PART III FORMULATION OF BASIC STRATEGY AND POLICY FOR EFFECTIVE POWER SUPPLY AND POWER DEVELOPMENT

CHAPTER 11

STUDY AND EVALUATION OF THE ENERGY SAVING PLAN

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(1) The electrification ratio in Viet Nam (the rate of electric power demand to total energy demand) rose from 6% in 1980 to 7% in 1985, 14% in 1990, and 15% in 1992 (as calculated from the energy balance table produced by IEV and IEA). The main feature is a sharp increase seen in the second half of the 1980s.

These electrification ratios, however, could be somewhat less when added non-commercial energy, as the total energy demand used in the above calculation covers only commercial energy. Compared with corresponding trends of other Asian countries, Viet Nam' s 1992 figure already stands near 17% posted by Thailand and Philippines. Consequently, it appears that the ratio in Viet Nam will continue to rise, but more moderately in the future than at the present time. It is, therefore, assumed that the portion of electric power within total energy demand in Vietnam is most likely to expand, and will not decline in the future.

(2) Other than the electrification ratio, there are certain other factors that serve as important indices for the national energy-saving policy in the electric power sector; the ratio between the primary energy input (PEI) into the power sector and total primary energy supply (TPES); the ratio between the amount of power generated and the primary energy input; and the ratio between end-use power consumption and the primary energy input are shown in Table 11-1.

In 1990, the primary energy consumption of the electric power sector was about 50% of total energy supply. (53.6% when calculated from ADB's energy balance table.) Regarding the future prospect predicted in IEV energy balance table, the above ratio in percentage is expected to exceed 50% by 2000 in the low case and the high case. This would mean that half the total energy consumption in Vietnam would be attributed to the electric power sector, indicating the importance of considering energy-saving plans in the electric power sector in Vietnam at this time.

The corresponding values of several Asian countries in 1992 are shown in Table 11-2.

Of the above indices, the ratio of power generated to PEI indicates power generation efficiency in the macro sense of the term, and the difference between the ratios, "power generated to PEI" and "end-use power consumption to PEI" indicates the overall energy loss ratio. Viet Nam's actual performance is seen as being considerably inefficient in comparison to that of Thailand or of Malaysia. However, Vietnam does have ample room for improvement and does have a large energy-saving potential.

(3) Energy-saving measures are also very effective in environmental control. For example, according to an analysis of the major contributing factors of effective environmental improvement achieved during the 1970s and thereafter - when Japan made major efforts to enforce its environmental protection measures, a 42% reduction in SO_X emission (in 1974-1986) was due to energy-saving efforts. This was followed by the introduction of flue gas desulfurization units at 35%, of fuel conversion at 16% with the remaining 7% due to changes in industrial products and other ("Quality of the Environment of Japan, 1990", published by the Environmental Agency).

Considering the above, this Chapter is structured in three sections:

- energy-saving measures in thermal power plants
- energy-saving measures in transmission and distribution systems
- energy-saving measures in final consumption sector

We mainly discuss, with recommended improvement measures, the power generation efficiency in thermal power plants; the energy loss ratio in transmission and distribution systems; and electricity intensities of the major industrial products in final consumption sector.

Table 11-1 Energy Index of Electric Sector in Viet Nam

(Unit: %)

	PEI/TPES	Generation/PEI	End-use consumption/PEI
1980	30.2	22.2	16.6
1985	36.2	24.2	18.4
1990	49.5	24.6	17.7

Estimated from IEV's energy balance tables (In terms of oil equivalent)

Table 11-2 Energy Index 1992 Records of Selected Asian Country

(Unit: %)

	PEI/TPES	Generation/PEI	End-use consumption/PEI
Thailand	35.7	38.8	33.5
Malaysia	23.2	38.7	35.0
Philippines	40.9	26.6	23.0
Indonesia	17.3	36.3	28.3
Korea	26.6	37.2	32.4
Taiwan	40.9	37.8	33.3

Prepared from IEA's Energy Statistics and Balances of Non-OECD Countries

11.1 Energy Conservation in Thermal Power Plants

11.1.1 Effective Operation of Thermal Power Plants

Energy-saving measures in thermal power plants require improvement in the average thermal heat efficiency of the power plant and an economizing of the station service power. The current profile of the existing thermal power plants is shown as follows:

Based on the data of Table 11.1-1, it is concluded:

* The Uong Bi and Ninh Binh thermal power plants have now been in operation for 20 years. This long term has resulted in an obvious reduction in their average thermal efficiency. In 1993, with the completion of the Hoa Binh hydropower plant, the annual availability factors of both plants lowered to 6% and 21%, respectively.

* Both the Tra Noc and Thu Duc heavy-oil thermal power plants maintain high availability factors with good indications in average thermal efficiency and station service power, reflecting good maintenance practices.

* With the commissioning of the 500 kV Da Nang and Plei Ku Substations and the expansion of the transmission and distribution network, the diesel power generation units, many of which are located in central and south Vietnam, will be gradually taken out of service or retired to auxiliary roles.

Based on this, it is recommended that, of the existing thermal power plants, the Pha Lai coal thermal power plant and the new GT's (Thu Duc GT and Ba Ria GT) be selected as the target power units for which major energy-saving efforts should be made to realize significant results. However, contribution of Pha Lai thermal power plant to energy conservation is not so much expectative, because the supply capability will be decreased by commissioning of Pha Lai II.

11.1.2 Conservation Potentials and Targets

(1) Positions of the existing thermal power units in PDP simulation

We indicate the following, based on our PDP simulation:

(a) The power plants in operation in 1995 are Pha Lai (coal), Ba Ria (New GT) and Thu Duc (New GT). Ninh Binh (coal), Uong Bi (coal), and Thu Duc (oil) are also in operation, but their output is negligible.

(b) The power generated is zero for the Tra Noc oil thermal power plant and also for the existing gas-turbine thermal power plant and diesel thermal power plants in the south.

These units will have no chance of generating power, as long as it is possible for the south to receive fuel-free excess power from the north.

(c) Power will be generated by the other stations, but their output is quite small.

Based on the above, we advise the following from the standpoint of energy-saving measures:

(a) Even in the 2000s, as they are expected to perform as adequate energy supply sources for the country, it remains appropriate to focus on three power plants, Pha Lai, Thu Duc GT and Ba Ria GT, for the application of energy-saving measures.

(b) If there is an electric power supply shortfall throughout the 2000s, the New GTs in the south may be called on to operate at high availability factors, although their fuel unit cost is expected to be relatively high. Consequently, it would be most effective from the energy-saving standpoint to turn the GTs into combined-cycle plants toward ensuring an improved power-generating efficiency. However, it would be better that they be operated as part of the base supply source when made into combined-cycle plants, since they are relatively small sized and must always be operated at high availability factors for the sake of operation economy.

(c) As Ninh Binh thermal power plant provides unfavorable conditions from the aspect of environmental protection, it is, therefore, not recommendable to provide measures to rejuvenate any of its components to prolong its service life. This unit is being used for phase modification to coordinate power systems, and it is recommended that its decommissioning should be very seriously considered following the commissioning of Pha Lai II.

(d) It is difficult to make speedy decisions on the Pha Lai thermal power plant regarding the energy-saving measures to apply because:

- Although it has been in operation for little more than 10 years, as the equipment has not been well maintained, a certain investment is now required for repairs and modifications.

- The simulation shows that the contribution of Pha Lai to the overall power generation and supply capacity will be reduced sharply with the commissioning of Pha Lai II. Furthermore, depending on the scenario of the nation's electric power development plan, it may still be utilized as part of the peak power supply capacity, even in 2010.

- From the standpoint of the employment of 2,400 operators and maintenance service people, its permanent shut-down should be linked to the plans for Pha Lai II.

In conclusion, the pending question for the Pha Lai thermal power plant is how much longer the plant should be kept in good order and what should be done to prolong its service life to meet the requirement, rather than what should be done about the energy-saving measures for it. Retaining Pha Lai thermal power plant as a viable entity is a matter of future discussion from the aspect of the power supply potential capacity in Vietnam's northern region.

(2) Average thermal efficiency and station service power expected of a new thermal power plant

Average thermal efficiency is a highly effective factor in energy-saving measures. For a new thermal electric power development plan, the goals for average thermal efficiency are set as follows:

	Average thermal efficiency (%)	Annual availability factor (%)
Coal thermal	34.0	70
Gas thermal	36.0	80
Combined cycle thermal	45.0	80

From the simulation (in the case of SS/GS), Vietnam' s national annual average thermal efficiency was assumed as follows:

Year	1991	1995	2000	2005	2010
Efficiency (%)	27.0	27.0	37.5	40.5	37.1

As the above shows, the national average thermal efficiency is expected to rise dramatically in line with the introduction of new power source.

Based on the above, it is seen:

(a) As higher plant efficiency, almost all newly-built power plants have been kept running at high operation rates from the very commencement of their commercial operations. And hydroelectric power, which provides low power generation cost, serves as the source of the base and peak supply of electricity. The obsolete thermal plants will gradually retire and become peak power suppliers as their availability factors diminish. This will constitute the most economic power development system as a whole, directly contributing to the energy-saving policy of the country.

(b) As base operation cannot be expected of the coal-fired power stations in the north throughout the 2000s, it is already necessary at the design stage to consider daily start-stop operation from an energy-saving perspective.

(c) The combined-cycle thermal power plants, when made available, should become a significant factor in expanding the power supply with relatively inexpensive cost performance.

(d) Ways to economize the station service power of a new thermal power plant will be a matter of future development. In the course of developing the construction plan, it can be taken into consideration from the design stage.

