DEVELOPMENTS IN NON-CONVENTIONAL ENERGY TECHNOLOGIES IN ASEAN COUNTRIES

Krissanapong Kirtikara
School of Energy & Materials,King Mongkut's Institute of Technology Thonburi
P.O. Box 51, Ratburana, Bangkok 10140, Thailand and
Chairman, ASEAN Sub Committee on Non-Conventional Energy Research

ABSTRACT

This paper provides a brief overview of the energy situation in ASEAN, demonstrating the role played by non-conventional sources. A number of non-conventional energy technologies are reviewed in detail to show how they are being developed in individual member countries. Also acknowledged are global developments in non-conventional energy technologies and their interaction with developments of these technologies in ASEAN.

ASEAN ENERGY SITUATION

ASEAN (Association of South East Asian Nations) is a regional grouping comprising Brunei, Indonesia, Malaysia, Philippines, Singapore and Thailand. While the majority of ASEAN's population are engaged in agriculture, the last five years has seen rapid industrialization and considerable economic growth. At the moment, ASEAN is a net energy exporter, however, by the next century probably PNG will be the only oil exporter remaining in our wider region. ASEAN does not, as yet, use nuclear energy for power generation.

Charts in the attachment show the actual and forecast primary energy demand in ASEAN. The indications are that more, and a wider variety of, fossil fuels will be used to maintain the current momentum of industrialization. Given that most of the machinery and equipment needed for industry is imported; given that the predictions indicate an increase by ASEAN in the use of coal, and given that ASEAN is likely to become a major trading group in the next decade, it is probably important for both Australia and New Zealand that ASEAN's economic growth be maintained.

ASEAN was slow to respond to the 1973 oil crisis and it was not until the 1980s that greater diversification of fuel sources was seen. This might indicate ASEAN's weakness at the time, lacking both the infrastructure and experience to develop alternative sources of energy on any large scale. Oil substitution remains the major energy policy issue for ASEAN, despite the relatively low oil prices that have prevailed since 1986.

The use of fossil fuels in ASEAN are mainly for electricity production to fuel industry and for transportation - both of which are interrelated; industry growth requires an increase in transportation. While electricity generation is diversifying away from oil, the demands from industry are overwhelming. Indications are that there is insufficient international finance available over the next decade to build the power stations that will be required to maintain ASEAN's industrial growth into the next century. While the trends in developed countries emphasise enhanced energy management (with even nil growth predicted for power stations in the USA), ASEAN is again struggling with inexperience and lack of infrastructure to follow this lead. In addition, the world's major financial institutions, even if they had sufficient resources, are reconsidering the environmental implications of major power projects [1]

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[1]Invited paper presented at Solar'92 Conference "Under one Sun", Australian and New Zealand Solar Energy Society Conference, 15-18 July 1992, Darwin, Australia.

based on fossil fuels. What little rivers remain untapped for hydro are economically marginal and would have minimal influence on current demands.

Despite this industrial growth, vast areas of the Philippines, Indonesia, Thailand and to a lesser extent Malaysia, remain undeveloped. Agricultural rural - based populations vary between 60 - 75% for these particular countries and much of this sector remains at the subsistence or marginal level. The nature of this sector also means that a large proportion of the population is remote (from the grid) and still rely heavily on traditional fuels. To illustrate the size of this problem, ASEAN has over 10,000 inhabited islands and a collective population over 260 million.

The importance of traditional or non-commercial fuels in ASEAN cannot be underestimated. While studies are being intensified to determine more accurately the extent of non-conventional or traditional sources and the socio-economic factors influencing their adoption, statistics remain sketchy and unreliable. Nonetheless, it has been estimated that traditional fuels accounted for as much as 38.6% of total energy consumption in 1985 (down from 53.7% in 1970). In some developing countries of the world figures quoted are as high as 90%. What is clear, is that these fuels (mainly fuelwood and charcoal) represent a significant slice of total energy consumed and, what is even more obvious, is that the forests that supported most of this consumption are gone.

ASEAN's rural population is shrinking, mainly due to industrialization. In theory, this should slow encroachment on upland (i.e. potential forest/watershed) areas and the remaining population might be supported by village or household woodlots, or by eventual connection to the grid. However, all of this is a two-edged sword. Industrialization means greater urbanization with the shift of the rural population to factory employment. Urban populations rely heavily on commercial energy (LPG, electricity, kerosene) for household use and increases in the urban population also mean greater demands for transport-both of which are sourced from fossil fuels. For the remaining rural population (still likely to be at least 50% for the foreseeable future), increases to their economic well-being also bring about a switch from traditional fuels to commercial fuels, again fossil fuel based.

