imprisonment for a term not exceeding one year, or both.

STAR APPLIANCES

The Energy Commission's energy efficiency and labeling programme can give electrical appliance manufacturers a competitive edge.

By M.Zamri Mustaffa (zamri@sirim.my)
Testing Services Department, SIRIM QAS International Sdn. Bhd.

The increasing cost of energy and a rising social awareness are some of the factors that change people's opinions and attitudes towards the need for energy efficient appliances. At the Earth Summit in Kyoto in 1997, the world set a target to reduce greenhouse gas emissions. One of the most significant greenhouse gas emissions is carbon dioxide (CO_2).

CO_2 is mainly emitted as a result of electricity generation and use as well as direct thermal losses in (for example) heating. Almost half of all CO_2 emissions from residential and commercial buildings come from electricity consumption. And in Malaysia, the use of electrical equipment and appliances is a major source of energy use and greenhouse gas emissions.

Energy efficiency is defined as "the ratio between the useful output of an energy conversion machine and the input in energy terms". In other words, energy efficiency is the relationship between the quantity of useful energy and the quantity of energy consumed. The useful output may be electric power, mechanical work or heat. Energy efficiency means using less energy to provide the same level of energy service or to perform the same function. It is expressed by the Coefficient of Performance (COP) when dealing with heat production and by the Energy Efficiency Ratio (EER) for appliances used for cooling.

THE ENERGY EFFICIENCY AND ENERGY LABELING PROGRAMME

The Energy Commission (Suruhanjaya Tenaga, or ST) has been promoting the Electrical Appliances Energy Efficiency and Labeling Programme for some time now in an effort to promote a culture of voluntary improvement amongst manufacturers. The ranking is based on the Star Index, which determines the star ranking of specific product models submitted for testing by manufacturers on a voluntary basis. The programme began in 2005 for domestic refrigerators and has since expanded to include electric fans, televisions, air conditioners and ballasts. Each product is included in the programme on the understanding that the consumer will benefit from its regulation for Energy Efficiency.

SIRIM QAS International is a recognised testing facility under the Energy Commission's Electrical Appliances Energy Efficiency and Labeling Programme.

The purpose of the programme includes:

1) improving Malaysia's energy efficiency performance.

2) encouraging the development and innovation of high quality products (market demand for more energy efficient appliances will spur for innovation

3) providing better and fairer competition in the marketing of products; and

4) helping consumers in their purchasing decisions

To achieve these goals, the Energy Commission is expected to eventually make the programme mandatory for products entering Malaysian market.

Under this programme, the least energy efficient products are labeled with a "One Star" and the most efficient products with a "Five Star". The "Star" rating for each model is shown by a comparative label that will be used for models approved by the Energy Commission. The label is affixed onto energy efficient products by manufacturers. The comparative ranking of products is based on the results of energy performance of refrigerators as tested by SIRIM QAS International.

ENERGY EFFICIENCY TESTS OFFERED BY SIRIM QAS INTERNATIONAL

SIRIM QAS International has been identified by the Energy Commission as a testing facility to provide testing services for electrical products and appliances identified under the Electrical Appliances Energy Efficiency and Labeling Programme. Since the inception of the programme, the Electrical & Electronics Testing Section of SIRIM QAS International has issued more than 500 test reports for energy efficiency, out of which more than 300 reports were produced in 2009 alone. This number is expected to increase further in 2010.

TESTING SERVICES OFFERED BY SIRIM QAS INTERNATIONAL

A summary of the performance indicators and standards used in electrical appliance testing at SIRIM QAS International.

REFRIGERATORS

The Energy Commission's Star Index is based on daily energy consumption rates obtained from tests in accordance with **MS ISO 8561:2000** (Household Frost-Free Refrigerating Appliances: Refrigerators, Refrigerator-Freezers, Frozen Food Storage Cabinets and Food Freezers Cooled by Internal Forced Air Circulation).

The Star Index is calculated as follows:

$$STARindex = \left(\frac{EEF_{\text{tested}}}{EEF_{\text{average}}} - 1 \right) x\ 100\%$$

$$\text{Note: Energy Efficiency Factor (EEF)} = \frac{\text{“Adjusted Volume” (litres)}}{\text{Energy Consumed Per Day (kWh)}}$$

DOMESTIC ELECTRIC FANS

Electric fan tests use the Coefficient Of Performance (COP) based on tests done in accordance with MS1220:2001. COP calculated as follows:

$$\text{Coefficient Of Performance (COP)} = \frac{\text{Air Delivery } (m^3/\text{min})}{\text{Input Power (W)}}$$

BALLASTS FOR FLUORESCENT LAMPS

Electronic ballasts and conventional ballasts with a Watt loss not exceeding 6W for 18/20W and 36/40W lamps. The testing standard used for conventional ballasts is MS 141: Part 2: 1993, while the standard used for electronic ballasts is MS IEC 929:1995.

Light ballast, by MikeBlyth, on Flikr.