(3) Reduction in diesel oil consumption

It is impossible to consider energy-saving measures in diesel power generation without referring to the completion of linking the 500 kV lines between north and south, thereby enabling a north/south exchange of electric power.

First, we refer to the benefit received by the central region of Vietnam. Prior to completion of the system, the areas which required electric power the most in the central region mainly depended on a direct supply through the transmission line from the Hoa Binh hydropower plant, more than 500 km away. This made it difficult to maintain high power supply reliability, with voltage drops and equipment deterioration occurring in both the transmission and transforming facilities. With this, as the transmission system at large in the central region was not well organized into a working network, it was unavoidable to depend on a multiple number of diesel power generation units in dispersed locations, despite the inevitable high cost of that power generation.

The linkage of a 500 kV transmission line was completed in mid-1994. This resolved the problem of voltage and frequency drops and that of the absolute amount of electric power supply capacity for Da Nang. In addition, a new substation at Plei Ku provided the keystone for power distribution in the three provinces in the central highlands. The planned extension of a 220 kV transmission line to Nha Trang located on the eastern seaboard to be completed by the end of 1995, along with the commissioning of the Vinh Son hydropower plant at the end of 1994, marked a very distinctive improvement in the region's power supply situation.

In the south, however, for many years there had also been a problem of power shortage due to the absence of newly initiated power development plans. This was also temporarily resolved through the commissioning of the 500 kV interconnected transmission line.

Now that changes have recently taken place in the mode of power demand and supply in the central and southern regions, it is expected that a new pattern of power demand and supply will emerge, including the establishment of EVN.

Here, we estimate the energy-saving effect to be achieved by reduction in diesel power generation in the central region and subsequent reduction in fuel costs.

Conditions	Annual energy	250 GWh (equivalent to 1993 value)
	Averaged efficiency	30%
	Fuel cost	320 US$/k$\ell$

$$\text{AnnualCost} = \frac{860(\text{kcal / kWh})}{0.30} \text{x} \frac{1}{9{,}200(\text{kcal} / \ell)} \text{x250GWhx320(US\$ / k}\ell)$$

$$= 78{,}000 \text{ k}\ell \text{ x } 320 \text{ U\$/k}\ell = \text{US\$25 million}$$

As a power supplier, diesel power generation rapidly lost its importance as the Da Nang and Plei Ku 500 kV substations began commercial operations in October, 1994. This will result in a sharp reduction in actual fuel costs, much more so than the fuel cost estimated by the above calculations.

11.1.3 Measures

(1) As described, of the exisiting thermal power plants, good results can be anticipated from the Pha Lai coal-fired thermal power plant and a new set of gas-turbine thermal power plants, from the standpoint of energy-saving measures. However, a high availability factor can no longer be expected from the Pha Lai coal-fired thermal power plant. Therefore, rather than planning energy-saving measures for its

components and facilities, it is recommended that efforts be focused on improving the overall availability factor of the entire system, in which the installed capacity of the power station in question will be gradually and systematically replaced with that of new power-generation units.

(2) The effective operations of coal-fired thermal power plants can be realized through (1) Reduced heat loss, and heat recovery, (2) Maintenance and improvement of the thermal efficiency of the steam cycle, (3) Reduction of station service power and auxiliary steam. However, for the existing coal-fired thermal power plants, it is not judicious to make plans requiring major modifications or changes to installed equipment and components, as low availability factors are predicted for these.

(3) There will be no room for further improvement of the existing oil-fired thermal power plants, as they are very well operated and maintained.

(4) It is essential that new thermal power plants be equipped with highly efficient components. Done properly, this results in high efficiency and high energy-saving. Especially, making a combined cycle system out of any new power plant and taking full advantage of its gas turbines, would lead to higher power-generation efficiency, which would also be highly effective from the energy-saving aspect.

(5) Refer to the Appendix regarding efficient operations in practice and examples of efficiency improvement through modifications and alterations in a coal-fired power plant.

Table 11.1-1 Energy Efficiency of Thermal Power Plant in Viet Nam

	Averaged Efficiency (%)*	Annual Plant Factor (%)	Station Service (%)	Commissioning Year
Pha Lai (Coal)	27	39 ('90)	19.2 ('93)	'83 ~ '86
Uong Bi (Coal)	18	25 ('90)	22.8 ('93)	'75
Ninh Binh (Coal)	17	30 ('90)	16.7 ('93)	'74
Tra Noc (Oil)	33	60 ('90)	6.2	'75
Thu Duc (Oil)	33	46 ('90)	6.7	'66, '72
Diesel (in Center)	N.A.	25	2.5	-
New GT (Thu duc GT)	N.A.	N.A.	1.3	-
(Ba Ria GT)				
Takasago(Coal)**	38	70	4.1 (94)	'68

* Estimated by JICA Study Team

** Excludes own use for desulfurization/denitrofication units

11.2 Energy Conservation in Transmission and Distribution System

11.2.1 Losses in Transmission and Distribution System

(1) Transmission and Distribution (T & D) Loss in Vietnamese Power System

Present situation of T & D loss in the Vietnamese power system is described in Clause 3.4.3. According to the third Master Plan, the 1993 T & D loss factor and station service ratio of whole Viet Nam and of each power company are as given below:

	T & D Loss Factor (%)	Station Service Ratio (%)
Viet Nam	19.9	5.8
Northern System	20	8
Southern System	20	3
Central System	18	7

The above T & D loss consists of ohmic loss in lines, transformer and other equipment loss, etc., and commercial loss, illegal use, pilferage, etc.

(2) Comparison with Other Countries

The T & D loss factor of the Vietnamese power system is considerably high compared with actual figures of other Asian countries, including developed and developing countries, as given below:

Country	T & D Loss Factor (%)
Viet Nam (1993)	19.9
Japan (1993)	5.7
Korea (1991)	5.6
Taiwan (1992)	6.3
China (1991)	8.2
Thailand (1991)	9.8
Indonesia (1991/92)	14.8

In Japan, during the period from 1951 to 1960 the average T & D loss of the power companies had decreased from 25.3% to 11.4%, less than a half, due to the raising of HT distribution voltage from 3.3 kV to 6.6 kV, use of insulated wires for the distribution lines and resultant increase in sectional area, and other improvements.

11.2.2 Conservation Potentials and Targets

The principle of "the lower the better" is self evident for the T & D loss. However, every loss reduction measure will cost a certain amount, and there must be a certain limitation in actual execution. For a 5000MW power system (roughly corresponds to the Vietnamese power system of year 2000), 10% reduction in T & D loss corresponds to a 600MW (including 20% system reservation) power station. Various loss reduction measures shall be realized taking into account economic merits.

For final decision of each individual measure, an economical justification must be confirmed for each case. However, taking into account the actual situation of similar developing countries, it is considered to set a target to reduce the T & D loss within the plan period from the present 20% to around 10%, a half of the present loss and roughly corresponds to the present Thai Value

11.2.3 Measures

Taking into account the present situation of the Vietnamese power system, the following measures are conceived to be appropriate.

(1) Long Distance Transmission

The present situation of the power supply in the Northern Region, too much dependence on the Hoa Binh hydropower plant, results in long distance transmission to the consumption centers and causes large transmission loss. Such situation can not be averted as the generation cost of this power station is low. The future implementation of the Son La hydropower project will also create a similar problem. Similar problem will arise also for the Yaly hydropower plant of the Central Region. In deciding the sites of constructing power plants proper distribution of power sources to avoid long transmission shall be taken into account.

Power loss in long 110kV lines can be curtailed by converting to the 220kV supply. In extension of the 220kV system to load centers supplied with 110kV lines, proper procedures such as power flow studies, economical justification, etc. are necessary.

(2) Proper Selection of Line Conductor Sizes

The most appropriate conductor size for a line shall normally be determined as the result of economic evaluation, so as to minimize the overall cost through the durable length of time. The loss value is evaluated in kW and kWh with a typical generation cost of standardized thermal power plant. A cost increase for a larger conductor is usually not much compared to evaluated cost decrease by ohmic loss reduction, which is in inverse proportion to the sectional area of conductor. Such a study tends to selection of relatively large conductors.

The 220kV line conductors used in Viet Nam for major lines seem generally small if future growth of demand is taken into account. In 10 to 15 years time, the power demand in Viet Nam is forecasted to grow to 4 to 5 times the present demand. Especially, for major lines around major cities of Hanoi, Ho Chi Minh, etc., future increase in power flow in 10 to 15 years shall be taken into account in the conductor selection. Use of double conductors shall also be considered in order not only to increase current carrying capacity but also to decrease reactance so as to improve transmission characteristics. Thus, the double conductor line has merits not only to large power transmission but also to long transmission of large power. It is a world-wide practice to install only double conductors on the major transmission lines of 220kV and above in voltage.

Also for distribution lines, economical studies and consideration to future increase will result in selection of larger conductors. The transmission and distribution loss of several percent in developed countries has been derived from pursuit of economical merits.

(3) **Power Factor Improvement**

The operating power factor of the Vietnamese power system is low, being 80 to 85% at the outgoing points of 110kV feeders. Flow of low power factor power in line cause not only large power loss but also significant voltage drop. To avoid this problem, the power factor must be improved as far as applicable.

It is a usual practice to install static capacitors for improving the system power factor at substations and at consumer ends.

- At substations, static capacitors are usually connected to the tertiary windings of main transformers (case of Phu Lam 500kV substation), or on secondary side bus (case of the Southern System of PC2 for the Mekong delta area). The unit capacity of static capacitor shall be decided so as to limit variation of bus voltage due to switching of unit capacitor within a predetermined range. In Japan, this limit is 2%. For Viet Nam, an appropriate limit shall be selected.