Large-scale adoption of non-conventional energy will depend on international developments in technology, international responses to global warming, and world fossil fuel prices and resources. Essentially, this is out of ASEAN's hands and it's effects, although more than welcome, are likely to have greater influence in the industrial and urban commercial sectors. With this in mind, ASEAN needs to pursue a synergy between industrial development and energy choice.

For ASEAN, the greatest potential from non-conventional energy technologies are fuel substitution and environmental benefits in the rural sector. It is here that non-conventional technologies can intervene in the switch from traditional to commercial fuels, and it is here at this small-scale level that ASEAN has the experience and technological capability.

NON-CONVENTIONAL ENERGY

Choice of terminology perhaps best illustrates the complexity and contrasts between the various non-conventional energy sources. For the purpose of this discussion, non-conventional energy refers to energy not derived from fossil sources and it includes direct-use geothermal as well as energy conservation and management. Still, nothing is perfect---having just described the significance of traditional fuels in ASEAN, charcoal might be non-conventional in Australia whereas it is very much conventional to a lot of people in ASEAN.

Without going too much into semantics, it is arguable that the world's natural forest resources can ever be renewed; energy from the sun and biomass use have been with us for a sufficient number of centuries now to shed their tag of 'new' ; while 'alternatives' implies that this form of energy is a small player in the field with fossil fuels and nuclear energy. Dr Grubb from the Royal Institute of International Affairs in London describes them as the "Cinderella Options" (see references). Since it should be obvious who the ugly sisters are, what we apparently still lack is a fairy godmother or a prince charming.

BRIEF COUNTRY ANALYSIS

Brunei

Brunei Darusalam, with a population of around 300,000 has considerable oil and natural gas resources and one of the highest per capita incomes in the world. It is estimated that petroleum products account for some 95% of export earnings.

As Brunei's oil resources are expected to be depleted by 2010, the government has been introducing austerity measures and making attempts to diversify the economy, including investment in Australia. Brunei is a regular member of the ASEAN Sub Committee on Non-Conventional Energy Research and takes an active interest in energy conservation, particularly in commercial buildings and industry. It is anticipated that Brunei will show greater interest in non-conventional energy technology development once its fledgling university other tertiary institutes are developed.

While part of Brunei's development plans include small to medium-scale industry, the OECD expects the country's primary energy consumption to decline by 2000.

Indonesia

Indonesia, with a population of 185 million (1989) has also earned considerable revenue from the export of fossil fuels and is the world's largest exporter of LNG. However, as these decline, Indonesia has shown some success in diversifying to other sources of income.

Indonesia's development plan for 1984-88 (Pelita IV) was designed to reduce reliance on oil by diversifying to coal, hydro, geothermal and natural gas. While the country has consumed less than the overall totals projected, oil requirements have increased beyond the anticipated amounts. Pelita V should see even greater diversification, particularly to natural gas.

Malaysia

Malaysia has enjoyed rapid economic growth, particularly on the peninsula where most of the country's 17.8 million population reside. Malaysia is also well endowed with energy resources including natural gas, oil and coal.

Malaysia's fifth Development Plan (1986-90) incorporated a Four Fuel Strategy program (Oil, Gas, Coal & Hydro) and gave emphasis to greater efficiency in use as well as energy conservation.

While overall consumption of oil products increased between 1986 and 1990, the diversification strategy has clearly been successfull in percentage terms, with oil consumption in the electricity sector being reduced from 66.5% to 42.1% over the period. Diversification was mainly to natural gas, while coal was introduced as a source in 1988.

It is expected that Malaysia 's oil reserves will be depleted by the year 2000, while non-associated gas is expected to last for a further century. Thus the Sixth Malaysia Plan (1991-1995) proposes that oil consumption by the electricity sector will be reduced to 5.5% while natural gas will take up 75%.

Phillippines

With an official population of 65 million in 1989, the Philippines is ASEAN's second largest member after Indonesia. In the post-Marcos era the country has been striving to attain a more sound economic footing. While industry has enjoyed a consumption-led recovery, the need to service the country's foreign debt continues to weigh down the economy.

Continued industrial growth is hampered by the need to overhaul the country's ailing electricity supply system, which is highly dependent on imported fossil fuels. While the Philippines has good geothermal and some hydro and dendrothermal potential, the geographical nature of this predominantly island nation, together with high transmission costs, makes for difficulty in supplying industry. Metro Manila is currently experiencing regular power failures which may be indicative of the need for major reinvestment in the power sector.

Faced with this position, the Philippines is trying to diversify power sources to the greatest extent possible and much effort has been invested in alternative sources of energy.

Thailand

Despite some periods of political instability, Thailand with a population touching on 60 million, continues to enjoy strong economic growth. While not as well-endowed as some other ASEAN members in energy resources, Thailand continues to reach for a balance between reducing imports/ oil dependence, while continuing economic momentum.

