

Energy, Electricity and Nuclear Power Growth in South-east Asia and Activities of the IAEA in the Region

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With 2.2 billion inhabitants, South-east Asia¹ accounts for more than half of the present total population of the world.

The 15 countries of the region cover such a wide spectrum of demographic and developmental situations that the practical value of aggregate regional indicators is unavoidably limited and their use may actually be misleading if any attempt is made to derive from them the type of conclusions which only detailed analyses of individual countries can provide. With all these caveats, a global summary of the main economic and energy parameters of the region as given in Table 1 is nevertheless illuminating. This table contains some major economic data for an aggregate of 13 South-east Asian countries, for China and for Japan.

Apart from making evident the tremendous gap in levels of economic development reflected in the ratio of more than 20 to 1 between the GNP per capita of a highly industrialized nation like Japan and the average GNP per capita of the rest of the region including China, the table also leads to some significant considerations regarding trends in present and future energy and electricity requirements.

PRIMARY ENERGY CONSUMPTION

With 53% of the world's population the SEAR, China and Japan consumed about 13% of world commercial energy in 1978. The percentage becomes more striking if Japan, which accounts for more than half of the regional commercial energy demand, is excluded from the total. It then appears that more than 50% of the world's population accounts for less than 8% of world commercial energy consumption.

¹ South-east Asia for the purposes of this article includes 13 countries (Afghanistan, Bangladesh, Burma, India, Indonesia, Malaysia, Pakistan, the Philippines, the Republic of Korea, Singapore, Sri Lanka, Taiwan and Thailand) grouped under the general heading of South Eastern Asian Region (SEAR), as well as China and Japan which are treated separately

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Table 1. General Economic and Energy Indicators for the South-east Asia Region¹, China and Japan

	Status in 1978 (in units indicated below)			Rate of Growth 1974–1978 (%)		
	SEAR ¹	China	Japan	SEAR	China	Japan
Population (millions)	1 170	900	114	2.3	1.4	1.1
GNP ² (billions of 1975 US\$)	236	310	580	6.5	5.7	5.6
GNP ² per capita (1975 US\$/capita)	210	340	5 090	4.2	4.3	4.5
Annual Energy Consumption (millions of tons of oil equivalent)	240	340	350	8.4	8.9	0.6
Annual Energy Consumption per capita (tons of oil per capita)	0.21	0.39	3.1	6.1	7.5	–0.5
Annual Electric Energy Consumption (terawatt-hours = billions of kWh)	206	227	565	9.2	14.3	5.3
Annual Electric Energy Consumption per capita (kWh)	176	252	4 960	6.9	12.9	4.2

¹ The South-east Asia Region (SEAR) is defined for the purpose of this table as comprising Afghanistan, Bangladesh, Burma, India, Indonesia, Malaysia, Pakistan, the Philippines, the Republic of Korea, Singapore, Sri Lanka, Taiwan and Thailand.

² Both statistical gaps and conversion into constant 1975 US\$ may lead to substantial discrepancies in GNP figures reported in different publications.

The massive growth of energy demand which will necessarily accompany any effort at economic development is also apparent from Table 1. Two features deserve special emphasis:

(1) The elasticity coefficients relating relative energy and GNP growth rates are particularly high both for the SEAR and for China (1.3 and 1.5 respectively for the 1974–1978 period) as against a remarkable 0.1 for Japan, illustrating the radical difference in the possible roles of energy conservation policies in developing and industrial countries.

Table 2. Installed Capacities of Electrical Plants in 1978 in the South-east Asia Region, China & Japan

	(Megawatts Electrical)				Total
	Hydro	Thermal	Nuclear	Geothermal	
Afghanistan	245	90	—	—	335
Bangladesh	110	860	—	—	970
Burma	197	253	—	—	450
India	9 450	16 710	602	—	26 800
Indonesia	550	1 110	—	—	1 660
Malaysia	350	1 225	—	—	1 575
Pakistan	867	1 232	125	—	2 236
Philippines	1 160	2 500	—	100	3 760
Republic of Korea	711	5 627	564	—	6 902
Singapore	—	1 470	—	—	1 470
Sri Lanka	335	86	—	—	421
Thailand	930	1 890	—	—	2 820
Taiwan	1 000	5 900	604	—	7 500
SEAR Subtotal	15 900	38 950	1 900	100	56 900
China	10 200	40 000	—	—	50 200
Japan	26 600	91 820	11 000	80	129 500

Note All totals have been rounded off.

(2) The very high energy content of each unit of production (of the order of 1 kg of oil equivalent per \$ of GNP for the SEAR and China, as opposed to 0.6 for Japan) which is characteristic of countries undergoing a rapid industrialization process.

On the basis of these admittedly approximate figures it appears that even a moderate growth of GNP per capita in the SEAR and China at the rate of, say, 4% per year would imply an annual rate of growth in total energy demand of the order of 8% for the foreseeable future. The evolution of energy consumption in Japan will depend on the success of the remarkable energy conservation programmes initiated by that country.