- For power system management, it is more preferably to improve power factor at the distribution ends at consumers. It is not practical to install static capacitors at small general consumers, and it is recommended to request large consumers to install static capacitors so as to improve the receiving power factor to 90 to 95%. In Japan, such improvement of power factor is included in a supply contract.

- As a policy, it is desirable to promote use of high power factor appliances by attaching static capacitor and other means. Actually in Japan, only high power factor fluorescent lamps can be sold and used. It is noted that this measure results in some cost by users.

(4) **Application of Higher Distribution Voltage**

The MOE decided to adopt the future distribution voltage of 20kV covering the whole country. Unified application of higher distribution voltage results in reduction of distribution loss with sacrifice of equipment cost.

The existing distribution voltage of 10/6kV combined with 35kV system in the north and 15kV in the south will be upgraded to the nation-wide 20kV. However, 35kV systems will be applied partly for long distance power distribution in mountainous areas.

(5) **Length of High Voltage Distribution Lines**

In the Vietnamese distribution system, length of high voltage distribution lines is very long. This causes large ohmic loss and voltage drop. The reduction of line length can be attained by increasing the number of distribution substations in a certain area.

(6) **Use of Insulated Conductors for Low Voltage Distribution Lines**

For low voltage lines in city areas, bare conductors are still used though the gradual conversion to PVC insulated conductors is progressing. Together with relatively low installation, this makes power pilferage easy.

The low voltage system near consumers shall have such construction so illegal power consumption is not possible. Any additional cost for such improvement will be covered by reduction in pilferage.

Thus actual reduction in the T & D loss will be able to be achieved through combined operation of various measures as mentioned above depending on economic feasibility. Measures to improve quality of electricity supply (supply voltage and frequency) and reliability of supply (chance of supply interruption) also contribute to reduction of the T & D loss. Each measure will require some cost for execution, and it is required to find out the most cost-effective measures and carry them out one by one.

11.3 Energy Conservation in Final Consumption Sector

11.3.1 Composition of Electric Power Consumption and Electricity Intensity

(1) Composition of Electric Power Consumption

As already described in Chapter 3, electric power consumption in Viet Nam centers on the industrial and residential / commercial sectors. Of 1994 records (9,198 GWh), industrial demand occupied 44%, and residential/commercial demand 41%. Among others, non-industrial, agricultural, and transport sectors accounted for 8%, 6% and 1%, respectively. Thus, major targets for energy conservation are the industrial sector in the first place, and the residential / commercial sector in the second.

(a) Industrial sector

Table 11.3-1 shows electric power consumption by major industry (composition of power consumption in Viet Nam) in 1992. It is noted that cement manufacturers accounted for 15.8% of overall industrial electricity consumption, followed by food manufacturers at 14.3%, textile/apparels at 14%, and chemicals at 12.3%. By region, the Northern region is characterized by heavy chemical industries consuming more than 70% of region-wide electric power demand for industry. In particular, cement manufacturers hold a prominent share. In the Southern region, where manufacturers such as foods and textiles hold massive shares, the ratio between heavy chemical and light industries is put almost at 50:50.

Judging from these situations, industries having high conservation potentials can be narrowed down, as suggested by common knowledge, to the four industries of cement, chemicals, steel and paper/pulp.

(b) Residential / commercial sector

Table 11.3-2 shows electric power consumption in the residential / commercial sector. The data on the Central region are not available. But, because electricity consumption in this region is limited, with its consumption patterns akin to those in the Southern and Northern regions, the sub-totals shown in the table seem reliable enough to represent nationwide trends. General households consume 75% of residential / commercial electricity consumption.

In Viet Nam, penetration of household electric appliances has just begun, and their diffusion ratio stay low still. According to IEV, in Ho Chi Minh City, where the country's highest ownerships are supposed, major electric appliances owned by every 100 households numbered as follows (1993).

Radios	37.4 units (incl. radiocassettes	25.6 units)
TVs	22.5 units (incl. color TVs	9.2 units)
Electric fans	42.2 units	
Refrigerators	4.1 units	

Excluding electric fans, the diffusion ratio above are comparable to corresponding figures registered in the 1960s by industrialized countries such as Japan and France. Calculating back from appliance-by-appliance electricity consumption and the diffusion ratio in industrialized countries today, roughly 80% of electricity currently consumed in Vietnamese general households is estimated to be bound for lighting. Namely, the greater part of residential electricity consumption reflects lighting demand.

From now onward, the share of lighting demand is likely to shrink rapidly, with a growing number of household electric appliances in use. Taking today's Thailand as an example, lighting demand accounts for 31% of commercial demand and 21% of residential demand, as shown in Table 11.3-3. Thus, the share of lighting demand in Viet Nam is likely to near the Thai pattern in the years to 2010. In relation to electric appliances, commercial-use airconditioners are likely to claim a higher share in total electricity consumption.

(2) Electricity Intensity by Sector

As in the preceding one, this section deals with both the industrial and residential/ commercial sectors.

(a) Industrial sector

Listed below is electricity intensity in producing basic industrial materials in Viet Nam (in 1992) according to IEV.

	Electricity intensity (kWh/ton)
Steel	1,900
Chemicals/fertilizers	120
Paper/pulp	1,200
Cement	150

Because electricity intensity in manufacturing sectors differs depending on manufacturing processes in use, simple comparisons should generally be prohibited. Nonetheless, it is interesting to see Japan's electricity intensity in producing representative materials (kWh/ton): cement 110, BF pig iron 32, electric pig iron 778, BOF steel ingots 41, electric-furnace steel ingots 485, crude steel total 187, hot-rolled steel products 192, machine-made paper 771, paperboard 490, pulp 787 (FY 1994 records, from Outline of Electricity Supply and Demand).

For instance, if put to a simple comparison with their Japanese industries, Vietnamese cement makers, the most electricity-intensive industry in this country, could save their energy needs by more than 30%. Paper/pulp producers and steel-makers could have even greater conservation potentials than the cement manufacturers. However, before discussing how much electricity is needed for producing a ton of basic materials in Viet Nam, it is essential to conduct fact-finding surveys in detail. In the days to come, additional examinations need to be made based on such detailed survey results.

(b) Residential/commercial sector

Listed below is area-by-area electricity intensity in the residential/commercial sector (source: IEV).

	Household (kWh/household/year)	Public facilities (kWh/capita/year)
Industrial cities	1,600	100
Towns	900	25
Remotely-situated towns	670	15
Communities in the delta river	500	13
Communities in central part	380	10
Communities in mountains	300	10

Common to both general households and public facilities, those located in major urban areas obviously and naturally are electricity-intensive, but the problem is that high electricity intensity can not always be counted straightly as a high energy conservation potential. It is because penetration of household electric appliances is under way primarily in urban areas, where increasingly growing electricity consumption is likely.

Speaking of the residential/commercial sector, electricity consumption per household keeps growing in parallel with improving economic levels regardless of countries, whereby improvement of intensity can hardly be hoped. Following Thailand as an example, the share of lighting in residential electricity consumption is expected to keep falling ahead and reach around 30% by 2010. The remainder will be consumed in running household electric appliances.

Accordingly, it is energy efficiency of electric appliances, which no doubt will become popular ahead, that directly links to energy conservation potentials. As for commercial demand, the most crucial is energy efficiency of room airconditioners newly installed ahead.

11.3.2 Conservation Potentials and Targets

(1) Conservation Potentials

While Vietnamese electric power demand is likely to surge in the years to 2010, the country can have considerable conservation potentials depending on conservation policies in practice.

Looking at conservation potentials by sector, energy-intensive industries, including cement, chemicals, steel, paper/pulp, are focused on first in the industrial sector. Detailed fact-finding surveys are essential in examining how much electricity is consumed in producing a ton of basic industrial materials in Viet Nam. As far as cement producers are concerned, the industry could trim its energy needs by more than 30% judging from what have been achieved by their counterparts in industrialized countries. As for the heavy chemical industries mentioned above, part of problems can be solved by introducing up-to-date facilities when new plants are built. If the cement, chemical, steel and paper/pulp industries have an energy conservation potential of 30% each, their combined conservation potentials in the industrial sector could be put at 13%, as the four industries account for about 44% of industrial electric power consumption. In such light industries as foods and textiles, largely consisting of small/medium firms, conservation potentials greatly depend on what conservation policies and incentives are taken. Overall, the industrial sector is estimated to have an energy conservation potential of around 15%.

The residential/commercial sector has conservation potential of an estimated 10%, though depending on energy efficiency of airconditioners, refrigerators and office/information machines in use and that of modern appliances to be introduced from now onward.

Thus, assuming that the industrial sector could save its energy needs by 15%, and the residential/commercial sector by 10%, an overall energy conservation potential overall would be 13%.

(2) Targets

As already mentioned, Vietnamese energy conservation potential is estimated around 13% when sector-by-sector potentials are added up. If an electricity conservation target is set at 10% of electricity demand projected this time (base case) and successfully achieved, conserved electricity would amount to 1,863 GWh as of 2000, and 5,595 GWh as of 2010. In order to achieve this target, a lot of effort is needed at public and private levels. In comparison, Japan's cement producers slashed their electricity intensity by 14% (fuel intensity by 15%) during the past decade.

11.3.3 Measures

(1) Industrial Sector

In this sector, industries having massive conservation potentials are cement, chemicals, steel and paper/pulp. To help their production plants save energy, the industries need to take relevant measures from both aspects of equipment and management.

Introduction of new equipment, if any, requires following steps which involves a broad range from production processes to operating know-hows and specific machines/tools.