The Fifth National Social & Economic Development Plan (1982-86) set the goal of limiting the increase in total energy use to 4.8% per year and reducing oil consumption to 46% of total energy use by 1986. This was to be accomplished by substituting internal sources of energy.

The Sixth Plan saw much the same policies but with greater emphasis on private sector participation. In practice, relatively low oil prices and the need to fuel industrial growth made the targets set during the Fifth Plan unrealistic. The priority for Thailand remains growth as more industries consume greater amounts of fossil fuels, either directly or through electricity. Energy consumption in 1989 increased by 15.9%. Within this figure, consumption of petroleum products increased by 17.7% and natural gas by 90.1%.

Thailand includes so-called renewable energy in its overall consumption figures. In

1989, renewables were claimed to take-up 28.5% of total consumption. However, this paper has already expressed some doubts about the reliability of statistics for traditional fuels and Thailand's "renewables" are claimed to be Fuelwood (37%) Charcoal (27%) Rice Husk (11%) and Bagasse (25%). With a declining agricultural sector and depleted natural forests, it is debatable whether or not these fuel sources can be renewed.

Legislation has recently been passed which will give a considerable boost to energy conservation and environment-related activities through government allocation of funds as incentives to both the private and public sectors. The Seventh National Social and Economic Development Plan gives renewed priority to oil substitution and a much stronger emphasis to abating the environmental consequences of fossil fuel combustion.

REGIONAL ACTIVITIES IN NON - CONVENTIONAL ENERGY

The ASEAN Sub Committee on Non-Conventional Energy Research (ASEAN-SCNCER) is a project management and implementation group under the ASEAN Committee on Science and Technology (ASEAN-COST). The SCNCER is comprised of government officials and academics responsible for non-conventional energy activities in their respective countries.

Since there are many similarities between ASEAN member countries in terms of climate, biomass resources, urban buildings and industrialization, as well as the desire for oil substitution, it was felt that regional cooperation in research and development on non-conventional energy would produce a more effective utilization of human resources and lead to a greater exchange of ideas and experiences.

Towards these objectives, the role of cooperating partners such as Australia has been critical to their achievement. Since its establishment over 12 years ago, the SCNCER has had cooperative programs with the US, Australia, Canada, New Zealand and to a lesser extent, Japan and UN agencies.

Since its inception, the SCNCER has given solar research, and particularly development and demonstration, a high priority (see Table 1). In the knowledge that Australia has particular expertise in solar energy, much of which is very relative to the needs of ASEAN, the SCNCER placed high priority on solar research collaboration with Australia. Unfortunately, but perhaps understandably, AIDAB preferred to give priority to coal;which of course meant that a research group on non-conventional energy would have to make a few adjustments. Nonetheless, Phase I of the program with Australia was regarded by all parties involved as being successful and both ASEAN and Australia set about designing a Phase II. For the solar component, the services of Professor Charters were called upon and many long hours were spent fine-tuning project proposals until we all felt that some good activities for collaboration with Australia on solar energy were in the making. Sadly this was not to be. Due to budget cuts, AIDAB decided to drop the solar component in favour of energy conservation and fluidised bed combustion technologies. This is perhaps even more regrettable since Melbourne University has recently formed an International Development Technologies Unit, which is demonstrating interest in areas such as solar drying. This Unit would have been given a considerable boost through a collaborative program with ASEAN which no doubt would have opened the door to many other exchanges and contacts in the solar field.

The SCNCER has since developed a program on solar drying with Canada. Even though it is now only in the early stages of implementation, it is already evident that Canada sees a market for solar technology and equipment in the ASEAN region. The University of Waterloo for example, has indicated that it is willing to open its solar testing facilities to ASEAN, free of charge, including return shipping.

Despite difficulties in developing cooperation with Australia on solar energy, ASEAN would like to leave a clear message that the door remains open and that the SCNCER would like to work with Australia in this field, by whatever means we can jointly come up with.

Table 1. ASEAN-SCNCER Priorities for Research and Development.

FIELD	FIRST DECADE	SECOND DECADE
Energy conservation	High	High
Solar refrigeration & airconditioning	High	High
Solar electric power generation	High	High
Bioenergy conversion	High	High
Coal gasification & liquefaction	High	-
Wind energy	High	Low
Micro Hydro energy	High	Low
Solar drying	High	High
Solar pumping	High	High
Geothermal energy (direct use)	High	High
Energy inventory & assessment	High	-
Solar hybrid systems	-	High
Solar water heating & testing	-	High
Clean coal technology	-	High
Energy & environment	-	High
Transport fuels	High	High
Cogeneration	-	High

In addition to the activities of the SCNCER, the World Bank has identified 26 financing schemes for renewable energy in ASEAN involving US$ 805 million. Some 64% of this is intended for the rural sector. Of the projects selected, it is interesting to note the different emphases given by the various countries, as shown in percentage terms in the following table.