ELECTRIC LAMPS

Lamp efficacy is measured in in Lumens per Watt (L/W) and is based on tests done in accordance with MS IEC 60969:2006 (Self-Ballasted Lamps for General Lighting Services) for fluorescent lamps.

Bulb, by only_point_five, on Flikr.

AIR CONDITIONERS

The Energy Efficiency Ratio (EER) of air-conditioners is calculated based on tests done in accordance to MS ISO 5151:2004 (Non-Ducted Air Conditioners and Heat Pumps). There are two types of tests: the Balanced Type Calorimeter or Psychometric type. The tested capacity value must be at least 90% of that declared by the manufacturer.

The EER is calculated as:

$$\text{Energy Efficiency Ratio (EER)} = \frac{\text{Cooling Capacity (Btu/h)}}{\text{Input Power (W)}}$$

$AVING$ THROUGH MAINTENANCE

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Quality and Enterprise Management Centre

Energy is an essential part of modern society. Regardless of industry, government or individual, it is no coincidence that all our initiatives take a firm stance towards adopting effective operations and maintenance (O&M) policies in order to limit further malaise in energy management.

Choosing suitable and effective O&M initiatives is crucial as they offer the opportunity to increase profits by using existing systems and equipment effectively. Replacing or upgrading energy-using equipment or systems is another option which can also save energy. Regardless of the initiatives taken, the energy conservation movement may depend on measuring and verifying (M&V) cost savings that may be impacted. Hence, the quality of maintenance affects the company's profitability.

There are no specific M&V calculations for assessing O&M initiatives. Nonetheless, this article will seek to highlight the issues and best approaches for gaining M&V savings by improving O&M initiatives in commercial and institutional buildings.

BACKGROUND

Energy Savings is defined as "a reduction in the cost of energy resulting from the lease or purchase of operating equipment improvements, altered operation and maintenance or technical services." Energy savings aside, improvements on a building's environment such as enhanced lighting and indoor air quality can impact productivity benefits. Hence, there needs to be major involvement in terms of operations and maintenance of a building facility.

Embarking on energy saving projects may require a lot of effort in finding the right contractor. This is to ensure that not only do these contractors adhere to statutory legal requirements or codes, but also to ensure credence that the project does really result in the projected cost savings, because building facilities often do not perform in the manner they were designed.

O&M measures can vary and may not necessarily involve the installation of new equipment. It can include repairs of defective equipment, fine tuning existing equipment that does not operate as efficiently, commissioning new equipment, improving maintenance procedures and installing computerised systems to monitor systems performance to trigger report warnings when the system does not operate properly. O&M measures can also involve human aspects such as increasing staffing competency, changing the staffing resource level or outsourcing the facility of O&M staffing.

ISSUES

There are certain factors worth highlighting when we seek to measure the value of these O&M benefits. These issues include defining the valuation of savings, determining and adjusting baselines, measuring the

Table 1: Overview of O&M Practices

O&M Practice	Description
Reactive Maintenance	The simplest initiative. Requires minimal support from O&M crews and infrastructure, minimal forethought and only requires maintenance if it is broken. The equipment is simply made to run until it either fails completely or ceases to serve its function and can only be overhauled or totally replaced. Although this appears to be the cheapest O&M practice, it is actually to be the most expensive in terms of life-cycle maintenance. Ironically, this maintenance method is also the most popular in plant manufacturing industries although it invariably results in high productivity loss, capital hardware loss, total manpower expenditure and high accident rates.
Preventive Maintenance	A combination of regular maintenance procedures and periodic checks of key operating parameters, both of which are crucial to ensure an energy system is not utilising more energy than required. Preventive Maintenance tests, inspections and servicing are based on the equipment's hours of operation. This can be labour intensive and can cause unneeded maintenance to be performed and incidental damage to equipment. Nonetheless, such preventive maintenance systems can be cost effective if the life span cycle of the product is well understood. Studies have shown that this kind of maintenance can result in savings of between 12% to 18%. Although preventive maintenance can make equipment last longer, there is still the possibility of abrupt failures.
Predictive Maintenance	Detects the gradual degradation of certain mechanisms and allows engineers to minimise or control it before the equipment deteriorates completely. Predictive maintenance requires checking equipment *before* it fails as it progresses through its life cycle operation, and has been made possible due to the availability of advanced techniques such as vibration analysis, oil analysis, thermographing and condition monitoring. Such techniques can increase the lifespan of these products and equipments by detecting problems earlier, thus resulting in faster and more effective corrective actions and definitely more energy savings.
Proactive Operations and Maintenance	This resembles Predictive Maintenance in that it detects anomalies or signs of degradation from deteriorating equipment except that it pushes the envelope further by also performing root cause analysis from system conditions. The O&M operation includes using computers and low-cost sensors to emable the automation of problem recognition, to run degradation mechanistic diagnostics and to suggest root cause solutions. This provides managerial personnel and maintenance staff a complete picture of what is actually happening, including fault degradation detection and prevention. The result is better knowledge of degradation rates and a more accurate estimate of the remaining life of equipment. The cornerstone of this maintenance initiative is predicting and planning which can eliminate system downtime and unnecessary maintenance.

persistence of savings, time period analysis and other indirect impacts of O&M measures. However, the most elusive factor to be addressed is risk.