- To grasp energy balance of existing equipment.
- To decide the scope of equipment to be improved, and set energy conservation targets.
- To examine options to help achieve the conservation targets;
  Process modifications
  Improvement of operation
  Improvement of performance of independent equipment
- Designing/manufacturing or ordering outside
- Shakedowns to demonstrate equipment and operating know-hows.

In regard to such independent equipment as pumps and fans, those widely in use can be employed. As for latest technology-based equipment, to introduce foreign technologies can be a viable option.

On the other hand, energy management can involve the following:

- To set conservation targets in terms of fuel/electricity intensity, and use them as indicators in energy management.
- To form energy management divisions, and appoint responsible staff for energy (electricity, heat) management.
- To analyze the management indicators regularly, and identify good results and/or problems of energy conservation.

- Education/enlightenment of employees on energy conservation

To establish this sort of system, it is recommended to provide every major equipment/process with a voltmeter, an ampere meter, a power-factor indicator, etc.

Given that to implement energy-saving measures in the industrial sector involves huge equipment investment, financial aids and tax incentives need to be considered.

(2) Residential/commercial Sector

In the residential/commercial sector, where energy-gulping factors are expected to become increasingly rampant, conservation measures in the commercial sector will be a matter of greater importance. Therefore, in order to advance energy conservation without sacrificing the service orientation, it is necessary to encourage construction investment and improve energy efficiency of a building overall through introduction of more efficient air-conditioners, etc. than now

In the residential sector, penetration of energy-efficient electric appliances is essential, and relevant conditions must be arranged to prompt introduction of such appliances. For instance, standardization of (or to set standards for) lighting equipment, air-conditioners, etc. can be viable.

The following action programs are considered to be useful for the energy conservation in industrial and commercial/residential sector.

(1) Master Plan for Energy Conservation

To achieve energy conservation requires powerful policy measures to cover all the fields concerned, including the industrial and residential/commercial sectors. Then, comprehensive conservation policy measures must be hammered out based on detailed fact-finding surveys on actual state of energy consumption. At least, it is necessary to organize following indexes.

(a) Industrial sector (by manufacture) :

Consumption per GDP or energy intensity per IIP (Index of Industrial Product) (kcal/dong), electricity intensity (kWh/ton), fuel intensity (TOE/ton), overall energy intensity (Kcal/ton), process flow and electricity/heat balance diagrams.

(b) Residential sector (urban and rural areas) :

Intensity (Kcal/household) by energy source (electricity, town gas, LPG, kerosene, coal), and by use (space heating, cooling, water heating, cooking, power source), diffusion rate of household energy - consuming equipment (units/100 households), efficiency of such equipment.

(c) Commercial sector :

Energy consumption unit/floor area (Kcal/m2) by energy source and by use.

In order to collect these indexes, it appears necessary to select model districts and conduct monitoring surveys there. Such survey results will enable judging energy conservation effects and decide priorities in investment, while allowing to produce viable recommendations on how to organize necessary legal system.

(2) Demand Side Management (DSM)

(a) Responses to leveling off peak power are not merely important in stabilizing electric power supply during peak hours but also, through effective use of generating facilities, lead to conservation of energy and resources in a broad sense.

To this end, it is worthy to consider the introduction, into the industrial sector, of an "electricity supply/demand adjustable contract system," which evaluates load leveling-off efforts through load control during peak hours and/or load shifts, well-planned equipment operations/repairs, heat-storage-based operations, etc. A discriminating electricity rating system "by time zone" to have price-induced effects is a viable option as well.

In the residential/commercial sector too, it is necessary to examine the introduction of some systems to evaluate load leveling-off efforts by hotels/department stores and the public sector, as well as employment of by-time zone discriminating electricity rating.

(b) To set energy conservation targets/ and guidepost and to prepare DSM programs for achieving the targets appear effective not merely in leveling off peak power but in prompting energy conservation itself. Lately, electric utilities in ASEAN countries have hammered out, or started examining, DSM programs, which are as comprehensive as including sector-specific investment plans, standardization of equipment and incentives.

(3) Promotion of Energy Conservation Moves

(a) Importance of an energy conservation campaign is twofold. For one thing, it is designed to help users utilize electricity well without wasting it. For the other, it helps produce surplus electricity to be supplied to communities/housing not yet benefited by electricity.

To this end, it is necessary to establish an equipment modernization diagnosis/guidance system to check electricity-related equipment in individual sectors, and introduce credit/subsidy systems to help finance equipment modernization. It is also needed to win sympathy among the public through far-reaching PR efforts via mass media.

(b) An energy conservation campaign must be in advance with utmost care. For instance, it appears viable to provide incentives to prompt replacement of household electric appliances and information/service-related electric machines with newest models as much as possible. To encourage switching of conventional household illuminators to fluorescent lamps is practical too. Fluorescent lamps, priced at 10,000-20,000 dongs a piece, are much more expensive than electric bulbs available only for 400-2,800 dongs a piece. A system needs to be established to enable users to evaluate worthiness of fluorescent lamps from a wide range of elements from electricity rate to light-source efficiency and the number of useful years, along with information/PR provision.

(c) An energy conservation campaign can produce successful effects only when concerted efforts are made at public and private levels. An organization to act as the prime organizer is also needed. Branch offices of local governments and transmission/distribution companies can provide PR publications and information to their local communities.

Table 11.3-1 Composition of Power Consumption in Industrial Sector (1992)

(Unit: GWh,%)

	North	South	Center	Total	Share (%)
Mining/processing	97.4	0.0	4.8	102.2	3.27
Manufacturing					
Pig iron/steel	152.6	0.0	132.5	285.0	9.12
Non-ferrous metal	21.5	2.9	18.3	42.7	1.37
Construction material (Cement)	410.7	19.0	64.0	493.7	15.79
Chemicals/fertilizer	187.3	26.1	170.4	383.8	12.27
Machinery	140.9	15.1	143.8	299.8	9.59
Wood processing/paper/pulp	20.5	6.9	177.1	204.5	6.54
Food processing	57.5	37.2	352.0	446.8	14.29
Textile/glass/lether	191.0	58.8	187.5	437.3	13.99
Water service	70.4	22.7	139.0	232.1	7.42
Others	111.6	7.3	79.7	198.6	6.35
Total	1,461.5	196.0	1,469.0	3,126.5	100.00

Source: IEV

Table 11.3-2 Composition of Power Consumption in Residential Sector (1992)

(Unit: GWh,%)

	North	South	Subtotal	Share (%)	Center
For household use	699.7	768.6	1,468.2	75.43	N.A
Lighting in official/public places	197.6	214.0	411.6	21.14	N.A
Others	0.0	66.8	66.8	3.43	N.A
Total	897.2	1,049.4	1,946.6	100.00	219.9

Source: IEV

Table 11.3-3 Distribution of Electricity Consumption by End Use in Thailand

(Unit: %)

Total 100	Lighting	Air Cond.	Refrige-rators	Heating/ Cooking	Motors	Others	Total
Industrial 46	10	-	-	-	80	10	100
Commercial 29	31	46	-	-	-	23	100
Residential 25	21	6	21	24	-	28	100

CHAPTER 12

EXAMINATION OF ENVIRONMENTAL PROTECTION PLAN

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In consideration of features of the Master Plan Study as well as to examine the entire configuration of environmental protection plan of the country, the following study items have been covered under this chapter. Based on results of the study, recommendations are also provided for making improvements in future.

(1) Environmental policy and institutional framework of the country
(2) Nature and social environments of the country
(3) Present situation of environmental considerations under hydropower projects
(4) Present situation of environmental considerations under thermal power projects
(5) Recommendations for enhancement of environmental protection in future

Two case studies have been carried out for each item (3) and item (4) above, respectively.

The following Sections 12.1 to 12.4 provided the summary of the study results. Findings and recommendations are summarized in Section 12.5. For more detailed information, data and descriptions, it is recommended to refer to the Appendix prepared for this Chapter 12.

12.1 Environmental Policy and Institutional Framework of Viet Nam

As a starting point of environmental considerations for national sustainable developments in Viet Nam, an action plan was prepared by Viet Nam State Committee for Science (SCS) in August 1991 under co-operation with United Nations Development Programme (UNDP), United Nations Environmental Programme (UNEP), International Union for the Conservation of Nature (IUCN) and the Swedish International Development Authority (SIDA). The contents of the plan was described in detail by a document titled "VIET NAM National Plan for Environment & Sustainable Development, 1991-2000, Framework for Action" (NPESD). As an important part of the action plan, the following items were stipulated in connection with institutional frameworks:

- Establishment of central and provincial environmental authorities
- Development of environmental policy, law and regulations
- Development of environmental impact assessment process
- Establishment of sustainable development strategies at sectoral level
- Establishment of monitoring frameworks and strategies
- Data collection, information management and networking

In line with the action plan, the Ministry of Science, Technology and Environment (MOSTE) was established in September 1992. Based on recently issued document titled "Environmental Problems and Waste Settlement" (IEV 93/G81, June 1994), it is said that MOSTE currently has twelve departments with a total staff of about 2,000. The Department of Environment was recently renamed as National Environmental Agency (NEA).

In parallel with the establishment of MOSTE, "Viet Nam's Environmental Protection Law" (hereinafter called "the Law") was prepared and put into force in January 1994. The Law constitutes the national basic policy, philosophy and requirements for environmental protection and for achieving sustainable development of the country. As an important part of implementing the Law, a temporary Guideline for Environmental Impact Assessment (EIA) of Techno-Economic Projects (hereafter called Draft EIA Guideline) was also prepared in September 1993. The Draft EIA Guideline defined various important aspects of EIA process and requirements. It was reported later that the Guideline had become formal in October 1994.