The energy resources available to the region to meet a rapid expansion of demand are, however, very limited. While China was in 1978 practically self-sufficient and even a net

Table 3. Nuclear Power Plants in the South-east Asia Region and Japan

	In operation ¹		Under construction and planned ²	
	Number of Units	MWe	Number of Units	MWe
India	3	602	5	1 082
Korea, Rep. of	1	564	4	3 034
Pakistan	1	125	—	—
Philippines	—	—	2	1 200
Taiwan	2	1 208	4	4 320
SEAR subtotal ³	6	2 500	15	9 640
Japan	19	12 130	15	11 400

¹ As of June 30, 1979

² Up to 1985

³ Total rounded off

exporter, Japan depended on energy imports for about 85% of her total needs. As for the other 13 countries of the region, the global picture of approximate equality between total energy production and consumption which prevailed in 1978 should not be viewed as particularly reassuring. First, regional production totals include oil from Indonesia which as an OPEC member should be considered separately. Second, the balance of total primary energy production and consumption conceals a variety of national bottlenecks, in particular with regard to liquid hydrocarbons whose imports place heavy burdens on the balances of payment of many countries of the region.

PRESENT AND FUTURE TRENDS OF ELECTRIC POWER

As in the case of primary energy, the present share of the region in world total electric capacity is relatively small (13% with Japan, 6% without). Table 2 illustrates the striking disparities between the capacities installed in the various countries.

Also as in the case of primary energy, a rapid growth of electricity demand is to be expected if economic development is to take place. The rates of growth recorded for the 1974–1978 period which are indicated in Table 1 (5.3% for Japan, 14.3% for China and 9.2% for the SEAR) foreshadow the future evolution. No less significant are the ratios between electricity and GNP growth rates (1 for Japan, 2.5 for China and 1.4 for the SEAR) which substantially exceed the corresponding elasticity coefficients for primary energy.

Table 4. Role of the IAEA in the South-east Asia Region (since 1975)

Market Survey for Nuclear Power (1973-75)	Nuclear Power Planning Studies	Nuclear Power Advisory Missions	Feasibility Studies
Bangladesh Korea, Rep. of Pakistan Philippines Singapore Thailand	Bangladesh Hong Kong Indonesia Korea, Rep. of Pakistan	Bangladesh Hong Kong Indonesia Iran Korea, Rep. of Malaysia Pakistan Singapore Thailand	Bangladesh Indonesia Pakistan Philippines
Nuclear Power Siting Missions	Safety Report Review Missions	Regulatory Body Advisory Missions	Nuclear Legislation Advisory Missions
Indonesia Malaysia Pakistan Philippines	Korea, Rep. of Philippines	Korea, Rep. of Philippines	Malaysia
	Transfer of Power Planning Methodology and Computer Programmes (WASP)		
	India Indonesia Korea, Rep. of Malaysia Pakistan Philippines Singapore Thailand		

Table 5. Manpower Development for Nuclear Power Programmes

(a) Training Courses (since 1975)

- 6 Courses on Planning and Implementation
- 6 Courses on Construction and Operation Management
- 2 Courses on Electric System Expansion Planning
- 1 Course on Planning Development and Construction
- 2 Courses on Role of Nuclear Energy
- 1 Course on Safety Analysis Review
- 1 Course on Quality Assurance
- 1 Course on Nuclear Manpower Development

(b) Seminars

- Economic Aspects of Nuclear Power (Vienna, Bangkok, Manila)
- Bid Evaluation and Implementation (Tokyo, Turkey)
- Manpower Development for Nuclear Power (Seoul)
- National Participation in Nuclear Programmes (Manila)
- Quality Assurance (Bangkok)

(c) Publication of Guidebooks

- Steps to Nuclear Power
- Economic Evaluation of Bids for Nuclear Plants
- International Inventory of Training Facilities and Authorization of Operating Personnel
- Qualifications and Training of Staff of the Regulatory Body for Nuclear Power Plants
- Manpower Development for Nuclear Power (to be published in 1980)

NUCLEAR POWER AND THE ROLE OF THE IAEA

The combination of rapid electricity demand growth with limited indigenous energy resources has naturally led several countries of the region to turn to nuclear power as an energy source combining technological maturity and cost attractiveness. Table 3 sums up the present status: 25 power reactors with a total capacity of 14 630 MWe are at present in operation in the region. While in mid-1979 Japan accounted for an overwhelming share with 19 nuclear stations and more than 12 000 MWe of installed capacity, 15 nuclear plants were under construction in India, Republic of Korea, the Philippines and Taiwan which will increase combined nuclear capacity of the countries from the present 2500 MWe to close to 10 000 MWe by 1985. The nuclear power plans of China are at present unknown.

For nuclear energy to continue to fulfill its role in energy supply it is imperative that nuclear plants be operated in a safe, reliable and economic manner. Aware of this fact, the Agency has

deployed a great effort in assisting its Member States in the introduction of nuclear power based on sound technical and economic considerations. Such assistance has been available to all the Agency's Member States and many of the less developed countries of the SEAR have resorted to it. On the one hand, the Agency has provided direct advice and performed specific studies for the countries, as shown in Table 4; on the other hand, it has offered to them the opportunity of training their personnel in the most relevant subjects required in a nuclear power programme, as shown in Table 5.

To complement this effort, the Agency has also developed and will continue to improve the necessary tools for long range nuclear power planning and to prepare guidebooks designed to assist the developing countries of the region in implementing economic nuclear programmes. In so doing it will pay particular attention to the developing countries of the South-east Asia Region whose rapid economic development is a major prerequisite for the stability of the world.