SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY COOPERATION AND DEVELOPMENT

SAARC ENERGY CENTER: STRATEGIC AND OPERATIONAL PLANS

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DISCLAIMER
The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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Preface

The availability of energy at reasonable cost has been a key determinant of industrialization. Local coal and the technology for using it made England the first country to undergo the industrial revolution, followed by similar developments in other European countries. The discovery of large oil and natural gas deposits, and the technology for extracting and refining the former, provided the world with additional commercial energy options. These latter sources had the additional advantage of being easy to transport, and natural gas is also a cleaner source. Electricity has been generated from falling water for almost a century, while nuclear power appeared on the scene about fifty years ago. All of these sources, plus traditional fuels such as firewood and agricultural wates, contribute to meeting the energy needs of South Asia. Coal still plays a very important role in the energy supply of many countries, including India and China, while all countries depend on oil products for their transportation requirements.

The countries of South Asia do not produce enough oil and gas for their needs, and thus have to import them. The costs of these imports are very high, and come at the expense of other domestic requirements. This situation has had a major effect on the development goals of the region. The South Asian countries could improve the situation by purchasing energy form each other where feasible, and by collective imports of joint imports of natural gas and electricity where practical.

In recognition of these facts, the member countries of the South Asian Association for Regional Cooperation (SAARC) decided to establish a SAARC Energy Centre, which came into existence following the final approval during the SAARC Summit on 13 November 2005. The Centre is currently housed at the Hydrocarbon Development Institute of Pakistan (HDIP), which continues to provide financial and logistical support during the initial phase of the Centre.

The present consultant is assisting HDIP and the SAARC Energy Centre (henceforth referred to as ENERSAARC) in formulating a long-term strategic and operational plan for the Centre. Input in the preparation of this Report has been received from a substantial number of well-informed persons, many of whom have policy-making roles. They were almost unanimous in their view that ENERSAARC be an organization that undertakes high-quality analyses on important energy issues facing the region, rather than just be a clearing house for information and a convener of conferences and workshops. This view was also implicit in the statement by the Energy Ministers of the SAARC member countries that ENERSAARC be a “Centre of Excellence”.

A critical mass of highly qualified staff, and adequate financial resources, are necessary for achieving the vision of the policy makers and other stakeholders for ENERSAARC. The current Report is based on the requirement that ENERSAARC be a centre of excellence. While the projected operating cost of the Centre may be somewhat high, the opportunity cost of not achieving excellence would be much higher.

It is our hope that, with the full support of the Member countries and the SAARC Secretariat, the SAARC Energy Centre will play an important role in providing critical analyses and information for the important decisions that the countries of South Asia face in the energy and related sectors. The people of South Asia expect no less.

Toufiq A. Siddiqi
14 August 2006

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II. South Asian Association for Regional Cooperation (2005). *Report of the Second Meeting of the Working Group on Energy, held at Islamabad, Pakistan*, 16-17 December 2004.

III. South Asian Association for Regional Cooperation (2005). *Concept Paper on the SAARC Energy Center To Be Established in Pakistan*. Document No. SAARC/EMM01/3, Annex III.

IV. South Asian Association for Regional Cooperation (2005). *Report of the First Meeting of the SAARC Energy Ministers, held at Islamabad, 1 October 2005*. Document No. SAARC/EMM01/3.

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Executive Summary

Recognizing the important role of energy in the overall development of their countries, the Heads of State or Government at the Thirteenth SAARC Summit, held at Dhaka on 13 November 2005, agreed to the recommendation of the SAARC Energy Ministers to establish the SAARC Energy Centre in Islamabad. The primary objective for the establishment of the Centre is to have a regional institution of excellence for the initiation, coordination and facilitation of SAARC programmes in energy and the Concept paper approved by the appropriate SAARC bodies specifies the goals for the Centre, *inter alia*, as follows:

- To strengthen South Asia's capacity to collectively address global and regional energy issues;
- To facilitate energy trade within the SAARC region, for example through the establishment of a regional electricity grid and natural gas pipelines;
- To promote more efficient use of energy within the SAARC region;
- To enhance cooperation in the use of new and renewable energy sources in the region, thereby contributing towards more sustainable development in the SAARC member countries.
- To serve as a focal point for providing reliable energy data for the individual member countries and the South Asian region;
- To enhance SAARC expertise in energy development and management;
- To promote private sector investment and participation in energy activities in the region.
- To undertake programs to achieve the goals mentioned above.

Keeping this mandate in mind, and considering the current priorities of the individual members of SAARC, as identified in the recent reports of the project on South Asia Initiative for Energy (SARI/E), titled "Energy Security for South Asia", and following extensive discussions with a number of officials and other stakeholders in the energy and related sectors, we have identified five thematic program areas for the work of the SAARC Energy Centre (ENERSAARC). These program areas are:

- Program on "Energy Trade between the SAARC Countries" (PENT);
- Program on "Integrated Assessments of Energy, Transport, and Environment" (PETREN);
- Program to minimize oil imports (PROMO) through improvements in energy efficiency and fuel substitution;
- Program to successfully implement technology transfer (POSIT);
- Program on rural electricity for poverty alleviation (PREPA).

In addition, ENERSAARC has the mandate to develop a detailed and reliable database dealing with numerous aspects of energy in South Asia. Its program areas will contribute

to the development of the database and utilize the database in carrying out their work. The Centre will also carry out training programs in areas of its work, and hold policy briefings for the SAARC member countries (Afghanistan has been included as a participating country in the program of ENERSAARC, although it has the status of an observer at present).

While the first part of this Report describes the strategic plans to achieve the goals set by the SAARC governments, the second part goes into the details of the operational aspects. The SAARC member countries asked that ENERSAARC be set up as a Center of Excellence, and the Report describes the capital, infrastructure, and annual operating budgets of the Center, to achieve this goal. In addition, it details the technical background required for the 20 professional staff needed for the Center. Two operating budgets have been prepared for ENERSAARC, one at a regional competitive salary scale is at $1.67 million per year, and the other based on the current SAARC approved pay scale at $0.75 million per year.

In view of the high cost of rental housing in Islamabad, it is suggested that ENERSAARC have its own housing area next to the Centre. The total land requirement for the offices and housing is expected to be around 2,080 square meters and 4,500 square meters respectively. The costs for the construction of the two buildings are estimated at $2.4 million. The initial capital equipment cost for the office equipment and furnishings is anticipated to be about $265,000. The detailed breakdown for the expenditure is provided in various Tables in the second part of the Report.

In accordance with the SAARC arrangements, the Government of Pakistan (GOP) is expected to provide the infrastructure and about **55%** of the operating costs of ENERSAARC, with the other countries providing the remainder. For specific programs, funding may be available from several other sources, which are suggested in the Report.

The degree to which ENERSAARC will become a Centre of Excellence will be determined by the quality of its leadership and by the competence of its staff, particularly its team leaders for the various programs. The background expertise required of the professional staff is suggested in a matrix form, since each person on the staff will be expected to contribute to at least two program areas.

With the strong support of the SAARC member countries, including the host country, Pakistan, ENERSAARC has the potential to become a major contributor to the development of the region, and a valuable asset for undertaking important energy analyses in a timely manner.

Section 1 Background

The critical role of energy in the development of South Asia has long been recognized by the SAARC member countries. The SAARC Working Group on Energy has been active since 2004, and has made a number of valuable suggestions. At its first Meeting under the restructured SAARC Regional Integrated Programme of Action, held at Islamabad from 15-16 June 2004, the Working Group made a number of recommendations[1] for consideration and approval of the SAARC Council of Ministers (Appendix I). One of the important recommendations was to explore the possibility of setting up a SAARC Energy Centre. The acceptance of this concept was announced at the Second Meeting of the Working Group on Energy, held at Islamabad on 16-17 December 2004[2] (Appendix II). A Concept Paper[3] on a SAARC Energy Center (Appendix IIII) had been prepared and circulated by the host government (Pakistan), and has been accepted by the appropriate SAARC bodies.

The Meeting of Senior Officials Preceding the First Meeting of SAARC Energy Ministers recommended for approval by the Energy Ministers the establishment of the SAARC Energy Centre in Pakistan, in accordance with the concept paper as approved by the Meeting[4]. The Centre is to be governed by specific provisions approved by the twenty-eighth session of the Standing Committee held at Kathmandu, on 19-20 August 2002[5]. The Heads of State or Government at the Thirteenth SAARC Summit, held at Dhaka on 13 November 2005, in the Dhaka Declaration[6], "welcomed the Joint Statement of the First SAARC Energy Ministers meeting in Islamabad. They agreed to the recommendation to establish the SAARC Energy Centre in Islamabad."

The establishment of the Centre was formally approved by the 13th SAARC Summit, held at Dhaka, Bangladesh, on 13 November 2005[7].

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[1] South Asian Association for Regional Cooperation (2004). *Report of the First Meeting of the Working Group on Energy, held at Islamabad, Pakistan*, 15-16 June 2004.

[2] South Asian Association for Regional Cooperation (2005). *Report of the Second Meeting of the Working Group on Energy, held at Islamabad, Pakistan*, 16-17 December 2004.

[3] South Asian Association for Regional Cooperation (2005). *Concept Paper on the SAARC Energy Center To Be Established in Pakistan*. Document No. SAARC/EMM01/3.

[4] South Asian Association for Regional Cooperation (2005). *Report of the First Meeting of the SAARC Energy Ministers, held at Islamabad, 1 October 2005*.

[5] South Asian Association for Regional Cooperation (2002). *Provisions relating to Financial and Administrative Matters of the Secretariat*. Document No. SAARC/SC.22/4, Section 5: Harmonized Provisions Relating to the Financial and Administrative Matters of the SAARC Regional Centres. Kathmandu: SAARC Secretariat.

[6] South Asian Association for Regional Cooperation (2005). *Dhaka Declaration*. Thirteenth SAARC Summit, Dhaka, 13 November 2005.

[7] Ministry of Foreign Affairs, Government of Pakistan (2005). Establishment of the SAARC Energy Center. Communication from Director (SAARC), MOFA, Islamabad, dated 18 November 2005.

Section 2 Mission Statement for the SAARC Energy Centre

The Mission Statement for the SAARC Energy Centre was provided in the Concept Paper referred to earlier (Appendix 1), and approved by the Energy Ministers of the SAARC countries in November 2005. It states that "The primary objective for the establishment of the Centre is to have a regional institution of excellence for the initiation, coordination and facilitation of SAARC programmes in energy". Its goals, *inter alia*, are defined as follows:

- To strengthen South Asia's capacity to collectively address global and regional energy issues;
- To facilitate energy trade within the SAARC region, for example through the establishment of a regional electricity grid and natural gas pipelines;
- To promote more efficient use of energy within the SAARC region;
- To enhance cooperation in the use of new and renewable energy sources in the region, thereby contributing towards more sustainable development in the SAARC member countries.
- To serve as a focal point for providing reliable energy data for the individual member countries and the South Asian region;
- To enhance SAARC expertise in energy development and management;
- To promote private sector investment and participation in energy activities in the region.
- To undertake programs to achieve the goals mentioned above.

The Energy Ministers of the member countries, in approving the concept paper, agreed that the SAARC Energy Centre (ENERSAARC) be established as "An effective and efficient organization". They also agreed that the Centre "Facilitate regular high-level policy dialogues, establish nodal networking, pursue sustainable energy development and externally funded programs, and contribute towards the development of an "Energy Ring" in the South Asia region".

Section 3 A Strategic Plan for the Centre

The SAARC Energy Centre has been given a wide and comprehensive mission, and it would plan to achieve most of its goals over a period of several years. The availability of financial resources and highly skilled personnel is always limited, and thus priorities have to be set for the initial work to be done by the Centre. Energy is a wide-ranging field, and there is a tendency for new Centers to attempt to do a little bit of everything, in order to meet the diverse interests of its constituency. It is important that the SAARC Energy Center (ENERSAARC*[8]) resist this temptation, and choose to start with only a few areas where it could make major contributions to the region. It could use several criteria for determining suitable topics for its initial work, such as:

- The urgency of the policy issue to be addressed;
- The applicability of the work to several countries in the region;
- Its contribution to meeting the basic human needs of the poorer or more remote parts of countries, as well as urban and industrial centers;
- Avoid duplication of effort by checking whether other recognized organizations in the region are already doing similar work;
- The potential availability of external funding for ENERSAARC to undertake high quality work on the topic.

An overview of the energy scene in South Asia would serve as a good starting point for applying the criteria mentioned above. An excellent review of the current situation in the individual countries and in the region overall has already been prepared as part of the South Asia Initiative for Energy (SARI/E)[9]. The Reports, under the overall theme of "Energy Security for South Asia", consist of a Regional report, as well as individual country reports on Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka (Afghanistan has been included as a participating country in the program of ENERSAARC, although it has the status of an observer at present). They have all been prepared by eminent authors from the region, and provide a wealth of information on the current situation and priorities. We shall highlight here only some of the policy concerns that have a high priority for the individual South Asian countries. We shall then go on to identify programs, each of which meets the identified priorities of several countries in the region.

As a starting point, it may be useful to provide a summary of the amount of energy used in each country, and the share of energy currently supplied by each source. This is done in Table 3.1. We have used the most recent data available for each country, which results in differing years being used for different countries. The data for Bangladesh, India, and Pakistan, are from the recently published BP (2006), whereas those for the other countries are from SARI/E (2005) and EIA (2006). All of the biomass data are from the

[8] The acronym originally proposed for the SAARC Energy Centre was SENTER. This was causing some confusion, since people thought the reference was to the Centre. We have suggested the name ENERSAARC as an alternative, since it avoids confusion and underscores the link to SAARC.