In addition to the above, MOSTE had gathered, readjusted and systemized a number of existing and available criteria relating to the environmental protection, and summarized them into a handbook called "Provisional Environmental Criteria". The Criteria was published in 1993 and is expected to be referred to by various sectors, provinces and socio-economic establishments until some kinds of formal criteria or standards are prepared. Besides, the Council of Ministers issued a decree in January 1992 and stipulated a list of protected rare and precious forest plants and animals. A list of special forest areas was also prepared, which would be considered as environmentally preserved areas.

The following is the list of environmental laws and regulations already issued by the central government:

(1) "Environmental Protection Law" of Viet Nam, January 1994
(2) "Temporary Guideline for EIAs of Techno-Economic Projects, September 1993. (It became formal and effective on October, 1994.)
(3) "The Decree on Protected Forest Animals and Plants", January 1992
(4) "Provisional Environmental Criteria", 1993
(5) "Land Law", July 1993

On the other hand, the People's Committees of most provinces and big cities like Hanoi, Ho Chi Minh City and Hai Phong have also set up their own Environmental Committees (ENCO) to be in charge of and responsible for environmental protections on the level of each province and city. In some provinces, the name called Committee for Science, Technology and Environment (COSTE) is used instead of ENCO. In any case, ENCO or COSTE is responsible to the People's Committee for the protection of environment at the province and city level. Based on available information obtained under the current survey, it is known that most big cities like Hanoi and Ho Chi Minh, and some provinces like Dong Nai and Ba Ria-Vung Tau have already established their own environmental regulations and standards, and started environmental monitoring activities.

For more detailed descriptions of the laws and regulations, refer to Appendix.

12.2 Nature and Social Environments of Viet Nam

Viet Nam is geographically located at east side of Indo-china Peninsular, with an area of 331,111 km^2 which is about 87.7% of the area of Japan, and within the boundary of between the north latitudes of 8°30′ and 23°23′, and east longitudes of 102°10′ and 108°50′. Therefore the entire area of Viet Nam is located within the tropical zone of the northern hemisphere. Neighboring countries are China in the north, Laos and Campuchia in the west. East and south sides are facing the Eastern Sea, the west side the Pacific Ocean. Total distance of the coastline is about 3,260 km. There are numerous small islands distributed along the east side sea.

Topographical structure is diverse in Viet Nam. It is composed of three constituent parts, namely mountains, plateaus and plains. Hills and mountains cover up to three-quarters of the country. About 85% of mountains are under 1,000 m high, and those above 2,000 m high constitute only about 1%.

Viet Nam has a humid tropical climate. In winter, northerly wind blows from China which brings somewhat cold and dry air to northern region of Viet Nam. The weather of Hanoi area in winter reflects this condition clearly. On the other hand, northeasterly wind also blows from Pacific Ocean and brings comparatively warm and humid air to the central and southern regions of Viet Nam. In summer, southwesterly wind blows from Indian Ocean and brings humid and warm air to the southwestern region, and sometimes to the southeastern and northern regions of the country.

Besides, the easterly or northeasterly wind comes from the Pacific Ocean and sometimes develops into tropical low pressure or even into typhoon, and strikes the coastline. Such wind current is active from July to October, causing heavy rain in Viet Nam. Consequently, the humidity is usually as high as 80% or more around the country in this season.

According to 1989 statistics, total population of Viet Nam was 64.4 millions, while it was 69.9 millions in 1993. There are 53 ethnic minority groups identified, which account for about 16% of the country's population. From population size, five main ethnic minorities are Tay, Thai, Muong, Hoa and Khmer groups.

Agriculture and forestry are important parts of economy of the country. Rice is one of most important agriculture products in Viet Nam. It is being sown on about 6 million ha and the average yield is about 19 million tons per year, which is about 3.8% of yearly total production of the world and roughly equal to that of Thailand. The area of forest in 1943 was about 14 million ha, but it became about 9 million ha in 1989, which account for about 25% of the nation's total land area. To maintain forest resources and sustain forest environment, afforestation is an important activity needed in the country. Afforestation along upstream of a river is also important to avoid acceleration of soil erosion and sedimentation, and thereby to decrease possibility of floods and maintain design life of a dam reservoir.

Viet Nam is rich in mineral resources. Outstanding resources are coal, bauxite, chromite, phosphate, antimony and iron ore. Limestone and marble are also available in many places. Crude oil and gas are being developed and produced now in the offshore of Vung Tau.

Textile and wood processing are main manufacturing industries in the country. However, it is found that there are many other manufacturing industries needed to be improved and developed, such as vehicles and their engines, steel production and manufacturing, ship building, various electric and electronic equipment, various chemical productions and so on. These are needed for strengthening the basis of social economic development of the country.

For more details, see the attached Appendix.

12.3 Present Situation of Environmental Considerations under Hydropower Projects

To understand the present situation of environmental considerations under hydropower development projects in this country, a couple of case studies were performed under the cooperation extended by the Forest Inventory and Planning Institute (FIPI) of the Ministry of Forestry, Energy Center of the Southern Region and IEV. Da River and Dong Nai River basins were selected for the case studies, of which the more study efforts were put in the case of Da River. Due to time and other limitations, the studies were carried out based on existing and available information. Therefore, the studies were not intended to clarify detailed present situation of environmental considerations being paid to the hydropower development projects. However, the studies were able to provide sufficient generic information for the study purpose. Moreover, the studies were also able to clarify some existing environmental issues under hydropower projects, which are not yet resolved, and what efforts are being made to resolve the problems. On the other hand, the studies also provided some evidence that the organizations involved are all capable to perform such kind of studies, and therefore should also be able to carry out full scale EIAs for the power development projects, if pertinent organizations are involved and enough financial support will be provided.

Some key parts of the reports and comments are summarized below. For details, see the Appendix and original reports (References (23) and (24)).

12.3.1 Case study on Da River Basin

(1) Hydropower projects in Da river basin

Based on the hydropower project planning of the IEV, potential projects are Hoa Binh, Son La, and Huoi Quang, (if Son La would be in Small or Medium size,) among which Hoa Binh hydropower project has already been completed and commissioned. Capacities are Hoa Binh 1,920 MW, Son La 2,400~3,600 MW, and Huoi Quang 800 MW. Concerned governmental organizations and the Northern Region are devoting their efforts to develop the hydropower projects in this river basin as one of most important development projects in the country.
Some salient parameters of Hoa Binh hydropower plant and Son La hydropower project are summarized below.

(a) Hoa Binh Hydropower Plant

Hoa Binh hydropower plant is located at Hoa Binh provincial town, which is 75 km west of Hanoi. This power plant has a rated head of 88 m and is equipped with 8 power units of 240 MW each totaling 1,920 MW. In the average year, it can generate 8,400 GWh and in abundant year, its output can reach 10,000 GWh. The power can be transmitted to the whole country through 500 kV transmission line. Hoa Binh hydropower plan can also play the roles of flood control, improvement of navigation condition on shipping routes in both Da river and Hong river, and increasing irrigation capacity of the river basin to the Bac Bo plain.

The water surface of Hoa Binh reservoir occupies an area of 230 km^2, stretching for more than 200 km from Hoa Binh to Son La, and it is also intended to create socio-economic environmental benefit by the reservoir, including such things as fishery promotion and developments of tourism and recreation.

In 1993, the power plant has generated 4,730 GWh producing 45% of the whole country power output. It is now playing key role of power generation in the country.

(b) Son La hydropower project

Having a normal reservoir level from 180 m to 270 m for the Son La hydropower project (HS), three alternatives as below are under consideration.

1) Large Son La (NRL: 250 - 270 m) : 3,600 MW
2) Medium Son La (NRL: 220 - 240 m) : 2,880 MW
3) Small Son La (NRL: 180 - 215 m) : 2,400 MW

The benefits which will be contributed by Son La hydropower project are as below:

- Increase flood control ability by combination with Hoa Binh reservoir.
- Power generation
- Firm water supply in dry season
- Improvement of fluvial transportation
- Improvement of socio-economic environment of the region and thereby improving livelihood of the regional people

Nature and socio-economic environments of Da River basin are summarized in the attached Appendix. The following provide some outlines on the resettlement issue of Hoa Binh hydropower plant and Son La hydropower project plan. All information here is based on the original report (Reference (23)).

(2) Resettlement issue

(a) Resettlement issue of Hoa Binh hydropower plan reservoir area

The first machinery unit of Hoa Binh power plant started operation on September 1988 and the water level of the reservoir reached EL 115 m as designed in 1991. The reservoir with the length of 200 km has flooded 11,000 ha of cultivated land. There were about 50,000 people, with 9,000 households belonging to two provinces of Hoa Binh and Son La, who had to move out of the reservoir area.

The resettlement of the affected people was started in 1982 with the following three methods :

- Move to higher places along the riversides
- Join to live with the people of nearby surrounding counties
- Establish new residential areas which are far from the reservoir area (move to other districts in the same province or other provinces)

The resettlement plan and compensation were made, and the plan was implemented step by step. However, those steps were not done well in the course of the implementation due to incompleteness and not being realistic of the plan. Mistakes and modifications caused a lot of difficulties to the inhabitants and also to the government. The compensation amounts were calculated based on the properties flooded, but unit prices were those decided by the government which were not equal to or sufficient with the market prices and further the payments have not been made in due time.