Table 2. Priorities Given to World Bank Renewable Energy Schemes.

TECHNOLOGY	INDONESIA	MALAYSIA	PHILIPPINES	THAILAND
Solar water heating	91.0	99.0	0.1	
Solar photovoltaics	6.4		94.9	
Charcoal production		1.0		93.0
Rice husk gasifier				7.0
Rice hull dryer			2.0	
Biomass cogeneration			1.6	
Ferrocement charcoal gasifier	2.6			
Microhydro			0.9	
Biogas digester			0.5	

Solar is clearly a priority. In Indonesia, the scheme hopes to sell almost 64,000 water heaters and estimates the current market for PV systems to be 300,000 units, though no size or power output is given. In the Philippines, it is planned to retail over 100 water heaters while the market for rural enterprise PV systems is estimated to be 1,000 units, small domestic PV systems 520,000 units, and battery charging systems at 1,300 units, again the wattage not being specified.

At this stage it is unclear whether this scheme will go ahead and whether or not it would be implemented through the private or government sectors. Should it come into being, the commercial market for non-conventional energy technologies would clearly benefit.

Finally, the Asian Institute of Technology (AIT) based in Bangkok is an engineering school serving the winder region. AIT has good programs in energy conservation and renewable energy and has a well established energy park. AIT also conducts short courses on solar refrigeration repair and maintenance on behalf of the World Health Organisation.

BIOMASS

Indonesia, Malaysia and Thailand

Biomass uses in these three countries are mainly confined to rural domestic cooking and village-scale industries (such as brick and lime making, tobacco curing). Efficient charcoal stoves and improved charcoal production techniques have been disseminated to local entrepreneurs. There has been active trade in industrially-produced charcoal between Malaysia and Thailand.

Considerable effort on biomass gasification is also pursued by these countries and the FAO. In the second half of the 1980's there was an attempt to introduce qasifier - driven electrical generators into rural Thailand without significant success.

Rice husks and bagasse are used, somewhat inefficiently, to generate steam and electricity for rice milling and the sugar industry. A recent interesting development is on increasing awareness of cogeneration potential from agricultural and wood industry-based residues-and the possibility of selling surplus electricity back to the grid. In 1991, legislation was passed in Thailand enabling the government utility to purchase privately-generated electricity; it is estimated that the potential electricity that can be generated by cogeneration is close to ten percent.

All three countries are actively engaged in RD&D on fluidised bed combustion of biomass and low-grade coal. Industrial scale FBC combustors based on Australian technology are being demonstrated. EC technology is also currently being sourced.

There are few large demonstration projects on biogas production integrated with livestock production and agro-industry. Unless strict enforcement on pollution control and some financial incentives are in place, no widespread adoption of such technology is envisaged in these countries.

In the late 1980's turn-key industrial biogas technology from Europe was introduced for treatment of wastes from twelve alcohol distilleries in Thailand. Severe technical difficulties have been encountered in all biogas units; none are yet fully operational.

Philippines

The Philippines is perhaps potentially the best endowed of all ASEAN members in terms of biomass resources having already commenced development of dendrothermal and having extensive agricultural wastes such as coconut shells, bagasse and molasses, rice husks and cassava fibre. Efforts are now underway under the ASEAN-EC COGEN Program to document the extent of these resources and to establish full-scale demonstration plants to use biomass resources for cogeneration.

In addition to establishing a number of dendrothermal power plants the Philippines has been active in RD&D in this area. Given the country's large sugar crop, R&D has also focussed on alcohol production and use in the transport sector, with economic results similar to Brazil and Australia. Research is also conducted on biogas, direct use of biomass, gasification and charcoal production. These programs have received bilateral support from the US,New Zealand, Finland, Japan, Italy and Germany. Maya Farms in the Philippines is often presented as a good example of commercial scale biogas production integrated with agro-industry and attempts are being made to replicate this technology, mostly for piggeries.

Under the ASEAN-Australia Energy Project, the Philippines has been active in RD&D on biomass production integrated with agro-industry.

Singapore

Up until the mid-1980s, Singapore produced small a amount of biogas from piggery wastes however, since then Singapore has invested in pig farms overseas and no longer runs piggeries on the island. The Ministry of Environment has been making use of biogas produced from its waste treatment plants, although the quanitity is apparently small and the plants still require supplementary electricity. Some electricity is also generated from municipal waste incineration.

Research on biomass as an energy source does not receive high priority in Singapore as it obviously has limited resources.

Potential of Cogeneration from Biomass

What has been regarded for centuries in Asia as being wastes are considered in Europe and other developed regions as precious fuel resources. Realising the enormous potential of agricultural and agro-related industry residues, the ASEAN-SCNCER has developed a cooperative program with the EC to better tap these resources.