[9] South Asia Regional Initiative for Energy (SARI/E, 2005). *Energy Security for South Asia*. New Delhi: USAID.

SARI/E Reports. The contributions of wind and solar energy are not included in the Tables, since these are still very small, even though increasing at a fast rate. Normally, one would give the energy data for the same year for all the countries, but it was felt that it may be useful to give the most recent data available for each country, and try to update the Tables as more recent data for the countries become available.

Table 3.1 Consumption of Energy in South Asia (2003-2005)

Country	Oil^	Nat. Gas	Coal	Hydro	Nuclear	**Total Coml.**	Biomass
	(million tonnes oil equivalent)						
Afghanistan	0.2	0.1	*	*	0.0	0.4	6.9
Bangladesh	4.2	11.9	0.4	0.3	0.0	16.8	16.6
Bhutan	0.1		*	0.1	0.0	0.2	0.3
India	119.3	28.9	204.8	19.0	3.8	375.8	106.0
Maldives	0.3	0.0	0.0	0.0	0.0	0.3	0.2
Nepal	0.8		0.2	0.2	0.0	1.2	7.4
Pakistan	14.4	23.1	3.2	6.1	0.5	47.3	23.4
Sri Lanka	3.0	0.0	0.0	0.8	0.0	3.8	3.6

*= small amount.
^ oil includes oil products

Sources: BP (2006) for commercial energy data from Bangladesh, India, and Pakistan for 2005.
SARI/E (2005) for biomass data for all countries 2003-2004, and for commercial energy data for Bhutan, Maldives, Nepal, and Sri Lanka.
EIA (2006) for Afghanistan commercial energy data.

It can be seen from Table 3.1 that Afghanistan and Nepal derive more than **80%** of their energy from biomass fuels such as firewood and agricultural wastes. Biomass also supplies almost half of the total energy used in Bangladesh and Sri Lanka. Coal is by far the largest source of energy in India, but the use of oil has been increasing rapidly. Natural gas and biomass currently supply about equal amounts of energy in Pakistan, but the use of the former has been growing rapidly. Natural gas is the largest source of commercial energy in Bangladesh, supplying about **80%** of the country's consumption.

While the energy consumption in South Asia has been increasing rapidly, the same cannot be said of energy production in the region. We provide the most recent energy production data in Table 3.2. The 2006 production data for Bangladesh, India, and Pakistan are from BP Energy Statistics[10] (2006) and for the other countries from the Energy Information Administration[11] (2006) and SARI/E (2005).

[10] BP (2006). *Statistical Review of World Energy*. London: BP.
[11] Energy Information Agency (2006). *Country Analysis Briefs: South Asia Overview*. Washington, D.C.: U.S. Department of Energy, March 2006.

Table 3.2 Production of Energy in South Asia (2003-2005)

Country	Oil	Nat. Gas	Coal	Hydro	Nuclear	**Total Coml.**	Biomass
	(million tonnes oil equivalent)						
Afghanistan	0.0	0.2	*	*	0.0	0.2	6.9
Bangladesh	4.0	12.8	0.4	0.3	0.0	17.5	16.6
Bhutan	0.0	0.0	*	0.4	0.0	0.4	0.3
India	115.7	33.0	212.9	21.7	4.0	387.3	106.0
Maldives	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Nepal	0.0	0.0	*	0.1	0.0	0.1	7.4
Pakistan	17.4	26.9	4.1	6.9	0.6	55.9	23.4
Sri Lanka	0.0	0.0	0.0	0.8	0.0	0.8	3.6

*= small amount.

Sources: BP (2006) for commercial energy data from Bangladesh, India, and Pakistan for 2005.
SARI/E (2005) for biomass data for all countries 2003-2004.
EIA (2006) for commercial energy data for Afghanistan, Bhutan, Maldives, Nepal, and Sri Lanka.

A comparison of Tables 3.1 and 3.2 shows that none of the South Asian countries is self-sufficient in oil, and a growing share of the foreign import expenditures of the countries is being used to pay for oil imports. The import dependency of the South Asian countries for the various energy sources is shown in Table 3.3.

Table 3.3 Dependence of South Asian Countries on Fossil Fuel Imports

Item	Unit	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Total Commercial energy consumption	mtoe	0.37	17.40	0.17	387.30	0.27	1.10	55.90	3.80
Oil and oil products imports	mtoe	0.21	3.70	0.04	107.40	0.27	0.77	12.30	3.00
Coal imports	mtoe	0.00	0.00	0.01	11.60	0.00	0.17	1.40	0.00
Natural gas imports (LNG)	mtoe	0.00	0.00	0.00	5.40	0.00	0.00	0.00	0.00
Data for year	Year	2003/4	2005	2003/4	2005	2003/4	2003/4	2005	2003/4
Reference		f	b	a	b	a	a	b	a
Import dependence as % of commercial energy	%	56.8	21.3	29.4	32.1	100.0	85.5	24.5	78.9
Cost of imports	US$M		2,000.0		44,600.0			6,500.0	
Year			2005		2005-06			2005-06	
Reference			c		d			e	

References

a: South Asia Regional Initiative for Energy (SARI/E, 2005). Energy Security for South Asia.

b: BP Statistical Review of World Energy (2006).

c: Daily Star (April 27, 2006).

d: Rediff India Abroad (2006). "India's oil import bill shoots to $44.64 billion", May 10, 2006.

e: Daily Times (May 13, 2006). "Trade deficit doubles in first ten months".

f. Energy Information Administration (2006).

During the past two years, the world price of oil and gas has increased dramatically. As a result, India's oil import bill jumped to $44.6 billion during 2005-06, an increase of **52%** from the year earlier[12]. Pakistan's trade deficit has doubled during the fiscal year 2005-06, mainly due to oil imports costing $6.5 billion, as opposed to $4.6 billion in the previous year[13]. Bangladesh imported $2.0 billion of oil and oil products last year[14], and this amount is also likely to have increased substantially during the current year. A similar situation with respect to the oil import bill also exists for Nepal, Sri Lanka, Bhutan, and the Maldives.

[12] Rediff India Abroad (2006). "India's oil import bill shoots to $44.64 billion", May 10, 2006.
[13] Daily Times (May 13, 2006). "Trade deficit doubles in first ten months".
[14] Daily Star (April 27, 2006).

The growing expenditures for oil imports are having a major impact on the development plans of all the countries of SAARC. Further, India is already importing natural gas as LNG, and plans to import a great deal more as LNG or as piped natural gas. Pakistan also plans to import natural gas within a few years. The regional implications of this doubling of energy prices for the energy sector, as well as for economic development, transportation, environment, and water resources, have to be addressed urgently.

The SARI/E reports[15] identified a number of priorities for the individual countries. Some of these are listed below as indicative of the types of important issues that individual countries have. More comprehensive lists are provided in the SARI/E reports.

Afghanistan

- Implement policies to build infrastructure, encourage energy investment, and professional training in technical and management areas.
- Develop renewable energy options to address the energy needs of remote areas. Hydro-power, wind, and solar energy provide viable options in selected areas;
- Provide secure corridors for the transit of electricity and natural gas from Central Asia to South Asia. The transit fee could provide substantial funding for Afghanistan's development;

Bangladesh

- Encourage the development of the natural gas resources of the country, primarily by the private sector. If adequate reserves are proved, it may become possible to export natural gas.
- Encourage the formation of a regional electricity and natural gas grid. Electricity can be exported by Nepal and Bhutan to India and then on to Bangladesh. Bangladesh may, in the future, be able to export natural gas to India.
- Support institutions such as the SAARC Energy Centre that are taking regional approaches to address the energy concerns facing the countries of South Asia;
- Encourage the use of newer biomass-based technologies, such as bio-gasification and improved stoves.

Bhutan

[15] South Asia Regional Initiative for Energy (SARI/E, 2005). *Energy Security for South Asia*. New Delhi: USAID. The individual country reports and their authors are:

- Afghanistan: Hilal A. Raza, Director General, Hydrocarbon Development Institute of Pakistan, and Chairman, SAARC Working Group on Energy.
- Bangladesh: Abul Barkat, Professor, Department of Economics, Dhaka.
- Bhutan: T.L. Sankar, Honorary Advisor, Energy Group, Administrative Staff College of India; and D.N. Raina, Senior Energy Advisor, Nexant, Inc.
- India: T.L. Sankar, Honorary Advisor, Energy Group, Administrative Staff College of India; and D.N. Raina, Senior Energy Advisor, Nexant, Inc.
- Maldives: T.L. Sankar,and D.N. Raina.
- Nepal: Mahesh Acharya, Project Coordinator, Nepal Electricity Authority.
- Pakistan: Hilal A. Raza, Director General, Hydrocarbon Development Institute of Pakistan, and Chairman, SAARC Working Group on Energy.
- Sri Lanka: Priyantha Wijatatunga, Director General, Public Utilities Commission of Sri Lanka.

- Encourage the development of Bhutan's considerable hydropower potential and the sale of electricity to India and Bangladesh;
- Provide electricity to the remote areas of the country;
- Support regional organizations such as the SAARC Energy Centre and its work in areas such as promotion of regional trade in energy, facilitation of coordinated analyses for energy planning, and assistance in the transfer of suitable technologies.

India

- Promote clean coal and coal-bed methane technologies to make use of substantial resources in the country;
- Increase domestic hydropower generation, and work with Bhutan and Nepal to purchase electricity from those countries;
- Explore the setting up of regional networks for supplying electricity and natural gas in South Asia;
- Encourage private sector exploration and development for oil and gas in offshore areas;
- Further develop its substantial wind and solar energy program, and seek greater private sector participation in the same;
- Develop institutions to explore and promote regional energy security options. The SAARC Energy Centre could play an important role in this context.

Maldives

- Develop solar and wind power to reduce energy imports, and to reduce pollution for the tourism-oriented economy. The telecommunications industry is already the largest user of solar power;
- Encourage private investment in renewable energy and in the transportation sector;
- Explore regional alliances to develop clean energy technologies such as renewable energy sources. The SAARC Energy Centre can assist in these efforts.

Nepal

- Support a regional electricity grid, through which the large potential of hydropower in Nepal could be used to meet some of the electricity demand of India, Bangladesh, and Pakistan, as well as of Nepal. Within 20 years, between 7,500 to 19,000 MW of power could be made available for export through a regional power grid;
- Increase the availability of electricity in rural areas, with the goal of having **80%** of the population having access to electricity at an early date.
- Diversify the sources of energy in the SAARC countries. There is considerable complimentarity in the resource endowments of the South Asian countries. In addition to the hydropower supply potential from Nepal and Bhutan, natural gas could be supplied from or through Bangladesh, and through Pakistan, and coal can be supplied from India.

Pakistan

- Sustain the expansion of natural gas use in the country by developing cross-border natural gas pipelines;
- Develop the domestic resources of hydropower and coal to meet electricity shortages in several areas. There are plans to add 40,000 MW of electricity capacity from all energy sources by 2025.
- Increase the access to affordable energy. It is planned that more than 12,000 additional villages are to be electrified during the period 2005- 2010.
- Develop institutions to promote regional collaboration in energy planning, renewable energy development, and CNG use for transportation. The SAARC Energy Centre can play an important role in achieving this goal.

Sri Lanka

- Introduce fuel diversity in electricity generation and transport to reduce dependence on oil;
- Emphasize development of wind power and biomass for electricity generation;
- Encourage energy efficiency and conservation at all levels;
- Initiate drilling in offshore areas where promising prospects have already been identified;
- Promote regional cooperation in the energy sector by creating opportunities for benefiting from regional energy resources and new technologies.

Using the issues mentioned above as a starting point, we can summarize some of the important aspects of the energy situation in South Asia. These are listed below:

a) There is great variety in the energy sources that provide most of the energy in the South Asian countries. India relies heavily on coal for its energy, whereas natural gas is the most important commercial source for Bangladesh and Pakistan. Biomass is by far the largest source of energy in the remaining five countries, i.e. Afghanistan, Bhutan, Maldives, Nepal, and Sri Lanka.

b) All of the SAARC countries are importers of oil. This is unlike the situation in ASEAN, which has oil-importing as well as oil-exporting countries. Thus oil will continue to be imported from outside the region, but it may be feasible to combine the imports of some of the smaller importing countries to benefit from economies of scale.

c) India and Pakistan are likely to consume all the natural gas they produce. This may be the situation for Bangladesh as well, unless the higher estimates for its reserves that have been projected by the U.S. Geological Survey are confirmed and accepted by all parties in Bangladesh. To meet the current and future demand for this environment-friendlier energy source, a South Asia natural gas pipeline system linking the suppliers in West and Central Asia, as well as those in ASEAN, with Pakistan, India, and Bangladesh, would be highly desirable.

d) Nepal and Bhutan have hydropower potential well beyond their likely demand, and these could be provided to other SAARC countries, if agreements on fair price can be reached and the electricity grids of the countries are linked.

e) Well over a hundred million people in South Asia have no access to electricity. Most of these are in remote locations, where it will be uneconomical for a long time to provide an electrical grid. Decentralized renewable energy systems have been successfully introduced in some areas, and could play a much larger role in alleviating poverty in those areas.

f) A considerable amount of energy technology has been, and is being, developed in South Asian countries. Since it is already adapted to the conditions prevalent in the region, it may, in many cases, have a higher likelihood of success than technology imported directly from industrialized countries. The transfer of regionally adapted technologies from each South Asian country to other SAARC members would be beneficial to all.