In the context of O&M, risk may be defined as a managerial dislike to pay attention to complaints and to subsequently perform continuous improvement. Decision makers are prone to be reserved in tackling O&M issues compared to deciding on a new set of equipment or redundant additional components of the system. This could eventually be detrimental to the O&M cost saving initiatives as it could lead to tarnished image, outright liability claims and, to a certain instance, loss of productivity.

Decision makers should therefore be more proactive towards making improvements in information management, creating awareness about the benefits of O&M measures and improving the way O&M project savings are measured.

EFFECTIVE O&M

The hallmark of an effective O&M initiative is in its detailed record keeping and control.

Proof of equipment inventories, work orders, detailed cost accounting and logs of system operation, performance and failures need to be available. This makes it difficult to justify against the projected potential savings due to the rather high administrative cost.

Modern software provides an overview of the operating and maintenance history of each system and piece of equipment while predicting future requirements. A fine example of such software would be "Automated Diagnostics": it detects and diagnoses faults and performance degradation in systems and equipments. It not only triggers an alarm should equipment operate outside normal working standards, but also acts as an intelligent advisor on what has happened, what the root cause is and what forms of corrective actions need to be taken. These concepts can be ably applied to components such as motors, valves, heat exchangers, compressors, filters, generators, boilers and electrical equipment to provide automated, integrated degradation and fault diagnoses in real time. Exactly how much O&M savings may be realistically achieved depends largely upon the procedures and the availability of engineering O&M

documentation such as O&M manuals and training plans.

O&M COST CATEGORIES

Capital Costs

This results from obtaining and replacing facilities, including financing cost. Effective O&M practice can help reduce capital costs by prolonging equipment lifetime and ensuring regular and consistent orderly replacements. It may be compared to capital investments towards maintaining, upgrading and monitoring of HVAC systems (Heating, Ventilation and Air Conditioning). It raises productivity, provides effective performance, services and fulfils increasing demand. Proper funding is therefore absolutely necessary to ensure that appropriate steps are taken to improvise or modernize systems that will offer optimal O&M cost savings.

Operating Costs

This cost relates to utilities, supplies, wages and salaries of operating staff. Additionally, there is the continuous commissioning of individual entities related to the O&M operation and maintenance initiative until the end of its life cycle success. What is important is to ensure good operating practices which in turn serves to minimize maintenance requirements.

Maintenance Costs

These costs relate to preserving and prolonging the lifetime of a facility as well as maintaining its peak performance in terms of energy efficiency. In maintenance, O&M activities and cost is related to equipment capabilities, performance and operating cost. This means that although better and newer equipment may result in easier and lower maintenance costs, well-planned O&M activities can also significantly contribute to massive energy savings.

Current cost and future benefits are also closely interrelated. For example: in order to fulfill increasing demands using obsolete technologies or ageing equipment, one would need to increase staffing and manpower. Although there is no capital expenditure on new equipment, operating expense will rise to keep up with the demand and further maintenance on the overworked equipment. Neglecting to fund proper maintenance can also cause result in premature wear and tear or the total replacement of equipment. Maintenance funding thus requires careful planning to ensure that cost is minimised throughout the total life cycle.

Monitoring ensures that O&M activities are geared towards optimising operating conditions.

"Preventive maintenance can result in savings of between 12% to 18%."

Consequential Costs

These are the indirect costs of poor O&M policies. For example: neglecting to have a proper maintenance plan can cause the abrupt failure of a manufacturing facility. This will result in a plant shutdown which will in turn tarnish the image on the company and may even spark possible lawsuits due to unfulfilled contracts. Another example would be improved lighting or efficient HVAC systems which affects the productivity of workers.

Effective O&M initiatives need to consider (and eliminate) potential consequential loss such as probable defects and leakage. More importantly, O&M should identify risks such as equipment failure, expensive repairs, building shutdowns, safety and health issues, liability claims and litigation.

O&M BUDGETING

This is a (cost) planning process for identifying goals, specifying the resources required to achieve those goals and the cost associated with the resources. Budgeting compares actual expenditure costs to expected expenditure costs. Organisations usually establish budgeting for both operations and capital investment, and they usually vary in approach in terms of managerial commitment to budgeting. Some budgeting strategies include:

- Status quo – budget to repeat last year's actual costs or budget

- Adjusted status quo – modify last year's actual costs for anticipated changes
- Straight line trend – project each year to show as much change as the previous year
- Staffing – budget costs in proportion to the size of the authorized staff
- Programmatic – base each cost on planned program elements
- Zero basis budgeting – budget each period on its own merits, ignoring prior budgets

O&M budgeting is no different from budgeting in any other part of an organization. It is dictated by corporate management decisions, it tracks overall costs and performs relevant comparisons since it mirrors the practice for the whole organisation. However, the detailed cost pertaining to particular work in a certain department requires the special attention of the organisation. Again, the presence of capable O&M tracking software has made this easier since it is simple, competent, complete and relatively inexpensive. Ultimately, it becomes easier to predict O&M cost and to validate and verify savings.