In addition to supporting RD&D and biomass assessment, the ASEAN-EC COGEN Program aims to bring together the private sectors of both Europe and ASEAN to promote cogeneration. Focussing on European technology, the Program will establish a number of Full-Scale Demonstration Plants in the region, while at the same time acting as an introductory service for commercial ventures. The scale and initial success of this Program can be seen from the following table.

Table 3. Identified and Potential Cogeneration Projects in the ASEAN Region.

BIOMASS SOURCE	TECHNOLOGY TYPE	EQUIPMENT CAPACITY	EC COUNTRY	END-USER SECTOR	ASEAN COUNTRY	REPLICABILITY SECTOR	COUNTRY	ASEAN PARTNER COUNTRY
IDENTIFIED PROJECTS								
WOOD WASTE	BOILER POWER GENERATION	2.5 MW	BE	TIMBER INDUSTRIES	MA	WOOD INDUSTRY	IN,MA PH,TH,BR	MA
WOOD WASTE	BOILER	1.8 MW	DK	TIMBER INDUSTRY	MA	WOOD INDUSTRY	IN,PH, MA,TH,BR	IN
RICE HUSK	BOILER COGENERATION	1.5 MW	BE	RICE MILL	MA	RICE MILL	MA,IN PH,TH	MA
RICE HUSK	BOILER	1 MW	IT	RICE MILL	MA	RICE MILL	IN,PH, MA,TH	MA
BAGASSE	DRYING	10 t/h	GE	SUGAR MILL	TH	SUGAR MILL	PH	TH
WOOD WASTE	SUPER HEATED WATER BOILER	8,360 MJ/h	BE	WOOD INDUSTRY	TH	WOOD INDUSTRY	IN,PH MA,TH	TH
WOOD & AGRO RESIDUES	GASIFIER	10-100 kVA	IT	WOOD & AGRO INDUSTRIES	PH	WOOD & AGRO INDUSTRIES	IN,PH,MA TH,SI,BR	PH
POTENTIAL PROJECTS								
COCONUT	BOILER	2 MW	BE	COCONUT MILL	IN	COCONUT INDUSTRY	PH,IN	
FIBRE AND SHELL	AUTOMATION AND CONTROL	-	FR	PALM OIL MILL	MA	PALM OIL	TH,MA IN	SI
RICE HULL	STEAM ENGINE	50-300 KW		RICE MILL	PH	RICE,COCO-MILL WOOD INDUSTRIES	MA,PH IN,TH	PH
COCONUT SHELL	CHARCOAL MAKING			COCONUT MILL	PH	COCONUT MILL	IN,PH	
URBAN/IND. WASTE	INCINERATOR COGEN.				SI	URBAN WASTE	AS	
INDUSTRIAL WASTE	BOILER/TURBINE INCINERATOR	-						TH
SAWDUST	BOILER AUTOMATION	1 MW		PAPER MILL	TH	WOOD INDUSTRIES ALL SECTORS	MA,IN PH,TH	
SAWDUST	BOILER TURBINE	1 MW		FURNITURE INDUSTRY	TH	WOOD INDUSTRIES ALL SECTORS	MA,IN PH,TH	
WOOD RESIDUES	BOILER COGENERATION	1-10 MW	GE		IN	WOOD INDUSTRIES	IN,PH,MA TH,SI,BR	IN
WOOD WASTE	BOILER DRYING COGEN.			FURNITURE COMPLEX	MA	WOOD INDUSTRIES	IN,MA PH,TH	MA
WOOD WASTE	GASIFIER	200 KW	IT	SAW MILL	IN	SAW MILL	IN PH.	IN
OTHER SUBJECTS OF INTEREST								
BAGASSE TRASH	BOILER COGEN.	60 MW		SUGAR MILL	PH	SUGAR MILL	TH,PH IN	
FIBRE AND SHELL	BOILER COGEN.			PALM OIL MILL	TH	PALM OIL	TH,MA	
RUBBER WOOD	STEAM BOILER			FISH MEAL	TH	FISH MEAL RUBBER INDUSTRY	TH	TH
BIOGAS	GAS ENGINE			PALM OIL MILL	MA	FOOD INDUSTRY	MA,PH,IN TH,SI	MA
BIOGAS	ENGINE TRANSF.		GE	FOOD INDUSTRY	PH		MA,PH,IN TH,SI	PH
FIREWOOD PLANTATION	BOILER COGEN.				PH		TH PH	
RUBBER WOOD	CHARCOAL MAKING			STEEL INDUSTRY	MA	FOOD INDUSTRY	IN,PH MA,TH	MA

SOLAR

Indonesia

Some commercial sales of solar hot water systems have been achieved in Jakarta, the first system being installed for a basement health club in October 1987 by Solarhart Indonesia.

With assistance mainly from Japan, Indonesia has established a number of photovoltaic village electrification demonstration projects. Demonstration projects have also been set-up for meteorological data recording as well as water pumping. As with most ASEAN countries, the focus for PV is in remote areas and is on a demonstration scale.