Taking into consideration the summary of priorities listed above, the mandate of the SAARC Energy Centre as approved by the Energy Ministers of the member countries (page 4), and the criteria for project selection mentioned earlier (page 5), a tentative list of programs that might be undertaken by ENERSAARC is suggested in the next section. The first five program topics are areas for in-depth analyses and recommendations, whereas the subsequent four themes deal with capacity building and interactions with policy-makers and stake-holders. These would not be started simultaneously, but would be phased in as suitable staff is recruited and funds become available. These are, of course, *suggested* topics that reflect many of the important stated priorities of the South Asian countries. The final decision on which programs will be selected for work by the SAARC Energy Centre, and in which sequence, will be determined by the Director of ENERSAARC, in consultation with its Governing Board.

3.1. Program on Energy Trade between the SAARC countries (PENT)

The Islamabad Declaration of the twelfth SAARC Summit, held in January 2004 mandated “South Asian energy cooperation including the concept of an Energy Ring”. Details of the “Energy Ring” were not spelt out in the Declaration, and one interpretation of it is provided below

All the SAARC countries are large importers of oil and oil products. India, Pakistan, and Sri Lanka are also importing varying amounts of coal. All of these imports come from outside the SAARC region, and put heavy strains on the economies of the South Asian countries, as shown earlier in Table 3.3.

There are considerable opportunities for promoting flows of electricity and natural gas between the SAARC countries. Looking at electricity first, demand is expected to grow at

rates exceeding **7%** per year up to 2020 in the larger countries, and even higher rates in some of the smaller countries[16], as shown In Table 3.4.

Table 3.4 Recent and Projected Demand for Electricity in South Asia

Country	Recent Gigawatt-hours	Year	2010 Gigawatt-hours	2020 Gigawatt-hours
Afghanistan	0.87	2003	1.13	3.88
Bangladesh	23.00	2005	31.60	72.80
Bhutan	0.64	2002-03	1.70	6.88
India	679.00	2005	893.00	1,756.00
Maldives	0.15	2003-04	0.36	1.57
Nepal	2.36	2003-04	3.81	8.08
Pakistan	96.00	2005	130.00	251.00
Sri Lanka	7.09	2002-03	11.20	23.90

Sources: BP (2006) for the Bangladesh, India, and Pakistan data for 2005.
EIA (2006) for the Afghanistan data for 2005.
SARI/E (2005) for all other data.

The large hydropower potential of Nepal, of which 43 GW could be developed economically[17], could be tapped for the benefit of that country, as well as of India, Bangladesh, and even Pakistan. About **70%** of the electricity generated in Bhutan during 2003 was exported to India[18]. Up to 1988, when the Chukha power plant was completed, Bhutan was an importer of electricity from India. This provides a good example of the two-way trade between countries at different times and in different locations.

The Bhutan Report[19] for SARI states: "Bhutan needs markets to develop its hydel export capacity. A Regional institution such as the SAARC Energy Center will serve as an important conduit to promote such trade, improve coordinated energy planning, and assist technology transfer and information sharing that can help Bhutan's national energy development and diversification efforts".

Nepal is also selling modest amounts of electricity to India, and such sales could easily be extended further. A lack of agreement between the two countries on the price of delivered electricity has been a major obstacle to the increased development of this important option.

[16] SARI/E (2005). Op. cit.
[17] Acharya, Mahesh (2005). *Nepal Country Report*. SARI/E
[18] Sankar, T.L. and Raina, D.L. (2005). *Bhutan Country Report*. Ibid.
[19] Sankar, T.L. and Raina, D.L. (2005). ibid.

The concept of building pipelines to bring natural gas from West or Central Asia to India and Pakistan has been discussed for more than a decade[20], and several "Memoranda of Understanding" have been signed with potential suppliers such as Qatar, Iran, and Turkmenistan. Tensions between India and Pakistan delayed the implementation of the projects for several years, but the two countries are now in agreement on the need for a common pipeline for the benefit of both. To provide an example of the scale of the project, we can look at the Iran-Pakistan-India pipeline, which has been examined in greater detail than the other options. The length of the pipeline from Iran to India would be about 2,600 km. The cost of building it is estimated to be around $8 billion. If the pipeline can be completed by 2010, Pakistan would initially expect to import about 10 standard cubic meters per day (MMscmd), rising to 60 MMscmd by 2015. India's initial imports would be 60 MMscmd, rising to 90 MMscmd within three years[21].

The natural gas reserves of South Asian countries and those of some other countries in Asia and the Pacific are shown in Table 3.5.

Table 3.5 Proven Natural Gas reserves of South Asian countries and comparisons with selected other countries

Country	Natural gas	
	Reserves (trillion cubic feet)	R/P ratio (years)
Afghanistan	NA	NA
Bangladesh^	15.4	30.7
Bhutan	0	NM
India	38.9	36.2
Maldives	0	NM
Nepal	0	NM
Pakistan	34.0	32.2
Sri Lanka	0	NM
Australia	89.0	67.9
China	83.0	47.0
Indonesia	97.4	36.3
Iran	944.0	*
Japan	0	NM
Kazakhstan	106.0	*
Malaysia	87.5	41.4
Myanmar	17.7	38.5
Qatar	910.0	*
Saudi Arabia	244.0	99.3
Thailand	12.5	16.5

[20] Toufiq A. Siddiqi (2003). *Energy for Sustainable Development: The India-Pakistan Natural Gas Pipeline*. Honolulu: Global Environmnet and Energy in the 21st Century.
[21] SARI/E (2005). Op. cit.

Turkmenistan	102.0	49.3
World	**6,348.1**	**65.1**

Source: BP (2006).

*: Exceeds 100.
^ There are considerable variations in the stated reserves of Bangladesh.
NM: Not Meaningful.
NA: Not available.

It can be seen from Table 3.5 that the natural gas reserves of India and Pakistan are less than **4%** of those of Iran or Qatar, and only a third of those of Turkmenistan. The non-SAARC countries mentioned are thus in a good position to supply the natural gas needs of India and Pakistan.

Concerns have existed for a long time over the physical security of pipelines in many parts of the world, and these have been highlighted during recent years by the frequent attacks on the existing pipelines in Africa, Iraq, and in the Balochistan province of Pakistan. Similar concerns exist about the Turkmenistan-Afghanistan-Pakistan-India pipeline, in view of the security situation in Afghanistan. There are also economic concerns related to the price being asked by the natural gas producing countries, in view of the increase in the price of oil during the past two years. These issues would need to be resolved, if the natural gas needs of the region are to be met by imports from West- or Central Asia.

The possibility of building a natural gas pipeline from Bangladesh to India has also been extensively discussed in the two countries. Questions about the size of potential reserves and their adequacy for domestic needs have been major obstacles to implementation of the project. While the proven reserves[22] of the country have been variously estimated at between 15 trillion cubic feet (Tcf) and only 5 Tcf[23], the additional reserves in place have been estimated by the U.S. Geological[24] survey as being about 31 Tcf. According to estimates by Petrobangla, the demand for natural gas is projected to increase from 0.35 Tcf per year in 2000 to 1.3 Tcf per year by 2020. The cumulative demand by 2020 would thus be around 14 Tcf by 2020, an amount comparable to the present proved reserves. If substantial additional reserves are proven, exports to India could become a reality.

India is also exploring the option of importing natural gas from Myanmar, either through Bangladesh, or directly from Myanmar. The 560 mile pipeline through Bangladesh would be more economical than the 870 mile direct pipeline from Myanmar through Northeastern India. Although the Bangladesh government has approved the pipeline

[22] BP (2006). *Statistical Review of World Energy 2006*. London: BP.
[23] Energy Information Administration (2006). *Country Analysis Briefs: South Asia Overview*. Washington, D.C.: U.S. Department of Energy, EIA.
[24] Energy Information Administration (2006). ibid.

through the country, it has asked for trade concessions and other benefits in return, but India has not yet indicated its willingness to accept the terms[25].

The current proven reserves of Myanmar are about 18 Tcf, compared to 39 Tcf for India and 34 Tcf for Pakistan. Myanmar currently exports 90 billion cubic feet (bcf) of gas per year to Thailand, and could export some to India since its own domestic consumption is relatively small.

ENERSAARC could make an important contribution by an impartial analysis of the extent to which trade in electricity and natural gas could contribute to meeting the demand for these fuels within the countries of the region, and the steps that could be taken to facilitate these trades. It could also undertake economic analyses regarding the cost of producing and providing electricity and natural gas to specific locations.

The third part of the "Energy Ring" is energy technology. Looking first at renewable energy, wind farms have been established in several states in India, especially Tamil Nadu and Gujarat. India now ranks number four (after Germany, the United States, and Spain) in the world in terms of installed wind capacity, which currently exceeds 4,400 MW[26]. The technology and experience it has gained in this field, as well as in solar photovoltaics (PVs) can be made available to other SAARC countries under mutually agreed terms. Similarly, other technologies that have been developed in Nepal for micro-hydro power generators, and in Pakistan for modifying petrol-based engines to run on compressed natural gas (CNG), could be shared with other countries in South Asia.

The energy flows discussed in the preceding paragraphs can be summarized in a conceptual "Energy Ring", as shown in Figure 3.1. The SAARC Energy Center can examine the current obstacles to developing energy flows in the region, identify the quantitative and qualitative benefits that could accrue to the individual countries from the implementation of the ring, and suggest ways to facilitate its implementation. The individual components of the "Energy Ring" are easier to see in Figure 3.2, which separates out the components showing flows of electricity, natural gas, and energy technology.

In view of its emphasis on trade in Electricity, Natural Gas, and Technology, the proposed Program is being called "PENT".

Private sector organizations are also interested in promoting energy trade between the countries of South Asia. One example is the recently established South Asia Regional Energy Coalition (SAREC) which is an important business advocacy organization whose primary mission is to focus on and promote the concept of an integrated South Asia energy market[27]. The organization attempts to achieve its goal by facilitating cooperative

[25] Energy Information Administration (2006). *Country Analysis Briefs: Bangladesh*. Washington, D.C.: U.S. Department of Energy, EIA, July 2006.
[26] Environment News Service (2006). *"Global Wind Power Industry Spins into High Gear," Accessed June 7, 2006 at www.ens-newswire.com/ens/feb2006/2006-02-23-04.asp*
[27] South Asia Regional Energy Coalition (SAREC, 2006). Accessed at www.sari-energy.org/sarec.

relations among South Asia's national and bi-national business organizations, with the leadership and support of the U.S. Chamber of Commerce. SAREC is supported by the U.S. Agency for International Cooperation.

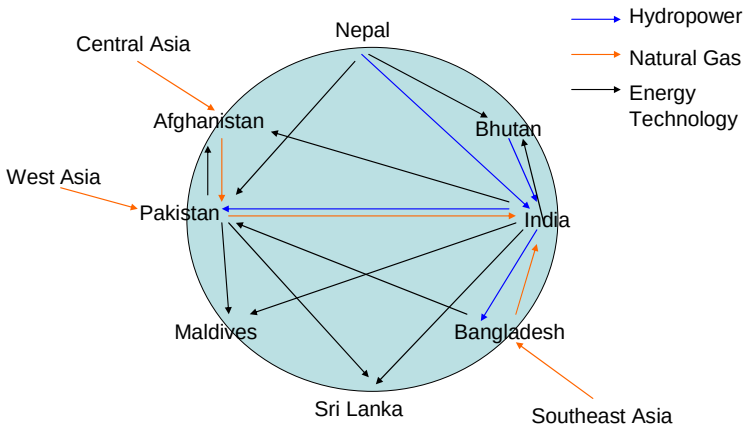

Figure 3.1 Illustrative "Energy Ring" in South Asia

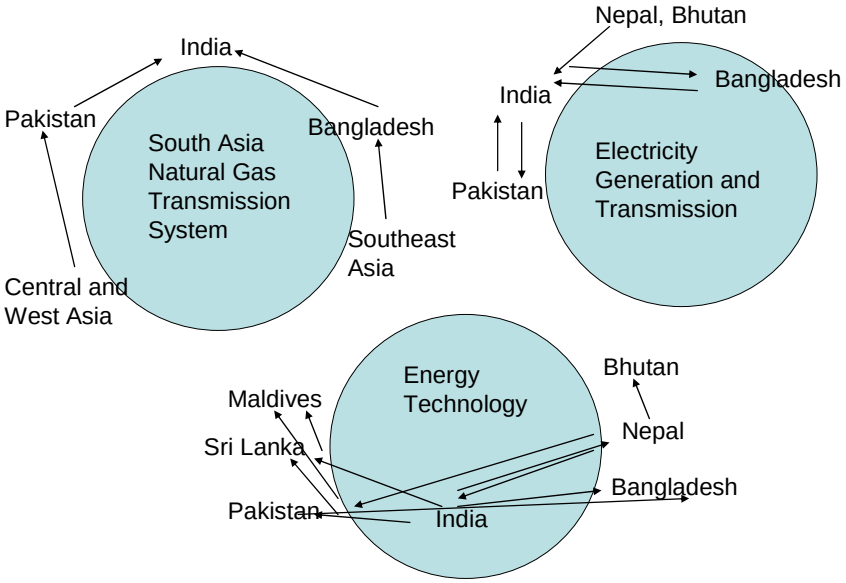

Figure 3.2 Components of the "Energy Ring" in South Asia

3.2 Program on Integrated assessments of Energy, Transport, and Environment (PETREN)

The availability of energy at reasonable cost is widely recognized as a necessary requirement for economic development. The consumption of energy is, in most countries, the largest source of air pollution, and in many cases, for the loss of forests. Present day transportation is almost entirely dependant on oil, with natural gas beginning to play a role in the SAARC countries. However, the consumption of petrol and diesel in buses, trucks, and automobiles is the primary contributor to air pollution in most of the cities of South Asia. It also contributes to urban sprawl and frequently to the taking of land that is needed for agriculture or forests.