CONCLUSION

O&M maintenance initiatives must be well planned, selected and executed, and corporate management needs to have the correct policy and mindset as it may reflect what the organization is practicing. For example: an organisation should limit managers' requests for O&M budgets and instead offer rewards or incentives for reducing O&M expense. This will make managers more cautious and result in better O&M planning.

O&M measures require continuous improvement and monitoring to ensure peak energy savings. Corporate management must be ready to admit that their current efforts to improve the operation and management of O&M processes may not be enough. Although the organisation may have spent a considerable amount of resources on improvement already, it is important that current management practices do not falter when faced with the challenge of justifying those practices to decision makers.

Table 2 defines all O&M measures and their applicable benefits. Monitoring is included since it can be used to reduce O&M costs and improve performance. Information from such monitoring can trigger warnings of degradation for conditions that requires special attention, especially if operating conditions fall out of the predefined limits of intended functions. Monitoring also ensures that O&M activities are geared towards optimising operating conditions and to check that equipment functions within its predefined scope during design, thus promoting energy efficiency.

Table 2: List of Common O&M Measures.

Measure	Capital Cost Savings	Operating Costs: Energy	Operating Costs: Labour	Operating Costs: Others	Maintenance Costs	Consequential Costs
Commissioning and Continuous Commissioning	✓	✓		✓	✓	✓
Improved process tracking and scheduling		✓		✓	✓	✓
Improved setpoints		✓		✓	✓	✓
Improved maintenance, general	✓	✓		✓	✓	✓
Improved preventive maintenance programme	✓	✓			✓	✓
Repairs	✓	✓		✓		✓
Predictive maintenance	✓	✓	✓	✓	✓	✓
Proactive maintenance	✓	✓	✓	✓	✓	✓
Monitoring and data logging		✓		✓	✓	✓
Training	✓	✓	✓	✓	✓	✓
Documentation			✓		✓	✓
Downsizing			✓	✓		✓
Outsourcing O&M			✓			✓

Extracted from "*Measuring and Verifying From Improvements in Operation and Maintenance of Energy-Consuming System in Commercial and Institutional Buildings*".

By: Hamdan Mokhtar (hamdan@sirim.my)
Biomass Energy Technology Programme

The rapid depletion of fossil fuel reserves as well as climate change has driven the Malaysian Government towards seeking renewable energy (RE) sources which are abundant, untapped and environmentally friendly. RE was introduced as the fifth source of energy when the Five-Fuel Diversification Policy replaced the four-fuel policy. The target was that RE would contribute 5% of the country's total energy mix by 2010 in the 8th Malaysia Plan (2001–2005).

The RE sources available in Malaysia are biomass, municipal solid waste, solar, hydro and wind. The progress of RE in Malaysia is rather slow and still in its infancy, with the current contribution to the nation's total energy mix at around 1%. The government continues to encourage and support the production of RE technology and generation of electricity from the RE resources. Many programmes to promote the RE have been successfully implemented such as ASEAN-EC Cogen 3, Biogen and the Malaysia Building Integrated Photovoltaic Project (MBIPV). The capital cost of the biomass cogeneration technology is still quite high and it's implementation within RE systems is on a small-scale basis of up to 10

Table 1: Estimated power that can be generated from biomass (2011-2050) through various RE technologies.

Year Ending	Cumulative Biomass (MW)	Cumulative Biogas (MW)	Cumulative Mini-Hydro (MW)	Cumulative Solar PV (MW)	Cumulative Solid Waste (MW)	Cumulative Total RE (MW)
2011	110	20	60	7	20	217
2015	330	100	290	55	200	975
2020	800	240	490	175	360	2,065
2025	1,190	350	490	399	380	2,809
2030	1,340	410	490	854	390	3,484
2035	1,340	410	490	1,677	400	4,317
2040	1,340	410	490	3,079	410	5,729
2045	1,340	410	490	5,374	420	8,034
2050	1,340	410	490	8,874	430	11,544

MW as stated in the guidelines of the Small Renewable Energy Programme (SREP)

A study conducted by Pusat Tenaga Malaysia concluded that 27 million tonnes of biomass and 65 cubic meter of palm oil mill effluent (POME) was generated in 2007. The pretreatment of biomass is an important process for it to be used in heat and power generation. Table 1 indicates the estimated power that can be generated from 2011-2050 through various RE technologies.