Malaysia

The use of solar hot water systems is increasing in urban areas, mainly for domestic purposes. Australia has also assisted with PV cold chain systems for some of the more remote areas of Sarawak.

Philippines

The Philippines has been active in solar R&D from airconditioning through PV down to simple domestic cookers. Applications have tended to focus on solar thermal for heating, cooling, drying and distillation, while PV research has been concentrating on water pumping and remote area power supply (RAPS).

It was recently reported that BP Solar (Australia) have made something of a breakthrough in establishing the commercial viability of domestic PV systems for particular locations. This area may also receive a boost under the World Bank scheme previously mentioned.

Singapore

Although radiation data exists for Singapore, interest has mainly been in solar thermal hot water heating for hotels, clubs and some domestic use. Research interest is high however, in the radiation effects on commercial building surfaces and in glazing. Predictive modelling of buildings is done with BUNYIP software developed in Australia, using Singapore weather data.

Thailand

Solar thermal hot water heaters for hotels and domestic use were mainly installed between the mid-1970's and 1980's; it is estimated that between 50,000-70,000 square metres of commercial collectors have been installed. Local capabilities have been developed for black chrome selective surface preparation at pilot-scale production level, although all domestically produced collectors utilize nonselective paints. Draft industrial standards on solar collectors have been completed. In-door test facilities employing a solar simulator having a 2x2 square metre test area have been estabilshed. The simulator is based on the EC approach and its characteristics closely match the EC standards.

About three quarters of installed PV wattage, estimated at 500 kWps, belong to the Telephone Organization of Thailand (TOT), the Provincial Electricity Authority (PEA) and the Electricity Generating Authority of Thailand (EGAT). TOT powers more than 50 microwave repeaters, with PV. PEA operates 3 stand-alone PV power plants (one 30 kWp and two 60kWp plants). EGAT's applications include tower and bouy warning lights, microwave repeaters, hybrid PV-wind (8kWp-22kW) and hybrid PV-microhydro (22 kWp-15kw) grid-connected demonstration plants.

During the early part of this decade, about 50 kWp of PV is being installed annually for rural water pumping and centralised battery charging for remote villages.

There are three PV panel assembly plants having a total capacity of about 300 kWp per year. Some PV panels and simple BOS are exported.

GEOTHERMAL

Located close to a volcanic chain, four of ASEAN's member countries are active in developing geothermal energy resources. A committee of ASEAN Power Utilities/Authorities cooperates in this development.

Indonesia

Geothermal drilling commenced in Kamojang (West Java) as early as 1926. This field was later selected for development in 1972 under a bilateral program with New Zealand. Since then, a 30 MW unit commenced operation in 1983 and two more units of 55 MW have since been added. The success of Kamojang has led to feasibility studies in other areas and Indonesia has plans to develop sites at Darajat, Salak, Dieng and Lahendong to add a further 290 MW by 1994.

A rough estimate given by the Indonesian Government of total geothermal potential is 10,650 MW, with most of this potential coming from medium-enthalpy fields.

Malaysia

Several hot springs occuring in Sabah, especially around the Senporna Peninsula, have attracted studies on the potential for geothermal development with assistance from New Zealand (1979) and the UNDP (1984).

Plans are now underway to develop an experimental scheme at Andrassy in Sabah.

Philippines

Next to the United States, the Philippines is the second largest producer of geothermal energy in the world.

A 2.5kW non- condensing pilot plant became operational at Tiwi field in 1969. Since then, a 330MW plant has been commissioned while other fields have been developed at Makiling-Banahaw (330MW), Tongonon (115MW) and Palinpinon (231MW). The Philippines has received assistance from New Zealand, Italy and Japan in developing these fields.

Total geothermal generating capacity is expected to reach 1,777 MW by the year 2000. In addition to extra capacity at existing fields the Philippines hopes to speed up this process by adopting 20 MW modular/standardized plant designs currently in use in Japan and Italy.

Thailand

Thailand's known geothermal resources are in the low to medium enthalpy range and are thus economically better suited to direct uses such as crop drying. However, the developments in binary cycle technology suggest that some fields may be suitable for electricity production.

While a 300 kW Ormat pilot plant has been established at Fang, further exploration is continuing with assistance from France, while Japan is assisting in field modelling.

WIND

Philippines

Some RD&D has been conducted on using windmills for low-lift irrigation and generation, although there has been no large-scale adoption and no current plans for wind farms. The Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) has been involved in developing wind data for the country.

Thailand

R&D work on wind electric power systems, supported by the Electicity Generating Authority of Thailand (EGAT), was quite intensive in the early 1980's. Recently, EGAT installed a hybrid wind-PV system in southern Thailand for technology demonstration. The unit incorporates a 22 kW wind turbine and an 8 kWp PV system.