According to the data of Da River Studying Committee of Hoa Binh Province, there are now 1,500 households with 8,299 people moved from the reservoir area lacking land to cultivate and being in the need of moving again to another area.
One of the most thorny questions is to provide job opportunity to the resettled people. In the areas where there is no job opportunity to the resettled people, the resettled people have to remove to other places. Some disputes on the land using right occurred between the new immigrants and the local residents due to lack of prior plan to avoid such problem.

At the time of the case study, the above issues have not yet been resolved. The local authority and Son La province government are requesting Central Government to provide financial support to resolve these problems, so that the resettled people can have stable livelihood and thereby the whole local society can enjoy the benefits from Hoa Binh hydropower plant which is one of the most important national projects currently completed.

(b) Resettlement issue of Son La Hydropower Project

The reservoir of Son La hydropower project will flood up to ten districts and the capital town of Lai Chau province. Among the ten districts, seven of them belong to Lai Chau province and the other three belong to Son La province. The names of the districts are as below :

- In Lai Chau province : Lai Chau capital town, Muong Lay, Sin Ho, Tua Chau, Tuan Giao, Muong Te, Phong Tho
- In Son La province : Muong La, Quynh Nhai, Thuan Chau

In case of the flooded reservoir level of EL 260m, there will be 233 villages flooded. In case of the flooded level of EL 220m, there will be 183 villages flooded.

1) Estimated population to be removed

Considering natural increasing rate of population, the total population to be removed in the years 2,000 and 2,010 is estimated as below:

a) In case of flooded reservoir water level of EL 220m

- In the year 2,000 : 105,170 people with 17,786 households
- In the year 2,010 : 137,300 people with 24,185 households

b) In case of flooded reservoir water level of EL 260m

- In the year 2,000 : 142,860 people with 24,190 households
- In the year 2,010 : 185,550 people with 32,951 households

2) The locations to where the affected inhabitants would move

At the time of the case study, no detailed information was available regarding the resettlement plan or program. However, some figures showing the locations to where the affected people would move were obtained. Some figures attached in the Appendix show the locations and directions of the immigration.

3) Short comments on the resettlement issue

It is not clear at this moment if a certain kind of resettlement plan or program has been studied or established for the Son La hydropower project plan. However, it is recommended that the project owner, concerned local and central governmental organizations will take the case of Hoa Binh hydropower plant as the lessons learned and prepare a detailed and realistic resettlement program during the feasibility study of the project. The resettlement issue is essential not only to successful achievement of the project but also to the improvement of the local socio-economic environment.

12.3.2 Case study on Dong Nai River Basin

This case study on Dong Nai river basin is intended mainly to understand the general environmental background in connection with the hydropower development projects in the basin. Due to available existing data and information were quite limited especially for those of the river basin as a whole, not every environmental subject could be covered under the study. However, the following descriptions are provided based on the best available current data and information.

Dong Nai river is the largest one in south Viet Nam, except Mekong river basin. Dong Nai river flow into the sea near My Tho in the south of Ho Chi Minh City.

The catchment area of the river is about 24,770 km^2 at Bien Hoa. Below Bien Hoa, catchment area of Dong Nai river can not be defined accurately as the river has a delta which is also formed by downstreams of other rivers, such as Saigon river and Van Co Dong river. There are two main tributaries of Dong Nai river, those are La Nga river and Be river.

As the Dong Nai river basin is large, the topography varies quite widely. The part of the basin on the east of Di Linh is a hilly plateau with elevation ranging from EL 1,000m to EL 1,400m. The central and northern part of the river basin, e.g. the area around Bao Loc and Gia Nghia, is also a hilly plateau, but with elevation ranging between EL 600m and EL 1,000m. The central southern part of the basin, e.g. the area around the confluence of Dong Nai and La Nga rivers, is a low hill plateau with elevation ranging from EL 50m to EL 125m. The western part, which belong to Be river basin, is a low hill plateau with elevation ranging from EL 10m to EL 200m.

In Dong Nai river basin, there are three existing hydropower plants under operation, two under construction and many other projects under planning. Details of them are listed below.

(1) Four hydropower plants under operation

- Da Nhim hydropower plant : 160 MW
- Ankroet hydropower plant : 3 MW
- Tri An hydropower plant : 400 MW
- Thac Mo hydropower plant : 160 MW

(2) One hydropower project under construction

- Ham Thuan - Da Mi hydropower project : 472 MW
  (expected commissioning year: 2000)

(3) The hydropower projects under study

- The projects of Dong Nai river
  (Dai Ninh, Dong Nai 4 & 8)
- The projects of La Nga river
  (Bao Loc, La Nga 3)
- The projects of Be river
  (Cau Don, Phuoc Hoa)

It is understood that more detailed data of nature and socio-economic environments of the river basin as a whole will have to be surveyed and collected, so that the whole river management can be implemented effectively.

12.4 Present Situation of Environmental Considerations under Thermal Power Projects

To understand the present situation of environmental considerations under thermal power projects in the country, a couple of case studies were performed under the cooperation of a Viet Nam consultant and the IEV. From point of view of environmental consideration, coal-fired thermal power plants will be the essential ones for review of their current status. Therefore, the following two operating coal- fired thermal power plants were selected for the case study:

- Pha Lai Thermal Power Plant : 440 MW
  (started full power operation in 1987)

- Ninh Binh Thermal Power Plant : 100 MW
  (started full power operation in 1977)

The study results were compiled into the report for each power plant. It is found that the contents of the reports are quite detailed, which have almost covered what are needed for an environmental baseline study. If full scale EIAs would be carried out for these plants in future, such as for the case of Pha Lai II project, the data and information obtained under the case studies should be useful and valuable for implementing the EIAs.

In the following, summary of the case study results are provided. For details, see attached Appendix and the original reports (References (25) and (26)).

12.4.1 Case study on Pha Lai Thermal Power Plant

It is understood that Pha Lai thermal power plant is the largest and most significant thermal power plant in Viet Nam. In the period 1983 to 1989, the plant took an important role of power supply in northern network which was usually faced with electric power shortage. Therefore, other problems such as plant's efficiency, environmental protection, and providing social infrastructure benefit to local society were not seriously taken into consideration. EIA was not carried out carefully for the plant construction and operation. No environmental monitoring system was equipped and therefore the effectiveness of the installed electrostatic precipitators could not have been evaluated to date.

On the other hand, the plant operating performance has been gradually degraded due to lack of key spare parts, not only for the parts of major plant systems such as boilers and operating control system, but also for the environmental protection systems such as the electrostatic precipitators, chemical neutralization system and oil polluted waste water treatment system. Since Hoa Binh hydropower plant was put into operation in 1989, the output of Pha Lai thermal power plant was continuously decreased. Although the emissions have been alleviated due to the output decrease, various problems are still existing. Considering the coming project of Pha Lai II, substantial overhaul and improvement of the existing plant system and related EIA study for the project will be key issues of the power plant.

In 1990, the IEV carried out a study on potential environmental impacts to be caused by the waste water from ash and slag disposal. The potential impacts on surface water quality, soil and vegetables were studied by taking samples and making analysis based on Vietnamese Standards TCVN2652-78 and TCVN4556-88.

Discharge water samples from discharge canal, surface water and well water samples from the surrounding area, also soil samples from the Binh Giang rice field were taken and analyzed.
Some main findings obtained from the various sample analysis results are summarized as below :

(1) Analysis of Thai Binh river water showed that there were no phenol, H_2S, Cu, Pb, Cr and As contained in the river water, while the value of suspended solid was high and exceeding sanitary standard.

(2) In the samples of Khelang ash disposal and at the end of discharge canal, there appeared contents of Cr,Cd,As and also H_2S. Especially, the contents of suspended solid was very

high and its high turbidity was clearly noticed. Therefore, further monitoring will be needed to follow the contents of such unwelcome elements.

(3) Well water quality

(a) Well water near Khelang dyke : The pH index was very low (acid character), and dissolved oxygen was tending toward lower level.

(b) Well water near Pha Lai town and discharging canal : The contents of SS, Fe, Pb and Mn were tending to increase.

(4) Chemical elements in vegetable samples : Cu,Pb and Cd were found in most of the samples. As was also found in a few samples.

It is understood that this study is an important and valuable part of environmental monitoring. Some findings such as having Cd and other metal elements found in samples of discharge canal and vegetables would need further study in future to clarify their potential sources.

12.4.2 Case study on Ninh Binh Thermal Power Plant

Ninh Binh thermal power plant is located in Ninh Binh Town, which is the capital of Ninh Binh province, and at about 100 km south of Hanoi. Right after start of the plant construction in 1971, the site had been hardly damaged by bombs and rockets launched from air attacks. After the Paris Agreement in 1973 (ceasing fire in Viet Nam War), the plant construction was started again. The final unit was put into operation in 1976.

During the years 1977 to 1979, operating hours reached about 6,500 hrs per year, while during the years 1980 to 1983 the plant operation reached about 6,000 hrs per year. However, after 1983, the plant operating hours have been gradually reduced due to the difficulty of obtaining spare parts and other factors.

In consideration of the war at that time, this plant was built in the way that it could withstand an aerial attack. That is, the plant is located closely to the foot of Canh Dieu mountain. The boilers are in constricted area 7 m underground, and the chimney is also built closely to the foot of the mountain. The stack height is 80 m, while height of the mountain is 96m to 102m.

As a result, the whole area of the plant site falls within the wind shadow of the neighboring mountain. Fly ash and exhaust gases emitted from the stack almost could not diffuse so far as desired, and thereby the emissions fall directly within the plant site area and also in Ninh Binh Town.

To understand the actual situation of the air pollution, an aerodynamic model test was performed and the ambient air quality was measured in Nov. 1992. Results of the test and measurement are summarized in the Appendix. To improve the micro-atmospheric condition and reduce the extent of the air pollution in the site and town areas, raising the stack height to 120m and other measures are being studied.