Biomass can also be used to produce bioethanol and blended with petrol for road vehicles. This technology, known as "second generation bioethanol", is still at the pilot plant stage. Palm oil mill effluent can also be used to produce biogas through the aerobic fermentation process. Many mills already capture this biogas for burning and in doing so, benefit from selling carbon credits through the Clean Develoment Mechanism (CDM). The government also introduced the B5 grade of biodiesel from crude palm oil to encourage its use in government vehicles.

The solar intensity in Malaysia is between 1400-1900 kWh/m^2 which shows potential for power generation and thermal energy. Solar photovoltaic (PV) panels are used to produce electricity and solar thermal collectors are used to produce thermal energy for drying agricultural produce. Three factories are under construction to produce solar panels in Malaysia already, and the technology is ready to be commercialised. Further R&D is required to reduce the installation costs of solar PV systems. The use of RE systems is also more viable if hybrid systems are introduced such as solar with wind energy and grid-connected solar PV projects.

SIRIM's Renewable Energy Research Centre was set up to carry out R&D activities in RE and to commercialise the technology. In developing the technology and human capital required to support it, SIRIM has signed several Memorandum of Understandings (MoU) with international organisations such as ARTER Technology (Russia) and Institute of Technology Bandung (Indonesia). Six projects have been approved by MOSTI in the areas of lignocellulosic bioethanol, biodiesel, solar photovoltaic thermal, wind and ocean. SIRIM is leading the way towards RE becoming a new source of economic growth of Malaysia.

For more information on SIRIM's Renewable Energy programmes, contact Dr. Ahmad Zainal Abidin, General Manager of the Renewable Energy Research Centre at ahmadz@sirim.my or call +6-03-5544 6038.

MALAYSIA'S FIRST BIOMASS POWER PLANT

Courtesy of TSH Resources Berhad.

The TSH Biomass Power Plant in Kunak, Sabah is the first grid-connected biomass power plant in Malaysia. It has a renewable energy purchase agreement (REPA) with Sabah Electricity Sdn Bhd to supply up to 10MW of green electricity for 21 years. The biomass power plant has a total capacity of 14 MWe and 33 tones per hour extracted low-pressure steam.

The TSH Biomass Power Plant is a co-generation plant that generates electricity and industrial steam from empty fruit bunches (EFB), shells and mesocarp fibre. The EC-ASEAN COGEN 3 programme awarded the venture FSDP status (Full Scale Demonstration Project) and a grant of approximately RM2 million. COGEN 3 is a programme that promotes co-generation and facilitate the use of proven, clean and efficient biomass and other technologies. An FSDP-status project is the implementation of proven technology on a full scale basis in order to demonstrate its technical reliability, economic viability, and environmental friendliness.) SIRIM represented the Bangkok-based ASEAN COGEN 3 programme in monitoring the plant's performance after full-scale commissioning.

The TSH Biomass Power Plant qualifies as a Clean Development Mechanism (CDM) project under Kyoto Protocol, and was in fact the first project in the country to be validated as a CDM project. The validation entitles the biomass power plant to Certificates of Emission Reduction (CER), more commonly referred to as carbon credits.

HERE COMES THE SUN

How the MS 1837 standard is helping to support the Malaysian solar photovoltaic systems industry.

Solar photovoltaic (PV) systems are today's primary renewable energy option, especially after the launching of the National Green Technology Policy on 24th July 2009 by the Prime Minister of Malaysia. Unlike other forms of renewable energy such as biomass or biogas, PV systems are the only form of renewable energy that is suited for installation on residential premises and buildings. With PV systems, individuals can contribute towards a greener environment by generating their own clean electricity.

The main advantages and benefits of solar PV systems are that they generate electricity close to the point of consumption thus minimizing energy loss through transmission and distribution networks. In addition to producing electricity *in situ*, the electricity generated is also clean and renewable. The current grid-connected solar PV capacity in Malaysia is only 2MWp, mainly installed under the Malaysia Building Integrated Photovoltaic Project (MBIPV), an initiative funded by the Government of Malaysia with funds disbursed through the United Nations Development Programme (UNDP). Under this project, incentives in the form of discounts are given to interested parties including individuals. Other fiscal incentives offered by the Government include exemptions from import and sales tax on the PV modules and inverters which are the main cost components of PV systems.

Today, there are more than 80 grid-connected solar PV systems installed on residential, commercial and industrial premises in Malaysia, ranging from 3kWp to 100 kWp. The performance of these systems is monitored by the PV Monitoring Centre (PVMC) managed by UiTM Shah Alam. Being close to the equator, Malaysia is blessed with year-round sunshine and solar PV has tremendous potential. In fact, solar PV has started gaining popularity in Malaysia and more independent systems are expected to be seen in the near future.

Currently, the electricity generated from grid-connected PV systems is sold to the local utility (TNB) via a 'net-metering' mechanism, or at the same rate that electricity is purchased from TNB. However, the Renewable Energy Act (under development) will propose to replace the 'net-metering' arrangement with a "Feed-in-Tariff (FiT)" mechanism for all forms of renewable energy (subject to the the Cabinet's approval). Such a scheme could accelerate the installation of more solar PV systems locally.