There have been discussions on the possibility of a detailed assesment of off-shore wind potential along the southern coast of Thailand, in the light of wind farm demonstration. No definite decision has been made.

OCEAN ENERGY

Indonesia

It is understood that an OTEC power plant has been commissioned for Bali. Details concerning the success or otherwise of this project are not yet to hand.

Philippines

With some of the deepest channels close to land in the world, the Philippines would seem to have considerable OTEC potential. While some R&D has been conducted on wave energy, it is likely that the country will await developments on the economic viability of ocean energy being undertaken in Hawaii before considering the major investment required.

Thailand

Assessment of thermal gradients of the Andaman Sea along the western coastline of the country has been proposed.

OBSTACLES

Despite varying levels of economic development and varying indigenous fossil fuel resources amongst the ASEAN countries, there is much common interest in research and development of non-conventional energy sources. Similarly, the major obstacles to successfully developing these resources appear common to most of our members. These might be summarized as follows :

Commercial Viability

As elsewhere in the world the economic viability of non-conventional energy sources is dependent on the price (subsidised or otherwise) and availability of electricity produced from conventional sources.

While in the longer-term some technologies such as PV may be economically attractive, most nations struggling to develop tend to lean towards shorter-term returns and proven, established technologies.

Just as the development of fossil fuels worldwide is in the hands of a few multinational companies, it can already be seen that these companies are taking a "watching interest" in non-conventional developments. British Petroleum is already active in solar and most of the geothermal development in the Philippines in undertaken by UNOCAL. Thus it would appear that, even with proven economic viability and government assistance in establishing markets, local investors in ASEAN will for the most part remain shy of non-conventional development, and the commercialsation of technology will be dependent on global developments and left in the hands of the few multinationals.

Social Acceptability

In many cases, the introduction of non-conventional energy technologies in rural areas has failed because insufficient attention was paid to the socio-cultural values and everyday practices and preferences of the recipients. Many farmers, whose lives are generally marginalized, often cannot afford the risk of adopting new technology, no matter how outwardly attractive.

Hit and Miss

As developments in non-conventional technologies have largely been driven by scientists and engineers, site selection has largely been determined by resource availability and climatic conditions rather than the needs of the end-users.

We must admit to many mistakes in moving our laboratory successes to the field. However, it is also valuable experience; lessons are being learnt and progress, albeit slow, is being made as we come to grips with the energy needs particular to our rural communities.

CONCLUSION & RECOMMENDATIONS

ASEAN is undergoing rapid economic development which in most cases is primed by indigenous fossil fuels and relatively cheap world oil prices. The demands of industrial growth have resulted in governments paying lip service to non-conventional energy. However, this is changing. At the moment, cogeneration using biomass resources (usually agricultural wastes) and energy conservation in industry are receiving more attention. For the future, dwindling reserves of fossil fuels, higher world prices, international demands for a better environment and lack of finance for major power projects, all indicate higher electricity prices. At present most ASEAN governments have maintained artificially low electricity prices to attract foreign industrial investors and to service rural populations. The environmental cost of this electricity and the opportunity cost to future generations by using indigenous resources are not accounted for. The future will also likely see more and more private generation.

Should this future scenario be accurate, non-conventional energy sources will become much more competitive and attractive. For the moment, at the policy level in ASEAN, they remain Cinderella. On a more positive note, the many cooperative R&D programs in the region have resulted in ASEAN having some technological capability and experience to better absorb the increased introduction of non-conventional energy technologies.

The current major focus for the development of non-conventional energy technologies in the ASEAN region should be on the replacement of traditional fuels in the agricultural/rural sector. This means weaning away from wood and charcoal to small-scale solar, hydro, wind and biomass use. Biomass and biogas also have great potential for rural industry, particularly in the treatment and recovery of wastes. Of particular interest here will be international R&D efforts in remote area power supply (RAPS) and there is much scope for collaboration.

At the moment our major need is to create awareness sufficient to get Cinderella to the ball. In this regard, the efforts of the Renewable Energy Resources Information Centre (RERIC) at the Asian Institute of Technology as well as our Sub Committee on Non-Conventional Energy Research have achieved much. Hopefully, international support from friendly countries will continue for these organizations as we cannot afford to wither on the vine when the dawn of non-conventional energy is so near at hand.

Since ISES now has a broad terms of reference, perhaps some consideration could be given to establishing a chapter in ASEAN to further promote these technologies and to add some coherance to the number of disparate groups that have evolved. Perhaps also, ANZSES could play a major role in this initiative and one consideration might be to hold a future ANZSES conference in the ASEAN region.