While energy is necessary to produce "Goods", all sources of energy have some "Bads" associated with them as well. The type of impact that is significant depends on the individual energy source, as shown in Table 3.6[28].

Table 3.6 Major Environment Impacts of Energy Sources

	Fossil Fuels							
Impact	**Coal**	**Oil**	**Nat. Gas**	**Biomass**	**Hydro**	**Nuclear**	**Solar**	**Wind**
Air pollution	H	H	L	H	L	L	L	L
Acid rain	H	H	L	H	L	L	L	L
Greenhouse gas emissions	H	M	L	H	M	L	L	L
Impact on oceans	L	M	L	L	M	L	L	L
Impact on inland waters	L	M	L	L	H	L	L	L
Impact on land	M	L	L	H	H	L	L	L
Disturbance to ecosystems	M	M	M	H	H	H	L	L
Solid wastes	H	L	L	L	L	H	L	L
Noise	M	M	L	L	L	L	L	H
Visual	H	H	M	H	L	L	M	M
Disaster potential	M	H	M	M	H	H	L	L

Source: Estimates by the author, in East-West Center (2006).

The 2006 Economic Survey of Pakistan points out that air pollution levels in Pakistan's most populated cities are among the highest in the world, leading to serious health issues[29] . The Survey points out that increased energy demand and an unprecedented growth in the number of vehicles in Pakistan are the main reasons for the growing levels of air pollution. The number of vehicles on the roads has increased five times during the

[28] Siddiqi, Toufiq A. (2006). "Chapter on Environmental Considerations" in *Asia-Pacific Energy Security*. Honolulu: East-West Center (to be published).
[29] *Economic Survey of Pakistan (2006)*. Islamabad: Government of Pakistan.

past 20 years. The biggest increase has been in two-stroke vehicles and diesel-powered lorries, which are among the most polluting in the world.

In addition, the rising cost of petrol and diesel have led to the increased use of cheap, inefficient and highly polluting fuels, according to the Economic Survey. The Government has been encouraging the use of vehicles powered by less polluting compressed natural gas (CNG). The number of CNG vehicles in Pakistan is estimated at just under one million, making Pakistan's CNG fleet the third largest in the world after Argentina and Brazil.

A similar situation exists in other SAARC countries as well. For example, the ambient levels of air pollution in many of India's largest cities[30] greatly exceed levels considered acceptable for good health by the World Health Organization[31] or the U.S. Environmental Protection Agency[32]. These are shown in Table 3.7. For comparison purposes, corresponding levels in some cities in the developed countries and in other Asian countries are also shown.

We have included here only the data for some cities in India, since the comparative numbers for the other South Asian countries were not available. However, the situation in Dhaka, Lahore, and Karachi is likely to be similar.

[30] World Bank (2005). *World development indicators, 2005*. Washington, DC: World Bank
[31] World Health Organization (2000). *Air quality guidelines for Europe.* Second Edition. Geneva: WHO.
[32] U.S. Environment Protection Agency (2005). Washington, D.C.: USEPA.

Table 3.7 Air Pollution Levels in a Few Very Large Cities of India and some comparisons

Country	City	Urban population (in millions) 2005	Particulate matter[ab] 1999	SO_2[ac] (1995–2001[d])	NO_2[ac] (1995–2001[d])
India	Delhi	15.33	187	24	41
	Hyderabad	6.15	51	12	17
	Kolkata	14.3	153	49	34
	Mumbai	15.8	79	33	39
Comparisons					
Australia	Sydney	4.39	22	28	81
China	Beijing	10.85	106	90	122
	Shanghai	12.67	87	53	73
Japan	Tokyo	35.33	43	18	68
	Yokohama	3.37	32	100	13
New Zealand	Auckland	1.15	15	3	20
Rep. of Korea	Seoul	9.59	45	44	60
Singapore	Singapore	4.37	41	20	30
Thailand	Bangkok	6.6	82	11	23
WHO recommended guidelines				**50**	**40**
EPA standards			**65–75**		

Sources: World Bank (2005); WHO (2000); EPA (2005).

[a]Micrograms per cubic meter.

[b]Average annual concentrations in residential areas of particulates smaller than 10 microns.

[c]Average annual concentrations.

[d]Data are for the most recent year available.

[e]Data are for 2000.

Delhi has been in the forefront in South Asia in terms of enforcing tighter emissions standards and fuel quality, but it risks losing these gains to newer challenges. At a public discussion following the release of a new book by the Centre for Science and Environment[33] on air quality in Asian cities, it was pointed out[34] that the most worrying trend in Delhi is the sheer growth in the numbers of vehicles in the capital, estimated at

[33] Centre for Science and Environment (2006). *The Leapfrog Factor: Clearing the air in Asian cities.* New Delhi: CSE.
[34] Centre for Science and Environment (2006). Press Release, April 19, 2006.

about **17%** of the total number in the country. Delhi has more cars than the Indian states of Maharashtra, Tamil Nadu, Gujarat and West Bengal combined.

The transportation crisis is building up not only in Delhi, but in almost all the cities of South Asia, because a growing share of daily trips is being made by personal transport. A car caught in congestion can emit nearly four times the usual emissions for the same journey Public transport is collapsing in most Indian cities[35]. Only eight of the 35 cities that have more than a million people have a dedicated bus system; and even these are under enormous pressure. Buses still meet nearly **61%** of the travel demand, though they occupy a mere **3%** of the total traffic. During the decade of the 1990s, the number of motor vehicles in India increased by **150%**, and in Pakistan by **50%**[36]. With a growing middle class, this trend has increased during the current decade.

Some cities in India have seen a decline in their pollution levels. In fact, according to a World Bank study, Delhi, Mumbai, Kolkata, Ahmedabad and Hyderabad have seen about 13,000 less premature deaths due to air pollution-related diseases[37]. Almost **57%** of the cities monitored in the country have critical PM_{10} levels (more than 1.5 times the standards). Many of the newer and smaller cities are more polluted than even the megacities.

The CSE Report states that the estimated health effects of air pollution in Indian and Asian cities are similar to those found in Western countries. However, the Indian and developing Asian cities are more at risk due to unique factors such as extremely high levels of pollutants, risk of multiple pollutants interacting with each other, and the impact of poverty. The impacts of air pollution are particularly large for the urban poor in India, **50%** to **60 %** of whom live in slums. Each year, two-thirds of the 0.8 million deaths and 4.6 million life years attributed to air pollution worldwide, occur in developing Asian countries.

Some of the links of the energy sector with the environment and transportation sectors are illustrated in Figure 3.3.

[35] Centre for Science and Environment (2006). ibid.
[36] World Bank (2004). *World development indicators, 2004*. Washington, DC: World Bank.
[37] Centre for Science and Environment (2006). ibid.

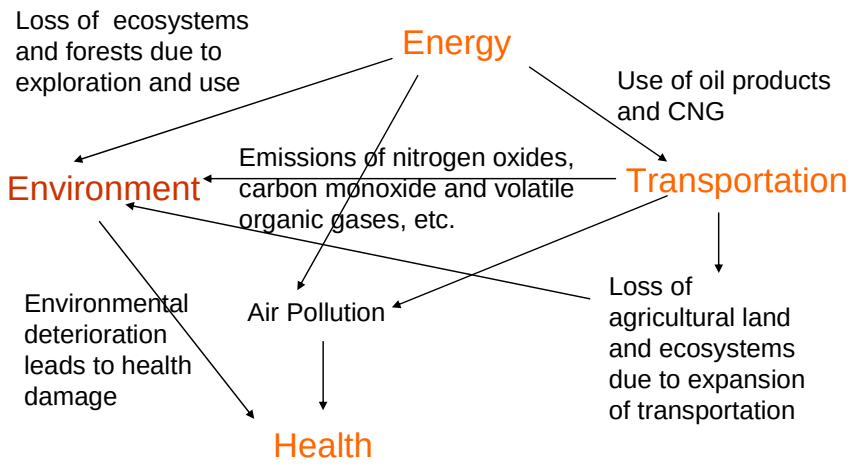

Figure 3.3 Illustrative Links between Energy and other sectors

In spite of the close links between the sectors mentioned, the planning for each is frequently undertaken with relatively small input from the other sectors. The Planning Commissions in the individual SAARC countries have tried to integrate the requirements of the various sectors, but have generally not gone to the level of analyzing what the impacts of growth in energy use, for example, will mean for the environment or for health. Further, the trend towards privatization in recent years has also made it difficult for the Planning Commissions in the individual countries to take an integrated approach. Also, their mandates stop at national borders, making integrated planning difficult when the resource under consideration, such as hydropower, affects more than one country.

The SAARC Energy Centre could provide a very useful service by undertaking integrated analyses and assessments at a region-wide level, and identify policy options that may be of mutual benefit to several SAARC countries. As an example, it might make a detailed analysis of the future energy use for freight transportation between Pakistan, India, Nepal, and Bangladesh. For long distances and heavy freight, a combined rail-truck transportation system may result in energy savings of up to **40%** when compared to a truck-only mode of shipment[38]. As cooperation and trade between the SAARC countries increases, it would help greatly in reducing energy use for transportation by moving much of the freight by rail. Environmental quality could also be improved by using electricity, perhaps provided by hydropower originating in Nepal.

Training programs using this integrated approach and the results of analyses for policy makers and other stakeholders are discussed in sections 3.7 and 3.8 respectively.

[38] IFEU and SGKV (2002). *Comparative Analysis of Energy Consumption and CO2 Emissions of Road Transport and Combined Transport Road/Rail*. Institut fur Energie and Umweltforschung Heidelberg GmbH, and Studiengesselschaft fuer den kombienierter Verkehr e.V. Geneva: International Road Transport Union IRU).

3.3 Program to minimize oil imports (PROMO) through improvements in energy efficiency and fuel substitution

The countries of South Asia have been hit hard in recent years by their dependence on oil imports. Not only has the volume of imports been rising substantially, but the price of oil has more than doubled. Taking India, the largest SAARC country, as an example, oil imports increased from about 35 million metric tons (MMT) during 1975-98 to about 92 MMT during 2004-05[39]. During the same period, the import dependency increased from **55%** to **78%** (This dependency is expected to increase to **94%** by 2030), and the cost of oil imports rose from Rupees 170 million to Rupees 1,180 million[40] . These costs have increased even further since 2004-05.

The total cost of importing crude oil and oil products for the SAARC countries amounted to over $50 billion during the fiscal year 2005-06. If the Centre can identify and help in implementing measures that might result in saving even **0.5%** of this amount, the saving would amount to about $25 million per year. This alone would justify the cost of establishing and operating the Centre, in addition to all the benefits accruing from its analytical and cooperative work.

There is enormous scope for improving the efficiency of energy use, including oil product use, in South Asia. ENERCON in Pakistan, for example, identified efficiency improvement possibilities in several sectors in that country. ENERCON used a Total Energy Management (TEM) approach with industry to provide data on potential energy savings and to demonstrate various technologies in real life situations with subsidies and grants[41]. The TEM approach consisted of preliminary audits, detailed audits, demonstrations, and publicizing of the results.

ENERCON has also introduced programs on energy conservation in industry These are based on the principle of full cost recovery using private sector organizations to deliver measurable energy savings to the nation. The more prominent of such programmes include boiler furnace tune-up, steam system survey, and electrical system survey. More than a 100 companies have benefited from this service.

The agriculture sector is a large user of energy in South Asia. In Pakistan, for example, it uses **19%** of the country's petroleum consumption. Further agriculture tube-wells constitute the single largest use of electricity, almost **20%** of the national total[42]. The sector is very energy-inefficient, with tube-wells and tractors typically operating at only half the efficiency that could be achieved in practice.

ENERCON's efforts in agriculture have focused on the two primary energy consumers:

[39] Misra, Neha, Ruchika Chawla, Leena Srivastava, and R.K. Pachauri (2005). *Petroleum Pricing in India: Balancing efficiency and equity*. New Delhi:TERI.
[40] Misra et al (2006). ibid.
[41] ENERCON (2006). The National Energy Conservation Center, Ministry of Environment, LG & RD, Accessed at www.enercon.gov.pk/programmes.asp.
[42] ENERCON (2006). ibid.

tube-wells and tractors. The research and development activities ENERCON has undertaken in these two areas are believed to be the first of their kind in any developing country. ENERSAARC could play a valuable role in transferring this experience to other interested countries in South Asia.

Development Finance Institutions (DFIs) were established in India more than 50 years ago to provide funds to industry in the country. During the past decade, they have been active in managing and lending for industrial energy-efficiency and environmental projects[43]. With the support of the Asian Development Bank, a team evaluated the potential role for IDBI in lending for energy efficiency and environmental pollution-control activities.