Emphasis is given to ensure that the solar PV systems installed are of good quality in terms of products and installations. This is made possible by the development of the Malaysian Standard **MS1837:2005** – Installation of Grid-Connected Photovoltaic (PV) Systems. The standard has been made mandatory for all grid-connected solar PV systems whereby PV systems are required to comply to the standard before they are approved and interconnected to the national utility (TNB) network.

The **MS1837** has been included in the grid-connected solar PV training manual which is accredited by the Institute for Sustainable Power Quality (ISPQ), a joint collaboration between the MBIPV Project and PVMC at UiTM Shah Alam. Its requirements are therefore made known to local PV Service Providers to make them aware of the importance of complying with the Standard. Among others, all main PV components must comply with the International Standards outlined according to the ratings of the electrical components and the protection requirements specified. Since grid-connected PV systems are quite new in Malaysia, the MS1837 Standard will help local PV Service Providers in guiding and enhancing the quality of system installations.

Four years has passed since the inception of the **MS1837** Standard, and it is timely that it is now being revised and upgraded to take into accounts the lessons learned in previous installations through the MBIPV projects. International practices and relevant standards are being referred to, including feedback received by local PV service providers. Other relevant Standards will also be incorporated into the revised Malaysian Standard. The revision is under development by the SIRIM Working Group on Solar Photovoltaic Systems, the body appointed by the Department of Standards Malaysia.

The revised Standard is expected to be launched in the second half of 2010.

MALAYSIA STANDARDS RELATED TO SOLAR PHOTOVOLTAIC ENERGY SYSTEMS

MS 62257-1:2009

Recommendations for small renewable energy and hybrid systems for rural electrification - Part 1: General introduction to rural electrification.

Rural electrification is one of the predominant policy actions designed to increase the well being of rural populations.

MS 62257-2:2009

Recommendations for small renewable energy and hybrid systems for rural electrification - Part 2: From requirements to a range of electrification systems.

Proposes a methodological approach for setting up and carrying out socio-economic studies as part of the framework.

MS 62257-3:2009

Recommendations for small renewable energy and hybrid systems for rural electrification - Part 3: Project development and management.

Provides information on the contractual responsibilities involved in the implementation of rural power systems.

MS 62257-4:2009

Recommendations for small renewable energy and hybrid systems for rural electrification - Part 4: System selection and design.

Provides a method for describing the results to be achieved by the electrification system independently of the technical solutions that could be implemented.

MS 62257-5:2009

Recommendations for small renewable energy and hybrid systems for rural electrification - Part 5: Protection against electrical hazards.

Gives the general requirements for the protection of persons and equipment against electrical hazards to be applied in decentralised rural electrification systems.

MS 62257-6:2009

Recommendations for small renewable energy and hybrid systems for rural electrification - Part 6: Acceptance, operation, maintenance and replacement.

Describes the various rules to be applied for acceptance, operation, maintenance and replacement (AOMR) of rural electrification system which are designed to supply electric power for sites which are not connected to a large interconnected system.

MS IEC 62124:2009

Photovoltaic (PV) stand-alone systems - Design verification.

The specifications, test methods and procedures included in this document cover stand-alone photovoltaic (PV) systems.

MS IEC 61194:2009

Characteristic parameters of stand-alone photovoltaic (PV) systems

Gives the major electrical, mechanical and environmental parameters for the description and performance analysis of stand-alone photovoltaic systems.

MS IEC 60364-7-712:2007

Electrical installations of buildings - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems.

Applies to electrical installations of PV power supply systems including systems with AC modules.

MS IEC 61215:2006

Crystalline silicon terrestrial photovoltaic (PV) modules - Design qualification and type approval.

Lays down the requirements for design qualification and type approval of terrestrial photovoltaic modules suitable for long-term operation in general open-air climates as defined in MS 1750 (IEC 60721-2-1). Only applies to crystalline silicon types.

MS IEC 61646:2007

Thin-film terrestrial photovoltaic (PV) modules - Design qualification and type approval.

Lays down the requirements for design qualification and type approval of terrestrial thin-film photovoltaic modules suitable for long-term operation in moderate open-air climates. Under revision by the WG on Solar Photovoltaic Systems.

MS 1837:2005

Installation of Grid-Connected Photovoltaic (PV) Systems.

Sets out the general installation requirements for grid-connected photovoltaic (PV) arrays with DC open circuit voltages of up to 1,000 V between positive and negative conductors or up to 1,000 V with respect to earth. Under revision by the WG on Solar Photovoltaic Systems.