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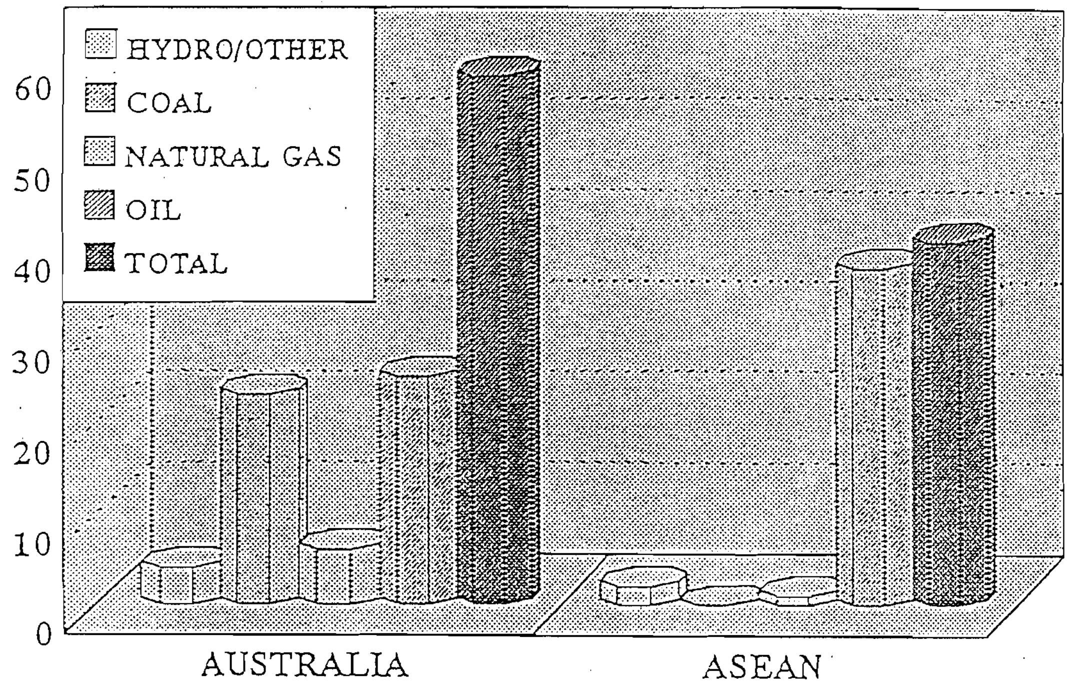

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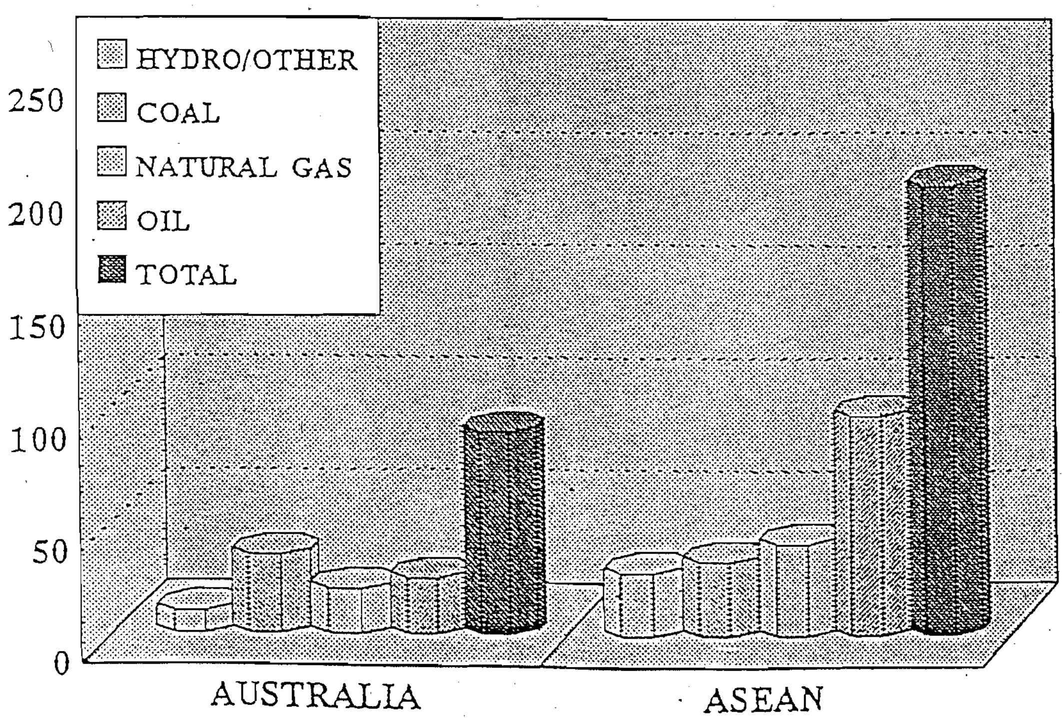

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