The primary energy-efficiency criterion for selecting industrial projects was that the modernized or expanded plant should show a minimum energy-efficiency improvement of **18%**. The evaluation of several industrial sectors revealed an investment potential, with a payback period of less than four years, which exceeded $1 billion (Rs. 45 billion).
The sector studies show that there is at least a **20%** difference between the current and best practice for energy use and that a significant potential exists for investment in energy efficiency and energy management activities. These include housekeeping measures such as improved lighting, variable-speed motors/drives, and improving power factors, installing co-generation and captive power generation units, and changing manufacturing processes to more efficient and less polluting ones. The study showed a potential for investment of at least 5 billion rupees each in improving energy efficiency in several sectors --- Iron and Steel, Textiles, Aluminum, Chemicals, Fertilizer, and Pulp and Paper.
There are differing factors that keep energy efficiency low in the sectors studied. The key barrier that was identified in the study was the institutional weakness in promoting energy efficiency and better environmental management.
Some examples for areas in which analyses could be undertaken by ENERSAARC to identify savings in oil and oil-product imports include:

- Establishing SAARC energy efficiency standards for appliances such as refrigerators, heaters, air conditioners, and light bulbs;
- Replacement of existing emergency generators with newer, more efficient models, standardized for use throughout the SAARC region;
- Rapid conversion of vehicles to compressed natural gas (CNG) and establishment of a region-wide network of CNG refueling stations.
- Replacing propane and kerosene in rural areas with wind energy for lighting and solar energy for cooking and heating water. The SAARC Energy Center could play an important role in identifying equipment that would be particularly suitable for the region, and setting up a maintenance system once the installations are completed.

All of the measures mentioned above would result in substantial reductions in oil imports, thereby enhancing the energy security of the region, as well as the possibility of

[43] Sathaye, Jayant; Ashok Gadgil, and Manas Mukhopadhyay (1999). *Development Banks and Industrial Energy Efficiency in India.*,EETD Newsletter, Summer, 1999.

reallocating the savings to other vital sectors such as education, health, and infrastructure development.

3.4. Program to successfully implement technology transfer (POSIT)

There are a huge number of energy technologies in use in one or more countries of South Asia. A vast majority of them have been transferred from industrialized countries. In many cases, the transfer has been relatively straightforward, while in other cases, the technology had to be modified to work properly under the conditions prevailing locally. There are some instances, such as improved cooking stoves and biogas plants, where the transfer of technology was not always successful. It is important to identify the technical and social factors that were responsible for the successful transfer of technologies, so that the transfer and diffusion of technologies in the SAARC countries can be facilitated.

In this and the following paragraphs, we mention several energy technologies that are at present being transferred to the SAARC countries. Wind turbines based on designs from Denmark, Germany, and the United States have been successfully built and are operating in India, particulalry in the States of Tamil Nadu and Gujarat . As mentioned earlier, India now has over 4,300 MW of wind power installed capacity, the fourth largest in the world. India's experience with wind power could be transferred to other SAARC countries, particularly Bangladesh, Maldives, Pakistan, and Sri Lanka.

Clean coal technologies are also of great interest to India and Pakistan. Indian coal generally has a very high ash content (over **40%** in many cases), often resulting in problems for power plants burning the coal. Further, the railway system of India has been running at more than the design capacity for many decades, and transporting coal with such high ash content is not very efficient. India has been working with a number of countries, particularly the United States, to apply clean coal technologies to deal with these problems. The National Energy Technology Laboratory (NETL) has, for example, been focusing in recent years on technology transfer and related capacity building for improving the efficiency and reducing emissions from coal-fired power plants. It earlier supported the development of the first commercial non-coking coal washery in India[44], to help meet the requirements of the new legislation that specifies that all coal shipped for a distance of more than 1,000 km. should have an ash content of less than **34%**. Advanced technologies for coal preparation, as well as for improving combustion are being applied or under consideration.

Pakistan does not use a lot of coal at present, but has plans to increase coal use substantially in view of its domestic coal resources. However, most of the coal in the country has a high sulfur and low energy content. Thus clean coal technologies will be required to make the best use of the coal, and to minimize the adverse environment and health impacts of using such coal. Technologies for the removal of sulfur prior to

[44] Smouse, Scott (2005). *A 25-Year History of Cooperation with India.* Paper presented at the Coal Working Group, U.S. – India Energy Dialogue, Washington, D.C. 18 Nov. 2005.

combustion, as well as several for flue gas removal (FGD) could be transferred. ENERSAARC could play a valuable role by identifying the key social and infrastructure considerations for the successful transfer of the technologies.

It is important to keep in mind that "Clean coal technologies" are clean mainly with respect to the local air pollutants, such as suspended particulates, sulfur dioxide, and nitrogen oxides. They do not substantially reduce the emissions of carbon dioxide, the principal greenhouse gas responsible for global climate change. Although the SAARC countries are not required at present to curb emissions of greenhouse gases as part of the United Nations Framework Convention on Climate Change, pressures to do so may increase in the future. India is already the fifth largest emitter of carbon dioxide (CO_2) from the combustion of fossil fuels. The United States is pointing at the rising emissions from countries such as China and India as one of the reasons for not agreeing to reduce its own emissions of greenhouse gases.

The Asian Development Bank has recently signed[45] an agreement to establish a knowledge hub on clean energy at The Energy and Resources Institute (TERI), based in India. The clean energy knowledge hub at TERI is expected to provide a gateway of knowledge and information on clean energy, energy efficiency, and issues related to mitigation and adaptation of climate change. It will also be the focal point for the collection, structuring, and dissemination of knowledge from a variety of resources. TERI is the first of several knowledge hubs planned by ADB. ENERSAARC could interact closely with TERI in clean energy and energy efficiency activities.

It is not just hard technologies, but also management techniques related to energy that can also be transferred. For example, the micro-financing of photovoltaic systems in Bangladesh, India and Sri Lanka, has been successfully tried out in selected remote areas. This experience could be replicated on a larger scale within the same countries, as well as in other SAARC countries, if initial funding can be provided. ENERSAARC can play a valuable role as an intermediary between the rural finance agencies and the energy users in remote location. This item is also related to the program described in section 3.5.

Another example of management techniques that can be provided within SAARC is the setting up of the infrastructure for use of compressed natural gas (CNG) in vehicles. Pakistan has had over 20 years of experience in this field. The network in Pakistan was established by the Hydrocarbon Development Institute of Pakistan, which is also the host institution for ENERSAARC. This should greatly facilitate the transfer of the experience to other South Asian countries interested in accelerating the buildup of CNG vehicles.

[45] ADB (2006). *ADB Setting up Clean Energy Knowledge Hub at India's TERI.* News Release 22 June 2006. Manila: ADB.

3.5 Program on rural electricity for poverty alleviation (PREPA)

There are well over five hundred million people in South Asia who have no access to electricity. In Bhutan and Nepal, for example, only about **40%** of the total population has electricity. In Afghanistan[46], the corresponding number is only **5%**. The data for all the South Asian countries are provided in Table 3.6.

Table 3.8 Access to electricity in South Asian Countries

Country	Population having access to electricity %	Year
Afghanistan	5	2003
Bangladesh	32	2005
Bhutan	40	2005
India	43	2000
Maldives		
Nepal	40	2005
Pakistan	53	2000
Sri Lanka	62	2000

Sources:

1. International Energy Agency (IEA). 2002. World Energy Outlook: Energy and Poverty, for the Year 2000 data.

2. SARI/E Country Reports (2005) for the 2003 and 2005 data.

3. EIA (2006) for the Bangladesh data.

Most of the people without electricity live in remote locations or in small communities where it has not been economically feasible to provide grid based electricity. In the SAARC countries, several programs already exist to supply small amounts of electricity in such locations, using photovoltaic (PV), micro-hydro or wind systems. A few examples of these are cited here.

In Bangladesh, the Local Government Engineering Department (LGED) has, with the help of the Japan International Cooperation Agency (JICA), established more than 15KW of solar photovoltaic system in several cyclone shelters in the coastal districts of the

[46] Raza, Hilal (2005). *Afghanistan Country Report*. South Asia Regional Initiative for Energy (SARI/E). Energy Security for South Asia. New Delhi: USAID.

country[47]. In each of the cyclone shelters, the solar installations have been designed to operate 18 lamps and one TV. These installations have greatly reinforced the importance of cyclone shelters and their effective utilization during the natural disasters. At other times, they enable the local community to continue adult education and similar program at night. Further, solar lighting at night transforms these shelters into lighthouses for sea vessels and fishermen.

The Global Environment Facility (GEF) is assisting the Government of Bangladesh in spreading the use of renewable energy technologies in remote areas[48]. The Infrastructure Development Company limited (IDCOL) of Bangladesh, in cooperation with Grameen Shakti and the Bangladesh Rural Advancement Committee, had installed more than 25,000 solar home systems during the first two years of the program. More than **98%** the households that took out the loans for the 20-40 watt systems have been making loan payments regularly.

In the Maldives, the Sate Electricity Company provides regular and continuous electric power to 24 of the 199 inhabited islands. Community- operated generators supply another 50 islands, and private operators serve 6 islands with continuous electricity[49]. The airports and the tourist resorts have their own power generation systems. All these power supply systems are run entirely on diesel oil, exposing them to the wide changes in oil prices. It would be possible to lower this dependence by making greater use of solar and wind energy, possibly in hybrid systems that use renewable sources and diesel oil.

The ECN study[50] identified a number of barriers to the use of renewable energy in the Maldives, including lack of information and data on renewable technologies, and the lack of reliable hardware in the local market. ENERSAARC could play a useful role in helping to overcome these barriers.

As far back as 2000, the World Energy Council (WEC) and the South Asian Association for Regional Cooperation (SAARC) had prepared a report[51] on renewable energy in South Asia based on the presentations and discussion at the Regional Meeting on Renewable Energy jointly held by WEC and SAARC in Colombo, Sri Lanka, 12-14 June 2000. The report includes a regional overview and the status of renewable energy in each of the seven countries at that time, and pointed out issues for the future. It was intended to pave the way for future regional activities on renewable energy development, ENERSAARC could be of great assistance in realizing these goals. One way in which the Centre could contribute would be by setting up a team to analyze the experience that has been gained in the region, identifying the programs that have been successful, and

[47] Local Government Engineering Department (2006). *Solar Energy Demonstration under LGED.* Dhaka: LGED, accessed at lged.org/sre/solar-lged.html.
[48] Global Environment Facility (2005). *Expanding Renewable Energy in Bangladesh.* Washington, D.C.: GEF, November 2005.
[49] Energy Consulting Network (2004). *Assessment of Least-Cost, Sustainable Energy Resources, Maldives.* Final Report, Fund for Danish Consultancy Services. Project INT/03/R11-02 MDV 1180.
[50] Energy Consulting Network (2004). ibid.
[51] World Energy Council, and South Asian Association for Regional Cooperation (2000). *Renewable Energy in South Asia*. London: World Energy Council.

identifying the causes for their success. Some general principles could be derived from these, and form the basis for a common approach that could be tested in designing and implementing new programs in each of the South Asian countries.

3.6 Development of an internally consistent database

The Concept paper on the SAARC Energy Centre that was approved by the SAARC Energy Ministers listed the setting up of a regional data base as one of the goals of the Centre (see page 4). Each of the SAARC countries has a database for collecting and organizing its energy data, but these have been developed independently, and are not strictly comparable. Regional energy policies need to be formulated on the basis of accurate and consistent regional data. ENERSAARC can make an important contribution in this respect.

Two examples illustrate the inconsistencies that exist when comparing separately designed databases:

- Almost all the South Asian countries have some electricity provided by hydropower. The total energy supplied by hydro during a certain period, such as a year, is sometimes based on taking the total kilowatt-hours generated during that time, and converting it directly to joules or quadrillion Btu. In other cases, the conversion is based on the amount of coal or oil that would have been required to generate the same amount of electricity. Since thermal power plants operate only at efficiencies of **30%-40%**, this number is very different to the one obtained using the first method.

As an example, the total energy provided by hydropower during 2004-05 by hydropower in Pakistan is listed as the equivalent of 6.13 million tonnes of oil equivalent (mtoe) in the official Pakistan Energy Yearbook[52]. However, the same number is listed as 2.32 Mtoe in the International Energy Agency (IEA)[53] database for 2003.

- "Traditional fuels" such as firewood and agricultural wastes still play a very important role in the energy supply of the South Asian countries. They are estimated to provide more than **90%** of the total energy consumed in Afghanistan and Nepal, about **50%** in Bangladesh, and more than **20%** in India, Pakistan and Sri Lanka[54]. It is well known that these estimates are subject to large uncertainties, partly due to insufficient information being available, and partly due to the different characteristics of the firewood and the conditions under which it is being burnt.

In many of the South Asian countries, the availability of biomass is actually declining. Energy planners thus need to make arrangements not only for meeting the growing needs

[52] Hydrocarbon Research Institute of Pakistan (2005). *Pakistan Energy Yearbook*. Islamabad: Ministry of Petroleum and Natural Resources, Government of Pakistan.
[53] International Energy Agency (2006). *IEA Energy Statistics*. 2003 Energy Statistics for Pakistan.
[54] World Bank (2004).

of urban and industrial areas, but also for providing energy in other forms for the rural areas to replace some of the energy formerly provided by biomass.

ENERSAARC can put together a team from several of the SAARC countries to design a common and consistent database and identify the types of data that would be of greatest use to policy makers.

Examples of the type of data that might be collected, in time series on an annual basis, include:

- Energy production at the Province, State, and District levels;
- Energy consumption at the Province, State, and District levels;
- Energy consumption in agriculture, industry, transportation, power generation, and domestic uses;
- Efficiency of energy use in the various sectors;
- Dependence of the different sectors on energy imports;
- Dependence of the individual Provinces or States on energy imports;
- Costs of energy imports on a national basis;
- Use of firewood, agricultural wastes, and other biomass at the Province, State, and District levels;
- Ratio of Energy to GDP measured both in terms of the traditional method and in terms of purchasing power parity (PPP);
- Ratio of energy used per ton of products such as steel, aluminum, etc.;
- Use of energy efficient light bulbs, refrigerators, etc.