The above standards are available from SIRIM. For more information, please contact:
Maziah Mukhtar
Head, Standards Promotion and Sales Section
Tel: +6-03- 5544 6359 Email: maziah@sirim.my

ISO 50001:
GETTING READY FOR THE BOOM

Energy management has been identified as one of the top five areas requiring an International Standard by the International Organisation for Standardization (ISO). In February 2008, the Technical Management Board of the ISO approved the establishment of a new project committee (ISO/PC 242 – Energy Management) to develop the new ISO Management System Standard for Energy, namely ISO 50001.

The ISO 50001 standard will enable organisations to establish the systems and processes necessary to improve energy efficiency, use, consumption and intensity. It specifies the requirements of an energy management system (EnMS) for an organisation to develop and implement an energy policy, establish objectives, targets and action plans which take into account legal requirements and information pertaining to significant energy use. An energy management system enables an organisation to achieve its policy commitments, take action as needed to improve its energy performance and demonstrate the conformity of its system to the requirements of this standard. This standard can be further be tailored to fit the requirements of the organisation including the complexity of the system, the degree of documentation and resources.

The ISO 50001 standard is based on the Plan-Do-Check-Act continual improvement framework and incorporates energy management into everyday organisational practices. It will provide organisations with a recognised framework for integrating energy efficiency into their management practices. It is being developed through the consensus process of the International Standard, which involves 40 participating countries including Malaysia as well as the United Nations Industrial Development Organization (UNIDO), which has liaison status.

The first meeting of ISO/PC 242 was held in Arlington Vancouver, USA in September 2008. Excellent progress was made in the technical discussions, and a first working draft was circulated for comment. A major point of discussion was the need to ensure compatibility with the existing suite of ISO management system standards. The second meeting of ISO/PC 242 took place in Rio de Janeiro, Brazil in March 2009. At this meeting, discussion delved more into the substance of what will make ISO 50001 unique. The meeting agreed to the circulation of the committee draft ISO/CD 50001 for vote and comment.

The third meeting of ISO/PC 242 was held in London, England in November 2009. The meeting was attended by more than 90 delegates from 22 countries. The Malaysian delegation comprised of two representatives namely Associate Professor Dr Robiah Yunus of UPM (Head of Delegation) and Ms Azlina Abd Latif of SIRIM Berhad. This was the first Malaysian participation in an ISO/PC 242 meeting. The meeting discussed comments received on ISO/CD 50001. The resolution of the meeting was to progress the document to Draft International Standard (DIS).

The DIS ballot has been circulated to National Member Bodies and will close in August 2010. The result of the DIS voting will be discussed at the fourth meeting of ISO/PC 242, scheduled for October 2010 in China.

In response to the development of ISO 50001, Malaysia has established its own Technical Committee on Energy Management, which also acts as the National Mirror Committee (NMC) to the ISO/PC 242. The NMC is currently chaired by Ir Francis Xavier of the Energy Commission. Members of the NMC include experts from various industry associations, business interest groups and government agencies including SIRIM Berhad. The new standard is expected to lead to reductions in energy cost, greenhouse gas emissions and other environmental damage.

The new ISO 50001 is targeted to be published in early 2011.

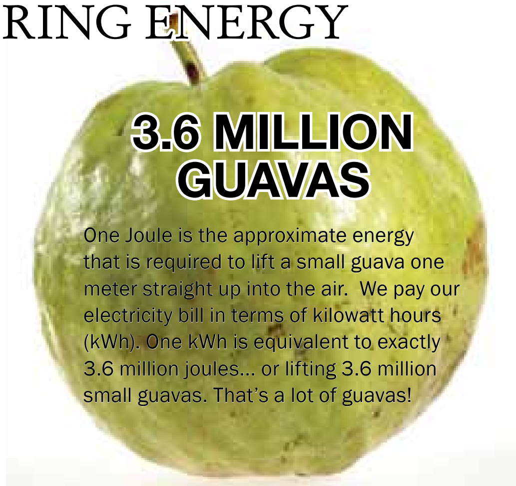
For more information on the ISO 50001 Energy Management Systems standard, contact Maziah Mukhtar, Head of the Standards Promotion and Sales Section at maziah@sirim.my or call +6-03-5544 6359.

DO YOU KNOW...?

ALL ABOUT MEASURING ENERGY

Humans rely on food for energy in the same way that manufacturing and transportation industries rely on fuel to support their economic activities. The intensive use of energy worldwide has raised some difficult questions about efficiency, dependency, security, waste, storage and price.

Recent experience with high oil prices and climate change concerns has spurred renewable energy legislation, incentives and commercialisation. Renewable energy is a naturally replenished energy generated from natural resources such as sunlight, wind, rain, ocean tides, rivers and geothermal heat. In addition to traditional renewable resources such as biomass and hydroelectricity, new renewable resources are mini-hydros, modern biomass, wind, solar, geothermal, and biofuels.