It is recommended that air pollution monitoring of the site area and its vicinity will be performed periodically in future, so that changing trend of air quality of this area can be understood.
For details, see the document of Reference No.26.

12.5 Recommendations for Enhancement of Environmental Protection in Future

The survey has reviewed and made study on present situation of environmental protection activities being implemented in the country from various aspects, including such items as below.

- Environmental policy, laws and institutional framework
- Environmental regulations of local governments
- Roles of central and local governments
- Present situation of nature and socio-economic environments of the country
- Review of environmental considerations having been applied to hydropower and thermal power projects

Details of the review results are described in the attached Appendix. In summary, some impressive points of the results are itemized as below.

- Viet Nam's Environmental Protection Law (the Law) was issued and became effective in January 1994. MOSTE was established in September 1993, and the National Environmental Agency (NEA) was formed within the Ministry to be responsible for the environmental protection activities of the whole country.
  The Law has clarified the national environmental policy and philosophy, and basic regulatory requirements for environmental protections.
- Temporary guideline for EIA of techno-economic projects was prepared, in which detailed EIA requirements are provided. This guideline became formal in October 1994. The decree regarding protected forest plants and animals was issued, in which rare and precious plants and animals are listed, and specific forest areas have been identified for protection.
- Provisional environmental criteria was issued and defined permissible environmental limits of various effluents discharged from industrial and other activities.
- Most of local authorities have already established Environmental Committees to carry out environmental protection activities on the level of local areas. Especially, Hanoi and Ho Chi Minh cities and some provinces have issued their own environmental regulations.
  Hanoi and Ho Chi Minh cities have already started environmental monitorings and licensing activity for new project establishments.
- Through a couple of brief environmental case studies made on Da River and Dong Nai River basins, and also on coal-fired thermal power plants, it is understood that the organizations in charge are all capable to carry out such studies, and various data are existing. This will mean that EIAs can be implemented by pertinent domestic organizations under some guidance from outside consultants.

On the other hand, there were also some findings which would need some improvements or development, so that more effective environmental protection activities can be implemented and achieved. The following sections identified the findings and provided some recommendations for considerations by pertinent organizations of the country.

It is believed that the bases of environmental protection plan of the country have already been established. With these bases, making some more improvements, obtaining more experiences and also having financial support from certain sources should be able to lead to meaningful implementation of the national environmental protection plan.

12.5.1 Environmental Regulations

(1) Environmental regulations

It is known that the temporary guideline for EIA of techno-economic projects became formal and effective in October 1994. It is important that concerned development projects will be planned and implemented based on the requirements of the Guideline.
It is recommended that environmental regulations and EIA requirement of local authorities will also be established, if not yet been prepared. Regulations of local authorities can be more specific and details to fit their specific local conditions.

(2) Review and licensing procedures of an EIA

The EIA Guideline defined the projects which are subject to review by MOSTE. However, it appeared the review and licensing processes have not been clarified. Also that the organization of having the authority of approval or denial of an EIA has not been clearly expressed. Moreover, it seems not clear that how a project plan be treated if its EIA report deemed not satisfactory from viewpoint of environmental considerations. The involvement of the public in the process of review of an EIA report should also be considered.

Through discussions with concerned MOSTE personnel, it was advised that the licensing process has not yet been clearly established at this moment. However, the process should be identical to both of domestic and foreign funded projects.

(3) Enhancement of environmental monitoring activity

Generally speaking, local governments should be responsible for environmental monitoring to check out environmental quality of their local areas. This will mean that local governments will have authority to regulate any techno-economic project activity within their regions to comply with the environmental requirements. In order to comply with such local government requirements, each techno-economic establishment owner/operator shall also carry out environmental monitoring by itself to assure that its activities will not violate the regulations.

From the above point of view, establishment of environmental monitoring programs by both local governments and industrial operators/owners is essential for environmental protections. It was found that only a few local governments, such as Hanoi and Ho Chi Minh cities, have such programs and started their necessary monitoring activities. To establish analysis laboratories or make use of such facility operated by specific organizations or universities will be needed for the activities. It appeared that foreign financial support and technical assistance would be required to enhance environmental monitoring activities.

12.5.2 Environmental Impact Assessment

In order to understand the situation of implementing EIAs in the country, every effort was made to collect a certain EIA report currently prepared for recent development project(s), such as those for Yaly hydropower projects or Hoa Binh hydropower plants. However, it is regretted that there were no complete EIA report(s), especially in English version, available for review. A little information was obtained through meeting discussions. A couple of case studies performed also provided some aspects of implementing an EIA. With these in mind, this section describes only what are deemed appropriate and what information would be recommendable to Viet Nam side.

(1) Defining detailed scope of work of an EIA

It appeared that defining a detailed scope of work of an EIA of a certain project may be a key issue for project owners or planners. Financial allocation for carrying out an EIA may also be related. Basically, it is first required to comply with the Viet Nam's EIA guidelines and then to incorporate the requirements set force by foreign or international project funding organizations. To reflect the latter requirements, it is essential to collect that information or consult with pertinent organization or consultants before setting up a scope of work. It is regretted that not every ODA funding country or international funding organization has prepared clear and detailed guidelines for the purpose of borrower's use. If this would be the case, to make use of consulting organizations should be able to resolve such a problem. In the following separate items, some information on Japanese and World Bank guidelines are described briefly for reference.

(2) Environmental assessment guidelines of Japan

There are two ODA funding organizations in Japan. One is JICA and the other is The Overseas Economic Cooperation Fund, Japan (OECF). JICA has issued a series of EIA guidelines to cover each area of development project, such as those in terms of harbor, airport, highway, railway, river work, waste treatment, sewerage, groundwater development, water supply, regional development, tourism, transportation, urban transportation, agriculture, forestry and dam construction projects, respectively. It is regretted that English versions of them are not yet available. On the other hand, OECF prepared an overall guideline to cover key points of concerns for each area of development. It is noted that the JICA guidelines are prepared mainly for the purpose of being used by the experts of the ODA project teams, while that of the OECF is prepared for considerations by the borrowers.
Some brief descriptions regarding the JICA and OECF guidelines are provided in attached Appendix for reference.

(3) Environmental guidelines of the World Bank

The World Bank issued an Operational Directive on Environmental Assessment (OD 4.00, Annex A) in October 1989, which mandates an environmental assessment for all projects that may have significant impact on the environment. The Directive requires the Bank staff to screen and categorize all its prospective loans (Categoly A to D) for potential adverse environmental impacts at the time of project identification. In October 1991, OD 4.00 Annex A was replaced by OD 4.01. The new Operational Directive ODA 4.01 categorizes projects/components into three categories, i.e. Categories A, B and C. It is recommended that "Environmental Assessment Sourcebook" of the World Bank will also be referred to for managing projects to be funded by the Bank.

12.5.3 Environmental Issues and Protection Measures

In this section, some typical environmental issues of thermal power and hydropower plant projects are discussed briefly and some concerned protection measures are also mentioned. For more details, see attached Appendix.

(1) Regarding thermal power plant projects

As every one knows, releases of fly ash, sulfur oxide (SOx) and nitrogen oxide (NOx) to the atmosphere are key issues of thermal power plants. To limit the releases, permissible emission standards are set forth and various flue gas treatment systems are being used in many countries. In addition, environmental standards of ambient air are also stipulated to protect against air pollution. For reference, the standards and flue gas treatment systems being adopted in Japan are described in the attached Appendix.

In case of flue gas desulfurization (FGD) system, lime/limestone gypsum process is most common in Japan to date. However, the scale of its waste water treatment system is usually large due to using a lot of water for the process. To avoid the disadvantage, activated carbon absorption process (dry type) is currently being introduced to new plant installations. In any case, cost of the systems being used in Japan is quite high because of their high efficiency. Therefore, it is recommended that some kind of redesigned systems be adopted in Viet Nam to reduce the installation cost. Consultation with the system manufacturers should be able to resolve this issue. The same recommendation is applicable to the case of NOx removal system.

In any way, it is recommended that dust collector system and desulfurization system be installed in coal-fired thermal power plants. NOx removal system should also be considered when feasible. It is noted that desulfurization system may not be required for natural gas thermal power plants, because sulfur is usually not contained in natural gases.

Before making a decision, it is recommended to make sure the composition of natural gas be used.

(2) Regarding hydropower projects

There are various potential environmental issues which may be incurred in connection with hydropower developments. Use of agriculture and forest lands, potential impact to flora and fauna in project area, resettlement of people, potential conflict with the water uses needed by the people and industrial activities in downstream areas, eutrophication of reservoir water and so on are all to be considered and evaluated. Necessary measures will have to be planned and taken for potential impacts. The extent of each potential environmental impact has to be investigated through environmental impact assessment (EIA).
Based on the case studies made on Da River and Dong Nai River basins, as well as the field survey made during the site visits in the country by the JICA Study Team, a few key existing environmental issues are discussed and some recommendations are provided as below.

(a) Resettlement issue

The case study report prepared on Da River Basin has described in detail the resettlement issue of Hoa Binh hydropower project. Discussions are made in the report regarding the causes of the existing problems and further actions to resolve the problems being planned by the concerned governmental organizations. From the contents of the case study report, it is understood that the concerned governmental organizations are aware of the importance of the unresolved issue and are preparing plans to resolve the problems. It is desirable that the following points are to be considered in the course of the problem resolution and for other development projects in future:

- Prepare an integrated program to cover the whole remaining issues and planned resolution measures, if such program has not yet been established. To organize a steering committee which is composed of concerned governmental organizations and local authorities.