Each of the five program areas mentioned earlier would be expected to contribute to developing the database, and ensuring the quality of the data that are included. They would also, of course, be using the data as bases for their analytical work. There would thus be a two-way interaction between the database and the programs.

3.7. Training program in integrated assessments

We have discussed the need for integrated assessments in section 3.2. Unfortunately, the professionals needed to carry out such integrated assessments are in very short supply. Such professionals need to be thoroughly familiar with several sectors such as energy use and its impacts on health and the environment, the pricing of energy and its impact on energy use, and the energy efficiency of different transportation modes.

ENERSAARC could initiate a program to train persons already having an expertise in at least one of the topics mentioned above that would take a systems approach to integrating the different sectors, and assist policy makers in those sectors in formulating policies that would be of benefit not only to their own sector but to other sectors as well. The common link between the integrated assessments would be energy. The program would be of roughly a month's duration, and would be for mid-career professionals from governments, academia, and NGOs.

In addition to lectures, each group of trainees from the different countries could be asked to address one policy issue that cuts across energy and at least another sector. The results of these analyses, after review and modifications, would be presented at one of the Conferences for policy makers mentioned in the next section.

3.8 Conferences for policymakers from energy-related sectors

In most regions of the world, including South Asia, policy-makers usually interact at the sectoral level, i.e. those formulating policies for energy in one country usually interact with those responsible for energy policy making in the other countries. Similar interactions take place for the transportation sector, for the environment sector, and so on. As discussed in section 3.7 above, it is important that policy making for the energy-related sectors be integrated, at least to the extent that each is familiar with how decisions in their sector affect, and are affected by decisions in the related sectors.

ENERSAARC could make an important contribution to the South Asian region by bringing together policymakers form the energy, environment, health, and transportation sectors from each of the SAARC member countries on a regular basis, in conferences of 2-3 day duration. Policy makers from each of the sectors mentioned above could brief the Conference on recent developments in their sectors which could have implications for the other sectors.

To illustrate, if one of the countries is planning to make a major effort to switch transportation from gasoline or diesel to compressed natural gas (CNG), and if private tourism between the countries is also being promoted, then CNG filling stations need to be set up in the neighboring countries as well. Further, the environment and health ministries can assume that the air pollution from the transportation sector may be reduced as a result of the switch to CNG. The energy sector needs to know that additional natural gas needs to be provided for transportation, beyond its traditional uses for heating and cooking, electricity generation, fertilizer production, and other industrial uses. The number of vehicles in use in the SAARC countries is increasing rapidly, so the actual number of vehicles using oil products will keep on increasing for many years. Thus the air pollution may not decrease in terms of absolute amounts, but it would be less than it would have been if CNG vehicles had not been introduced.

The conferences for policy makers would also provide an opportunity for presenting the analyses undertaken by ENERSAARC, as discussed in section 3.7 earlier.

3.9. Professional development

The vast majority of universities in the SAARC region do not train students in interdisciplinary subjects such as energy. ENERSAARC could provide courses of about 8-week duration to some of the best masters-level students with backgrounds in disciplines such as physics, chemistry, biology, engineering, economics, law, and

business, in some of the basics of the energy systems from production to transportation and consumption. This could be done in a global context, while emphasizing the special situation in the SAARC countries. A “Certificate in Energy Systems”, for example, could be given to students who complete the course successfully. The course could be developed in conjunction with leading universities in the region, and if desired, the certificate could be given in association with these universities, which might accept the credits earned towards the Masters degree.

Section 4 Staffing the SAARC Energy Centre

The Concept Paper for the establishment of the SAARC Energy Centre[55], as approved by the Energy Ministers of the member countries, states:

"The SAARC Energy Centre is envisioned as a catalyst for the economic growth and development of the South Asia region…. The primary objective for the establishment of ENERSAARC is to have a ***regional institution of excellence*** (bold and italics added) for the initiation, coordination and facilitation of SAARC Programs in energy."

In view of the importance of energy for the development of the SAARC countries, it is essential that the work undertaken by the Centre be of the highest quality and address the crucial energy-related issues that are at the top of the decision-making agenda in the SAARC countries. The analyses and reports prepared by the Centre should be of direct use to the policy-makers of the region. There are many organizations in each of the SAARC member countries which work on selected aspects of energy. It would be important to work with them and avoid duplication of effort.

A Centre can only be excellent, if the people working in it are highly competent. This would require that ENERSAARC recruit as its senior staff professionals who already have considerable experience in producing high quality policy analyses, invited presentations in international conferences, and documented publications in well-known journals dealing with energy and related issues.
.
A "Center of Excellence" requires a critical mass of highly capable and recognized long-term professionals to lead teams in selected thematic areas, and a Director with a vision of where the Centre should be headed and how it should get there. It should also have a group of junior professionals selected on a competitive basis from the SAARC countries, and occasionally from elsewhere. As the reputation of the Centre is established, visiting scholars and professionals from outside the region are likely to come at the expense of their own institutions to benefit from the in-house expertise available at the Centre.

In addition to the research and analysis oriented staff, ENERSAARC would require competent persons for the administration of policy-oriented seminars and technical workshops, as well as for setting up and maintaining a database and web site.

A suggested staffing level for ENERSAARC is shown in Table 4.1

[55] South Asian Association for Regional Cooperation (2005). *Concept Paper on the SAARC Energy Center To Be Established in Pakistan*. Document No. SAARC/EMM01/3.

Table 4.1 Suggested Professional Staffing Level for the SAARC Energy Center

Title	Number
Director	1
Deputy Director (Coordination)	1
Deputy Director (Programs)	1
Deputy Directors (Team Leaders)	5
Research Fellows	5
Research Associate	5
Information Technology Specialist	1
Communications Specialist	1
Total	**20**

The number of professionals suggested above is based on ENERSAARC having five groups when fully operational. Each group would have a team leader, a research fellow, a research associate, one visiting Fellows, and one or two consultants working in their home countries. There may be additional persons working in the group, based on its success in obtaining external funding for the programs.

A centralized administrative unit would provide secretarial assistance to each group, as needed. A suggested staffing level for the General Services staff is shown in Table 4.2 .

Table 4.2 Suggested General Services Staffing Level for the SAARC Energy Center

Title	Number
GSS-1	
PS to Director	1
Admin. Officer	1
Accounts Officer	1
GSS-2	
Computer Operations Officer	1
Librarian	1
Research Assistants	10
GSS-3	
Admin. Asst.	1
Accounts Asst.	1
Library Asst.	1
Data Entry Operator	1
Receptionist	1
Storekeeper	1
GSS-4	
Drivers	5
GSS-5	
Messengers	3
GSS-6	
Peons	4
Gardner	1
Guard/Watchman	3
Cleaners	2
Total	**39**

Section 5 Financing the SAARC Energy Centre

5.1. Annual Budgets

The Heads of State or Government of the SAARC member countries have mandated that the SAARC Energy Centre be a "Centre of Excellence". This would require that the senior management and professional staff receive salaries competitive at least with those they would receive in top universities or semi-government agencies in the region. The recently promulgated salary scale for Tenure-Track professors at top universities in Pakistan is about $3,000 per month. Good consultants working on energy-related programs in many SAARC countries are earning more than $3,000 - $5,000 per month. This is the group from which ENERSAARC would expect to recruit many professionals for its staff.

We have prepared a budget which would be consistent with having ENERSAARC as a "Centre of Excellence". This annual budget (labeled CE) is shown in Table 5.1. In this budget, the salaries for the administrative (GSS) staff would also, on average, be roughly twice the usual GSS scale.

Table 5.1 "Center of Excellence" Annual Budget for the SAARC Energy Center

Category	Number of persons or events	Monthly salary per person ($)	Annual operating budget ($)
Executive Director (full time)	1	5,000	60,000
Deputy Directors	2	4,200	100,800
Deputy Directors (Team Leaders)	5	3,800	228,000
Research Felows	5	2,800	168,000
Research Associates	5	2,000	120,000
Visiting Fellows for one year each	8	3,000	288,000
(Local Exp. For Visiting Fellows)*	8	1,500	144,000
In-country Consultants (two person-months per year)	10	3,000	60,000
Information Technology Specialist	1	2,500	30,000
Communications Specialist	1	2,500	30,000
General Services Staff (as shown in Appendix 4)	39		158,000
Utilities			30,000
Vehicles fuel and maintenance	4	600	28,800
Office equipment supplies			40,000
Staff travel for conference presentations and regional meetings			70,000
Conferences for regional policy-makers and other stakeholders	2		60,000
Training seminars for mid-career professionals	1		50,000
	Annual Operating Budget		**1,665,600**

* In view of the high cost of housing in Islamabad, it is strongly urged that ENERSSARC have its own residential complex with about 32 units.

The annual budget of about $1.67 million shown in Table 5.1 is the operating budget for the third and subsequent years, when ENERSAARC can expect to be fully operational. The budget for the first and second years, when the Center is partially staffed and operational, is expected to be $750,000 and $1.2 million respectively. These numbers are based on the implementation Time Line shown in Figure 5.1.

We also present in Table 5.2 an alternative budget for ENERSAARC which reflects the current pay-scales of SAARC. In this case, the annual operating budget for the first year would be about $350,000, rising to about $500,000 in the second year, and reaching the level of about $751,000 from the third year onwards. All of these numbers would, of course, have to be adjusted for inflation.

Table 5.2 Annual Budget for ENERSAARC Based on SAARC Salary Levels

Category	Number of persons or events	Annual expenses per person ($)	Annual Total category budget ($)
Institutional Costs			
Director (part time)	1	9,270	9,270
Deputy Director (Coordination)	1	20,200	20,200
Deputy Director (Programs)	1	20,200	20,200
Deputy Directors (Team Leaders)	5	20,200	101,000
Research Fellows	5	18,580	92,900
Research Associates	5	18,580	92,900
Information Technology Specialist	1	18,580	18,580
Communications Specialist	1	18,580	18,580
General Services Staff (as shown in Appendix 4)	39		79,000
Utilities			30,000
Vehicles fuel and maintenance	4	7,200	28,800
Office equipment and supplies			40,000
Local Hospitality for Governing Board Members			5,000
Sub-total Institutional costs			556,430
Program Costs			
Conferences for regional policy-makers and other stakeholders	2		60,000
Training seminars for mid-career professionals	2		60,000
Travel for presentation of ENERSAARC analyses at regional conferences	20		50,000
Printing and distribution of Publications	10		25,000
Sub-total program costs			195,000
	Annual Operating Budget		**751,430**

5.2 Organization Chart

Reflecting the staffing requirements mentioned in section 4, an organizational chart for the SAARC Energy Centre is proposed in Figure 5.1.

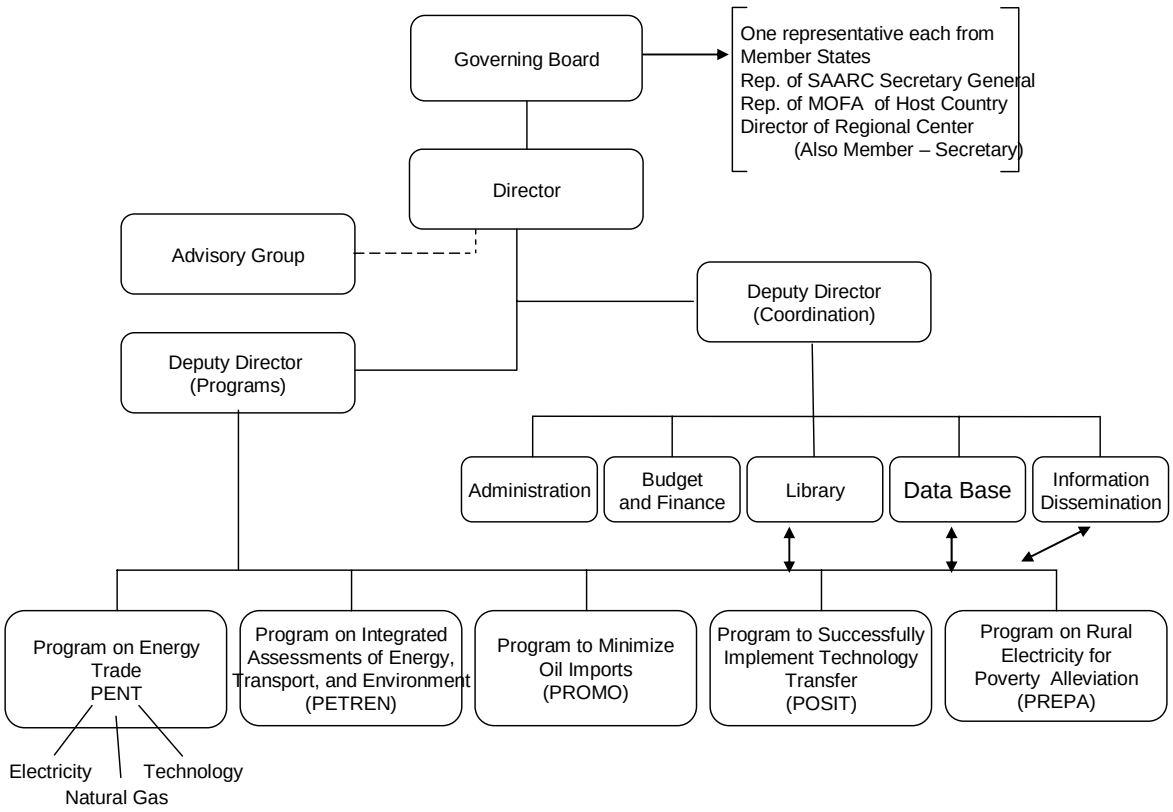

Figure 5.1 ENERSAARC Organization Chart Proposed July 2006

The Policy-making body for ENERSAARC is the Governing Board. Since SAARC already has an Energy Working Group, it is suggested that the latter also serve as the Governing Board of ENERSAARC., to avoid a proliferation of supervising groups.