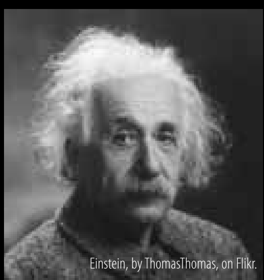


3.6 MILLION GUAVAS

One Joule is the approximate energy that is required to lift a small guava one meter straight up into the air. We pay our electricity bill in terms of kilowatt hours (kWh). One kWh is equivalent to exactly 3.6 million joules... or lifting 3.6 million small guavas. That's a lot of guavas!

THE ULTIMATE ENERGY SOURCE

The best known equation in all of science is $E = mc^2$, where E is energy, m is mass and c is the speed of light. Predicted by Albert Einstein, this formula highlights the equivalence and the interconvertability of mass and energy. In 2005, this equation was verified to an accuracy of 0.4 parts per million.



Einstein, by ThomasThomas, on Flikr.

Albert Einstein

In the SI System, the value of the speed of light (c) in vacuum is 299,792,458 m/s with no uncertainty. Using Einstein's equation, we can derive the approximate energy per kilogram of matter as 9.0×10^{16} joules per kilogram.

Thus, one gram of mass is approximately equivalent to the following amounts of energy:

- 25 million kilowatt-hours; or
- 22 billion kilocalories; or
- 85 billion BTUs.

HOW IS ENERGY MEASURED?

The unit for measuring energy in the International System of Units (SI) is joule (J). It is named after James Prescott Joule, famous for the First Law of Thermodynamics, and can be expressed as follows:

$$1\,\mathrm{J} = 1\,\mathrm{N} \bullet \mathrm{m} = \frac{\mathrm{kg} \bullet \mathrm{m}^2}{\mathrm{s}^2} = 1\,\mathrm{W} \bullet \mathrm{s}$$

The above relationship can be interpreted as follows:

- Joule is not an independent unit of measurement, but a derived unit of measurement
- The precise measurement of Joule will depend on the known values of mass (kg), distance (m) and time interval (s)
- Uncertainties in the known values of mass, distance and time interval will make the Joule measurement uncertain
- Joule is the energy exerted by the force of one Newton (N) acting to move an object through a distance of one meter.
- Joule is the work required to continuously produce one watt (W) of power for one second

There are other units of energy such as the calorie (1 calorie = 4.2 J) and the British Thermal Unit, BTU (1 BTU = 1.055 kJ). Progress in science and technology has made it possible to construct electrical energy standards that can achieve accuracy in parts per million. Energy measuring instruments are required to be calibrated at appropriate intervals to ensure their accuracy.

Accurate energy measurement is required because:

- **Economic reasons**: The high cost of fuel demands the installation of highly accurate metering systems, especially in countries that import fuel
- **Buyer-seller agreements**: Buyers would like to pay for the exact amount of energy used and the seller would like to know exactly how much energy has been delivered.
- **Consumer protection**: Consumers would like to get the amount of energy that they have paid for. This is the reason why energy meters for households require pattern approvals by the authorities.

The National Metrology Laboratory (NML) provides critical measurement and electrical calibration services to all industries covering requirements such as voltage, current, magnetics, photometry, vibration, impendance, power, energy and acoustics.

CERTIFICATIONS AND UPDATES ON MALAYSIAN AND INTERNATIONAL STANDARDS

UPDATES ON SIRIM QAS INTERNATIONAL CERTIFICATION

PLEASE REFER TO THESE WEBSITES FOR CURRENT INFORMATION
ON PRODUCT AND MANAGEMENT SYSTEM CERTIFICATIONS.

www.malaysiancertified.com.my
www.sirim-qas.com.my

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Phone: +603 5544 6809 / 6822

E-mail: azlinad@sirim.my *or* shuana@sirim.my

UPDATES ON MALAYSIAN STANDARDS (MS)

THESE WEBSITES CONTAIN UP-TO-DATE INFORMATION ON MALAYSIAN STANDARDS (MS)

MS Development Structure:
http://smsonline.sirim.my/FPublic.jsp
http://www.sirim.my/std_dev/msstructure_files/msstructure.htm

Recently Approved MS:
http://www.sirim.my/std_dev/msapproved/latest_approved.htm
http://www.sirim.my/services.asp

MS Development Process:
http://www.sirim.my/std_dev/msflow/processflow.htm

Drafts of MS for Public Comment:
http://www.sirim.my/std_dev/h4_01.htm

Industry Standards Committee (ISC) Websites:
http://smsonline.sirim.my/FPublic.jsp

MS Online:
http://www.msonline.gov.my

THE ABOVE INFORMATION IS ALSO AVAILABLE AT THE FOLLOWING URL:

http://www.sirim.my/std_dev/stdpage.htm

OR FROM:

Department of Standards Malaysia (STANDARDS MALAYSIA) Tel: +603 8318 0002

SIRIM Berhad Tel: +603 5544 6102

UPDATES ON INTERNATIONAL STANDARDS

FOR UPDATES ON INTERNATIONAL STANDARDS, PLEASE REFER TO:

http://www.iso.org
http://www.iec.ch