The Director reports to the Governing Board, and also serves as its Member-Secretary. He would provide the intellectual leadership for ENERSAARC, in addition to having the primary responsibility for interacting with the host government and other countries, as well as securing additional funds for the planned work of ENERSAARC. He would also supervise and evaluate the work of the Deputy Directors, including Team Leaders, as well as the professional output of the teams. The Director should thus be a well known energy professional with at least 15 years of scientific, technical and management experience in the energy area. He should have an excellent record of publications and presentations at the domestic and international levels. These major responsibilities require the services of a full-time Director, rather than one who has taken it on in addition to his regular job.

A number of persons are required at the Deputy Director (DD) level. The DD for coordination would have primary responsibility for ensuring the smooth functioning and for overseeing the administrative and budgetary matters of the Centre. He would supervise and evaluate the work of the secretarial and technical staff, and designate them to work with individual teams.

The DD for Programs would monitor and evaluate the work of the individual programs, and provide assistance to them in achieving the program goals. Each Team Leader would also be at the Deputy Director level, and may in rotation serve as the Deputy Director for Programs. Each of the Deputy Directors should have had at least 10 years of experience in energy analysis and in managing a team of professionals.

The required qualifications for the other staff at ENERSAARC will be defined by the relevant Deputy Directors in consultation with the Director. Some suggestions for the technical backgrounds of the professional staff are provided in section 7.2.

5.3 Capital Costs and Space Requirements

Under the SAARC Agreement, the Government of Pakistan is expected to provide the physical facilities for ENERSAARC. The current temporary location of ENERSAARC in the HDIP building is not suitable as a long-term location for ENERSAARC.

The Centre building will require space for the staff, as well as for supporting facilities such as a library and a conference room. In view of the very high cost of rental housing in Islamabad, and the need to find suitable accommodation for the professional staff coming from other SAARC countries, it is strongly recommended that ENERSAARC construct its own housing for 32 professionals. Of the proposed 32 units, 25 would be reserved exclusively for the use of the Director, Deputy Directors, Research Fellows, and Research Associates who will be working at ENERSAARC for periods of 1-3 years. The other 7 units will be for the use of visiting Fellows and consultants who may come for periods of 1 week to 2 months.

The estimated **space requirements** for the ENERSAARC office and residential complex are given in Table 5.3 below:

Table 5.3 Space Requirements for the SAARC Energy Center

Category	Number	Space requirement (square meters per person)	Space required for category (square meters)
Main Office Building (2 or 3 Floors)			
Executive Director	1	60	60
Deputy Directors	2	40	80
Deputy Directors (Team Leaders)	5	40	200
Research Associates	10	20	200
Visiting Fellows	8	30	240
Technical professionals	5	20	200
Secretarial support for research, seminars, and training programs	8	15	120
Library	1	120	120
Conference room for 70 people	1	150	150
Group Meeting Rooms (Large)	2	40	80
Group Meeting Rooms (Small)	3	20	60
Cubicles for persons in training programs	20	10	200
Cafeteria and lounge	1	100	100
Toilets (3 for men and 3 for ladies)	6	30	180
Storage facilities	3	30	90
Total space requirement for the main building			*2,080* (in square meters)
Residential Building (2 Floors)			
Two-bedroom flats	32	130	4,160
Dining room for functions	1	100	100
Visitors lounge	1	80	80
Kitchen*	1	60	60
Pantry	1	20	20
Toilets	3	30	90
Total space requirement for the residential building			*4,510*

* The flats will have thir own kitchens. The large kitchen will be for keeping warm meals catered for special functions, and for serving breakfast to short-term visitors.

Pantry	1	20	20
Toilets	3	30	90
Total space requirement for the residential building			*4,510*

* The flats will have thir own kitchens. The large kitchen will be for keeping warm meals catered for special functions, and for serving breakfast to short-term visitors.

Construction Cost

The total built-up area for the ENERSAARC main office building and the residential facility adds up to approximately 6,590 square meters, i.e. about 71,000 square feet. Assuming a construction cost of Rupees 2,000 per square foot, the total construction cost for the two buildings is estimated at Pakistan Rupees 142 million ($2.4 million).

Land Acquisition

A suitable piece of land would also be required for building the main office building and the residential building. It is suggested that a three-acre plot be allocated for the ENERSAARC facilities. Since the Centre's staff would expect to work in close consultation with policy-makers, it would be highly desirable to have the Centre located relatively close to the policy makers in Pakistan, where counterparts from the other SAARC countries may be expected to visit.

Capital Equipment Cost

ENERSAARC needs electronic and information processing equipment that is essential to the proper functioning of a modern international centre. Each person should have a personal computer connected to a central server. There should be appropriate audio-visual equipment in the Conference room, and in at least one of the smaller meeting rooms. A more detailed list of equipment is provided in Table 5.4, along with the estimated acquisition costs.

Table 5.4 Initial Capital Expenditures for ENERSAARC

Equipment	Number	Cost per unit (Rupees)	Total for category (Rupees)
Personal computers	30	100,000	3,000,000
Laptop computers	3	150,000	450,000
Server with network	1	1,000,000	1,000,000
Multimedia Projectors	3	150,000	450,000
Sound systems in 2 rooms	2	Varies	1,500,000
Network Colour printer	1	150,000	150,000
Network Black & White Printers	2	100,000	200,000
High speed color Photocopier	1	350,000	350,000
Other office equipment, e.g. binder	1	Varies	200,000
Fax Machines	2	25,000	50,000
Telephones	25	2,000	50,000
Tables and chairs for conference rooms	50	20,000	1,000,000
Furniture for Professional staff	20	55,000	1,100,000
Furniture for GSS staff	39	30,000	1,170,000
Vehicles	4	1,300,000	5,200,000
Total initial capital equipment expenditure			
		Pak Rupees	15,870,000
		US $	264,500

Section 6 Potential Sources of Funding

In accordance with usual procedures, the host government, Pakistan, is expected to provide the land and building for the SAARC Energy Centre, as well as about **55%** of the operating budget of the Centre. The other members of SAARC would be expected to provide the remainder.

Since ENERSAARC is expected to serve the SAARC countries by providing advice on contemporary and current energy-related issues. As such, there may be times when expertise will be needed from outside the organization. For such knowledge, it may be necessary to contract with international experts. To facilitate this, it will be necessary to raise funds from external sources. Some possible sources of funding are listed below:

6.1. Multilateral Development Agencies

- **The Asian Development Bank**
  A mission from ADB has already visited the Centre, and expressed an interest in some of the areas that are discussed in this document, such as the integrated development of policies dealing with energy, environment, water, and transportation. It is suggested that the Executive Director of ENERSAARC visit ADB to follow up on the discussions.
- **The World Bank**
  The World Bank has been active in the energy sector almost since the time it commenced operations. It has usually provided loans for specific energy and infrastructure projects. Since ENERSAARC does not have the authority to borrow funds, it would need to explore the possibility of getting outright grants for analytical studies.
- **UNDP**
  Over the years, UNDP has supported a number of regional programs dealing with energy. Most of its funding, though, is earmarked for single-country projects. ENERSAARC may initially explore the feasibility of UNDP providing two consultants for program development, including the writing of proposals. It could subsequently submit a project for possible funding by UNDP's Regional Bureau for Asia and the Pacific.
- **UNEP**
  The United Nations Environment Program has also been active in dealing with aspects of energy that affect the global and local environment. The UNEP Risoe Centre on Energy, Climate and Sustainable Development (URC) is one of the organizations that supports UNEP in its aim to incorporate environmental aspects into energy planning and policy worldwide, with a special emphasis to assist developing countries. URC is sponsored by UNEP, the Danish International Development Assistance (DANIDA) and the Risoe National Laboratory of Denmark. It would be desirable for ENERSAARC to explore opportunities for support directly from the UNEP headquarters in Nairobi, as well as with URC.

- **The European Union**
  In addition to bilateral support that may be available from individual European countries such as France, Germany, Sweden, and the United Kingdom, the European Union, with its Headquarters in Brussels, has as a whole entity, also supported energy programs in several countries. Opportunities for support from EU should be explored by ENERSAARC.

6.2. Bilateral Development Assistance Organizations

A number of countries, including Japan, Canada, Germany, the United States, the United Kingdom, and Sweden have provided development assistance to South Asian countries for decades, including in the energy sector. The U.S. Agency for International Development, for example, provides considerable assistance to many Asian countries as part of the South Asia Regional Initiative (SARI/E) in energy, and provided support to the Planning Commission of Pakistan for energy planning for several years prior to that. It has also agreed to assist in harmonizing energy efficiency codes and standards for the region[56].

The United States has reaffirmed its commitment to assist nations of South Asia in meeting their growing energy needs by adopting and advancing renewable energy technologies. At a recent South Asia Conference on Renewable Energy, the Mission Director of USAID in India stated[57] that his organization is committed to working with the governments and the private sector of the countries of South Asia to advance renewable energy technologies. He pointed out that a diversified energy portfolio with a strong renewable energy component can better ensure a sustainable energy economy while helping to preserve a clean environment. He added that USAID's efforts to promote regional energy cooperation through its South Asia Regional Initiative/Energy (SARI/E) program and its work in the energy sector in India and other countries of this region underscore this principle. The SAARC Energy Centre could make a valuable contribution in this effort.

The German Agency for Technical Cooperation (GTZ) has a TERNA (Technical Expertise for Renewable Energy Application) program that supports participating countries in the evaluation and use of wind energy[58]. Since Germany has the largest installed wind capacity in the world, it would be particularly worth exploring whether GTZ could provide support in this area through ENERSAARC, which would benefit almost all the countries in South Asia. ENERSAARC has held preliminary discussions with GTZ, and the latter organization has expressed an interest in possible support for programs dealing with rural energy and energy efficiency.

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[56] U.S. Agency for International Development (USAID, 2006). *Congressional Budget Justification for Fiscal Year 2006.*

[57] U.S. Agency for International Development (2006). "*U.S. to Assist South Asian Nations Advance Renewable Energy Technologies*". Statement by the Mission Director of USAID at the South Asia Conference on Renewable Energy, 18 April 2006.

[58] Gesselschaft fur Technische Zusammenarbeit (GTZ, 2006). Accessed on May 26, 2006 at www.gtz.de/de/themen/umwelt-infrastruktur/energie/6657.htm.

The Japan International Cooperation Agency (JICA) has active programs in Electric Power Supply and Renewable Energy. It is providing support to many countries for policy formulation and institution building and to expanding the use of renewable energy[59]. It also supports energy conservation programs.

China has worked closely with Pakistan in many sectors, including energy, transportation and industry. During recent years, its cooperative activities in other South Asian countries have increased. ENERSAARC may wish to explore the possibility of cooperation and support from semi-governmental organizations such as the Energy Research Institute (ERI) of the National Development and Reform Commission (NDRC).

Possible support for ENERSAARC from Public Sector Corporations, Foundations, and the Private Sector should be explored. Examples of such organizations are listed below without further discussion:

6.3. Public Sector Corporations

- National Thermal Power Corporation, India (NTPC);
- Gas India, Ltd. (GAIL);
- Oil and Gas Development Corporation.

6.4. Foundations

- Energy Foundation (USA)
- The Aga Khan Foundation
- Other Foundations operating in South Asia

6.5. Private Sector

- Oil companies such as Oil and Gas Development Company Limited (OGDCL), Shell Pakistan, ENI Pakistan Limited;
- Natural gas transmission companies such as Sui Northern Gas Pipelines Limited, Sui Southern Gas Company Limited;
- Other companies such as Schlumberger and Reliance Industries.

[59] Japan International Cooperation Agency (JICA, 2006). *JICA Initiatives.* Accessible at www.jica.go.jp/english/global/ener/initiatives.html.

Section 7 Human and Financial Resources

The implementation of the Strategic and Operational Plans discussed earlier require that the financial and professional resources to undertake the various activities be available at a very early date. These are the topics covered in the current section.

7.1. Fund-raising

It is axiomatic that any "Center of Excellence" requires highly qualified staff and a suitable level of funding. Most of the basic funding for ENERSAARC will be provided by the host government and other member countries of SAARC. A substantial amount of funding for specific programs would need to be raised from multi-lateral and bi-lateral development assistance agencies, the private sector, and other organizations such as those listed in Section 6 of this Report.

It is suggested that the Director of ENERSAARC visit potential donors in their regional or home bases, and explore possible support by them for the activities of the Centre.

7.2. Recruitment of staff

All organizations evolve over time, and initiatives taken at present need to reflect the current situation rather than the one that prevailed two decades ago. This also applies to SAARC and the Centres it has established so far, as was recognized in the Dhaka Declaration[60], which states under Item 50 (Strengthening Institutional Mechanisms of SAARC):

"The Heads of State and Government agreed that with the incremental broadening of the SAARC agenda and increased emphasis being placed on implementation of plans and programmes, there was a need for a commensurate strengthening of institutional capabilities of SAARC. Recognizing the importance of thematic Ministerial meetings, they emphasized that these meetings should focus on regional challenges and priorities and contribute to the objectives of SAARC. They agreed that on completion of twenty years of SAARC's existence, it was essential that a comprehensive review and reform of all SAARC institutions and mechanisms, including the Secretariat and the Regional Centers should be undertaken….."

The SAARC Energy Center is the first SAARC Center to be established simultaneously with the Dhaka Declaration, and could serve as a prototype for future SAARC Centres. The existing SAARC Centres played an important role in bringing professionals in selected fields from the SAARC countries together for the first time, and initiating cooperative activities in several fields.

[60] South Asian Association for Regional Cooperation (2005). Dhaka Declaration. Thirteenth SAARC Summit, Dhaka, 13 November 2005.

SAARC celebrates its 21st anniversary this year, which is generally considered as the age at which youth goes over into adulthood. Several major changes have occurred during the past 20 years in South Asia. One is the availability of instant communication, and access to global information and data via the internet. Further, the role of the private sector in South Asia was very small during the 1980s, and most of the well educated and highly competent people worked for public sector institutions, including the civil service, research centers, and universities. The situation is very different now, and there is tough competition from the private sector, non-governmental organizations (NGOs), and international agencies for highly qualified staff in high priority areas such as energy.

If the Centre is to fulfill its mandate for excellence, it would have to compete with the private sector, NGOs, and development agencies for the services of outstanding energy professionals. The financing for the Centre would have to reflect these realities, and one of the two budgets proposed in Section 5 is based on a competitive salary scale. The SAARC Energy Centre could be considered as a prototype for new institutions that might be established by a mature SAARC, and possibly for modifying the modus operandi of existing ones.

ENERSAARC will need professionals with a diversity of expertise in various fields, and each of the persons recruited will be expected to contribute to more than one program. Each program would require a minimum of 4 person-years of professional input per year, but this could be provided by a combination of 6 or 7 persons at the Research Fellow and Research Associate levels. For the programs proposed, it is suggested that the professional expertise of these include the following:

- Energy Trade Economist;
- Policy Analyst for Integrating Energy and Related Sectors
- Analyst for assessing the environmental impacts of alternative energy systems and projects;
- Electrical Engineer for analysis of integrating grids of different countries, and for incorporating electricity from renewable systems;
- Solar and wind energy specialist;
- Economist for assessing the benefits and costs of energy projects;
- Specialist for the socially acceptable design and maintenance of rural energy systems;
- Specialist in analyzing emissions from vehicles and in conversion to low emission fuel use;
- Specialist in database development;
- Specialist in identifying the factors that determine successful transfers of technology and in proposing specific technologies for transfer.

This can be illustrated in the form of a matrix, as displayed in Table 7.1. The types of professional backgrounds of the longer-term research staff of the institute are also shown in the Table 7.1.

Table 7.1 Staff Background and Illustrative Contributions to Programs

Professional Staff	**Programs**				
	PENT	PETREN	PROMO	POSIT	PREPA
Research Fellows					
Energy Trade Economist	X		X		
Policy Analyst for Integrating Energy and Related Policies		X	X		
Environment Impact Analyst		X		X	
Electrical Engineer	X				X
Renewable Energy Specialist				X	X
Research Associates					
Economist for Benefit-Cost Analysis		X		X	
Specialist in energy for rural development			X		X
Specialist in reducing emissions from energy use		X	X		
Specialist for database development	X	X			X
Specialist in technology transfer			X	X	
Visiting Fellows					
1	X				
2		X			
3			X		
4				X	
5					X
In-Country Consultants					
	X				
		X			
			X		
				X	
					X

7.3. Strategic alliances with cooperating institutions

There are a number of good institutions in South Asia and elsewhere, with which the Centre could cooperate for mutual benefit. The Energy and Resources Institute (TERI) is the leading institution in the region dealing with issues of energy, environment, and other related concerns. TERI also provides a secretariat for the Asian Energy Institute (AEI), which is a network of 11 energy institutes from all parts of Asia. In addition to TERI, there are three other South Asian institutes participating in AEI. TERI and AEI would clearly be important strategic partners for ENERSAARC for its analytical and dissemination activities.

The initial list of important institutions in South Asia with which ENERSAARC may have strategic partnerships could include:

- The Energy and Resources Institute (TERI), based in India
- Bangladesh Centre for Advanced Studies (BCAS)
- Bangladesh University of Engineering and Technology (BUET)
- International Centre for Integrated Mountain Development (ICIMOD), based in Nepal
- Alternative Energy Promotion Center (AEPC) in Nepal
- Global Change Impact Studies Centre (GCISC) in Pakistan
- Sustainable Development Policy Institute in Pakistan

There are a number of organizations *outside* South Asia with which it would be valuable for the Centre to have active collaboration. These include:

- The ASEAN Energy Centre. The interaction between ENERSAARC and the ASEAN Energy Centre has been explicitly mentioned in the document establishing the former. The ASEAN Centre has been in existence for over 20 years, and deals with many of the issues in Southeast Asia that face ENERSAARC as well.
- The International Institute for Applied Systems Analysis (IIASA), which is one of the original organizations set up to promote cooperation between the West (Europe and North America) and Eastern Europe during the height of the cold war. It was the only major organization where scientists and professionals from both sides worked during the cold war, and the work has continued subsequently, with the addition of China, Egypt, and Japan as non-European full members of IIASA. IIASA is based in Vienna on land provided by the Austrian government.
- Asia Pacific Energy Research Centre (APERC), based in Japan. Their Institute of Energy Economics has an international reputation.
- Stockholm Environment Institute (SEI) is one of the world's leading institutes dealing with issues related to energy as well as environment. It has established regional centers in the United Kingdom, U.S.A., and recently in Bangkok.
- Several laboratories of the U. S. Department of Energy, such as the National Renewable Energy Laboratory (NREL) in Colorado, the Argonne National Laboratory in Illinois, the National Energy Technology Laboratory (NETL), and the Lawrence Berkeley National Laboratory (LBNL) in California. NREL is probably the leading laboratory in the world for the development of renewable energy technologies, while the Argonne and Berkeley Labs have considerable expertise in energy systems analysis, and the economic and environmental, and transportation aspects of energy.
- The Energy Research Institute (ERI) of the National Development and Reform Commission (NDRC) of China, and its four subsidiary centers:
  - Center for Energy Economy and Development Strategy Research;
  - Energy Efficiency Center;
  - Center for Renewable Energy Development;
  - Center for Energy, Environment and Climate Change Research;
- Tsinghua University and its energy institutes.
- Centre for Energy-Environment Research and Development, Thailand;

- The Renewable Energy and Energy Efficiency Partnership (REEEP), which is based in the Asian Energy Institute, headquartered at TERI in New Delhi. REEEP is a public-private partnership formed in 2002 during the World Summit on Sustainable Development in Johannesburg and has the status of an international NGO. It currently has 140 partners (39 of which are governments) and represents one of the key partnerships in the field of renewable energy and energy efficiency[61]. REEEP receives financial contributions from Austria, Canada, Germany, Ireland, Italy, the Netherlands, Spain, the United Kingdom, the United States and the European Union. As the main donor, the United Kingdom has supported REEEP since its inception. Since the aim of REEP is to contribute significantly to the global uptake of renewable energy and energy efficiency by carrying out projects that help to remove barriers to the marketplace for clean energy, it offers good opportunities for ENERSAARC to cooperate in the PROMO and PREPA projects..

- Interactions with various universities, NGOs, and other organizations, with which links can be established on an ad hoc basis.

7.4 Initiation of programs

It is suggested that only one or two programs be initiated during the first full year of operation of ENERSAARC. The reputation of the Centre will be determined by the quality of the work it is doing, so it is important to have a critical mass of highly competent people working in one or two areas, rather than being spread too thin. A tentative schedule for the initiation and implementation of the programs, as well as for other activities of ENERSAARC, is shown in Figure 7.1 in section 7.6.

7.5 Setting up of database

There are vast quantities of data available in the SAARC countries, and the Centre would need to be very selective in deciding what should be included. A group of energy professionals should meet very early during the startup of ENERSAARC to determine what data are required for the programs being undertaken by the Centre or needed by the policy-makers in the region, the accuracy of the data available, and the need to reconcile data from the different countries using a common methodology. Some of the possible categories in which data could be collected were mentioned earlier in this Report. Only verified data should be included in the database. Ideally, it should be a goal for ENERSAARC that professionals and policymakers would look to its web site first for reliable regional data, and only if it is not available there, go to other sources.

ENERSAARC staff in each of the program areas would be expected to contribute to the development of the database, and to ensuring the accuracy of the data they supply, as discussed earlier in Section 3.6.

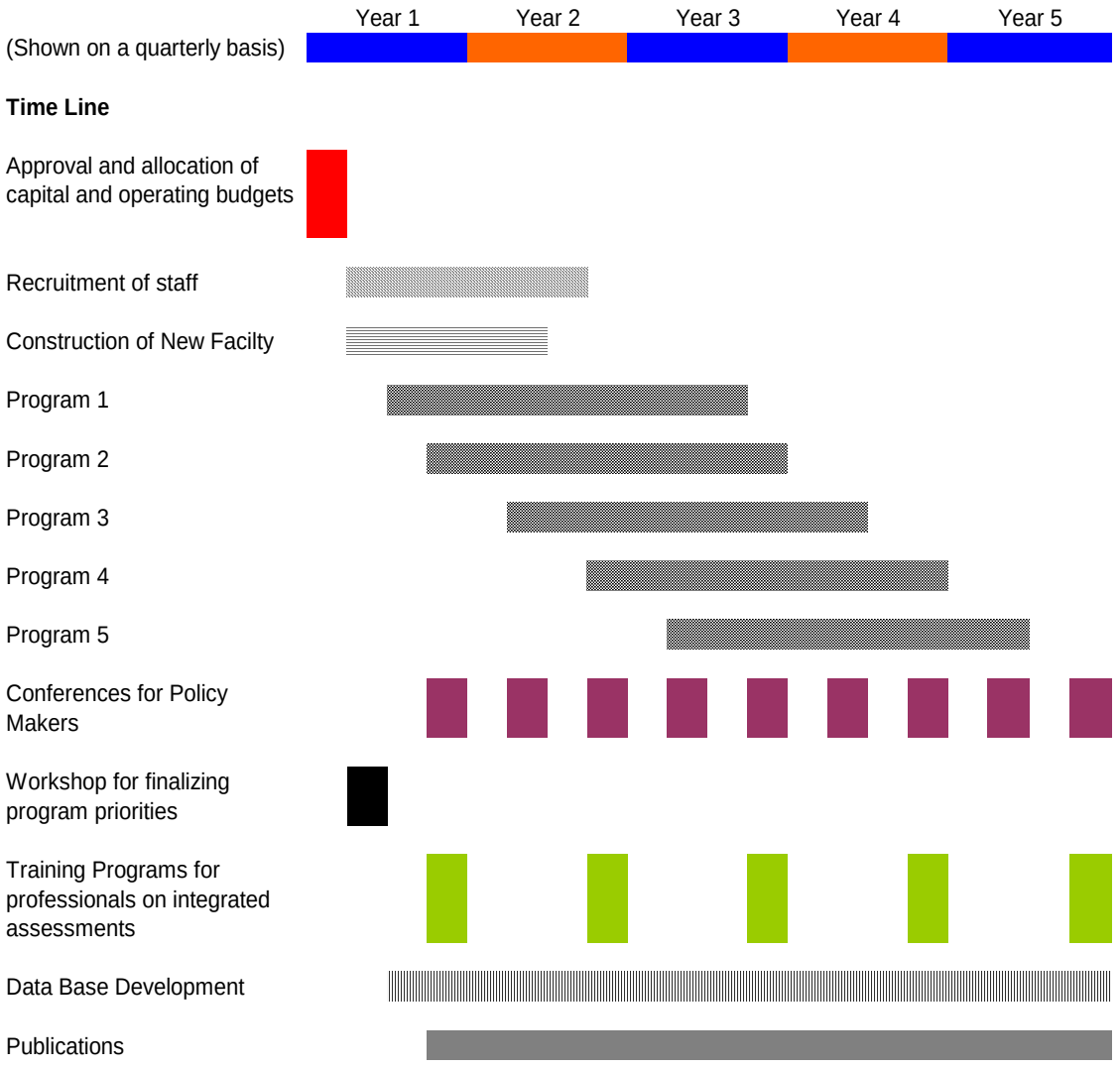
[61] The Renewable Energy and Efficiency Partnership (REEEP, 2006). Accessed at static.teriin.org/news/nov056.htm.

7.6. A tentative implementation plan

The various activities planned by ENERSAARC would be started sequentially, to enhance the likelihood that critical mass can be achieved in each area. The Centre can be expected to operate on a fully-staffed basis during the third year of operation.

A suggested implementation plan for the SAARC Energy Centre is shown in Figure 7.1.

Figure 7.1 Suggested Implementation Plan for the SAARC Energy Center



The requisites for implementing the activities shown in Figure 7.1 are, of course, financial commitments, the availability of physical facilities, and well-qualified staff. Ensuring these will be the first priority of the Centre. Energy plays a crucial role in the development of the SAARC countries, and ENERSAARC can make an important contribution in this vital area by undertaking high quality analyses for decision-making, and promoting energy cooperation in the region.

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