- The steering committee will be responsible for the whole program implementation. Enough budget shall be allocated for the program implementation. It is recommended that the Northern Region take the key role and final responsibility for this issue.

- Taking the resettlement issue of Hoa Binh hydropower project as the important lessons to be learned for future projects.

It should be noted that resettlement program is one of key issues to be covered in the EIA of a project. A good and realistic resettlement program shall be established and clearly described in an EIA. The program shall also cover the follow-up activities to monitor the livelihood of resettled inhabitants. Power companies shall be responsible for establishment of such a program. It is noted that the World Bank and other ODA donor countries are all paying much attention to the resettlement issue of a project plan which will receive funding assistance from them.

(b) Eutrophication of reservoir water

Because of the inflow of large amount of substances having nitrogen and phosphorus from upstreams of a reservoir, water quality of the reservoir could be degraded due to breeding a lot of aquatic organisms, such as planktons. BOD and COD values will gradually be increased. It was reported that water quality of the Tri An reservoir is getting degraded. In spite of not having water quality data available at the time of the site visit, this issue is usually expected. The issue of organic fouling to plant components is also an issue which is related to the water quality. However, key problem of eutrophication is that no more fishes could survive at the ultimately degraded condition and offensive odor would be generated by the degraded water. If such condition would be reached, discharged water will raise severe negative impact to downstream areas.

This is an issue which can not easily be resolved and is also happening in industrialized countries. Many nature lakes are also suffering from this problem.
The countermeasures which can be taken to decelerate the progress of eutrophication are as below:

- Waste water treatment at the sources of upstream area
- Cut out the trees and clean up other organic substances existing in the reservoir area before water filling
- Forced circulation of reservoir water, if possible
- Perform periodic plant maintenance to clean up the plant components

(c) Water reduction area issue

Water reduction area will usually be generated between water intake point to water discharge point of a hydropower plant. If the distance between the two points is long, significant negative impacts may occur in the water reduction area, including those on nature environment and agriculture.

During the site visit to Tri An hydropower plant reservoir, it was known that there is a water reduction area of up to 7 km long. To understand the extent of possible negative environmental impacts occurring in the section, it is recommended to perform an environmental survey covering both nature and social environments. If it would be found that some significant negative impacts are existing or occurring, a certain amount of water discharge should be considered to mitigate the impacts.

In general, a certain amount of water should be discharged from spillway to protect the environment in such a water reduction area. The amount of the discharge water may be up to about 3% power reduction of a hydropower plant. This is the current practice being recommended in industrialized countries.

CHAPTER 13

FORMULATION OF BASIC POLICY STRUCTURE

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13.1 Electricity Tariff System

13.1.1 Basic Principles in Setting Electricity Tariff

As widely accepted, in case of electricity pricing the following principles should be taken into account :

Electricity as one of basic products for household and industry
Reflection of actual cost structure
Avoidance of discriminatory pricing

The first principle addresses the social needs to keep the price level affordable and to avoid easy price hikes. The government is expected to enforce appropriate measures to control the power industry which tends to go for price increases taking advantage of its monopoly. The second and third ideas are often referred to as the fundamental principles of "fair pricing." In other words, electricity tariff system should be designed to fairly reflect actual incurred cost and also actual usage of individual customer. If these principles are not properly implemented and electricity tariffs are distorted by political decision, difficult problems will come to surface. That will create a situation where some customer groups are undercharged at the expense of other groups, which will not be resolved easily. Fairness is important to gain people's acceptance on electricity tariffs, which eventually leads to trust in the administration of central government.

13.1.2 Common Practices in Developing Countries

Apart from the above mentioned principles, other social or political factors also play important roles in actual determination of electricity price in developing countries. For example, the electricity price is often cut for lower income segment or particular industries to which the central government pays special attention from the viewpoint of social welfare or economic development. The electricity pricing, therefore, would be a combination of the basic principles and political considerations.

13.1.3 Review of Current Tariff

The current tariff schedule took effect in August 1994 pushing up the average price level from 450 Dong/kWh to 500 Dong/kWh. This increase is one of the strategic price adjustment actions to improve the profitability of power industry based on the zero subsidization policy. The Vietnamese government is going to raise the average price level by about 50 Dong/kWh every year until 2000 up to 770 Dong (7¢)/kWh, which would be barely in the price range of other countries in Asia like Thailand or Indonesia. This price level should be regarded as the upper limit to compete with those countries in the world marketplace. Apart from the price level discussion, a notable change which deserves appreciation in the new tariff is the introduction of progressive rate in the residential sector (Refer to Table 13.1-1).

13.1.4 Recommended Changes in Tariff System

Reviewing the current electricity tariff, several issues can be pointed out for longterm improvement. First, the difference between residential charge and industrial charge seems too small, which implies that the residential charge is set below the actual cost. The low voltage customers are responsible for bearing the distribution cost, which should lead to high residential charge compared to the high voltage industrial use. With the current tariff, industrial and commercial customers in Viet Nam are overcharged. The current tariff structure is based on a principle which is different from fair pricing. The idea is, which is often seen in developing countries, charging on the basis of bearability. This will not work if the discrepancy between price and actual cost has become substantially large. A practical method to adjust the residential charge to a higher level is to lower the limit (150 kWh/month) of the first step charge (450 Dong/kWh) and to increase the level of second and third step charges; 600 and 800 Dong/kWh respectively at this moment. In actual implementation, this change should be gradually conducted to go along with inflation and net GDP increase.

Electricity charge is one of the most important elements in the cost of industrial products. International comparison of electricity price must be intermittently performed because electricity price is one of very important factors to attract investment from overseas and also to gain competitiveness of Vietnamese products in the world marketplace (Refer to Table 13.1-2). High electricity charge leads to lowering international competitiveness and hence hampering economic growth. For example, in the rapidly growing southern part of China, the electricity price for industry is 3-4¢ / kWh, which is significantly lower than that in Viet Nam. The economic policy should aim at keeping industrial electricity tariff as low as possible to help increase the cost advantage of Vietnamese industries.

Second, introduction of capacity charge, particularly for industry, should be considered. This is a major step to modernize the current electricity tariff system because electricity usage pattern, kW vs. kWh, will become more and more diverse as economic growth continues. The current tariff, which has only energy charge, cannot deal with diverse demand patterns. Although allocating total cost into capacity cost and energy cost would be very complex so that the calculation of the capacity charge may be difficult, a charge for capacity is necessary to apply the fair pricing principle.
Of course, electricity demand meter must be installed at each customer who is charged for capacity to determine the actual electricity demand accurately. In actual implementation, this system should be started from large - scale industrial customers (about 300 large - scale candidate customers whose aggregate electricity consumption is 50 GWh have been identified), and increase the number of customers continuously.

Third, some incentive measures to reduce peak - time demand should be added to the current tariff system. The time - of - use (TOU) tariff has been introduced, however this is not widely applied due to the shortage of TOU electricity meters. Power companies are requested to install TOU meters selectively to the customers who have good potential to use electricity during off - peak periods. In addition, a price discount program for high load factor customers may be effective to cut out peak - time demand. The customers who are using large amount of electricity (kWh) compared with maximum demand (kW), generally deserve lower charge because they are contributing to improving the load factor of power company. When introducing the capacity charge, this load factor discount program will be easily introduced.

13.1.5 Strategic Considerations for Future

(1) Long Run Marginal Cost vs. Average Cost

Being a capital intensive industry, the most important corporate finance issue of electric power industry is how to secure enough long - term capital for future investment. In this regard, capital cost to cope with growing demand should be properly included into electricity tariff so that adequate cash flow can be generated. The level of capital cost varies depending on the source of funds; internal cash, debt, stock issue, etc. If the cost is not properly reflected into tariff system, the power company will face financial difficulty because of inadequate revenue to cover growing capital cost.

The most controversial argument is whether or not the electricity price should be set based on Long Run Marginal Cost (LRMC). Advocates of the LRMC based pricing are stressing the advantage of generating sufficient internal cash for the local portion of investment. If electricity tariff is decided by LRMC, it will be very attractive for foreign investors who are looking for good opportunities to invest their money. It is obvious that capital rich investors can put their money in power plant projects only when the selling price of electricity, or ROI, is good enough compared with other investment opportunities. From investor's point of view, it is desirable if the tariff is set based on future cost because the cost of future power plants would be fully recovered by electricity sales. It is reported that foreign investors demand very high rate of return in projects in developing countries. In case of thermal power development project their target ROI is around 20%.

This LRMC argument can be supported if Viet Nam is really going for power plant projects with a BOT style private financing; foreign investment capital on power plant project on a commercial basis. But the viability of this argument is not very clear for the next several years from now when international aid organizations, whose terms and conditions are less demanding, are the major fund suppliers. In this stage, the LRMC based pricing is not a good benchmark but rather the inevitable high electricity prices would only lead to consumers complaints and losing cost advantage of Vietnamese economy. It should be noted that in many Western countries including Japan the baseline of electricity tariff is set and approved based on average cost, not LRMC. Marginal cost is only used in case of fine adjustment of each classified tariff.

Moreover, the LRMC based pricing theory cannot be justified because it is using future cost instead of actually incurred cost for current electricity pricing. Also this results in constant price hikes when marginal cost is increasing and give less incentive to company - wide cost reduction

(2) Cost Reduction As Top Priority

Electricity is a highly public product which is one of the most important items for industry and household. It is, therefore, quite difficult in a political sense to raise tariff so often because the social impact is so large. When the cost is constantly increasing, it is strongly requested to build some cost reduction incentives in the electricity tariff system. In this regard, it is not very appropriate to set future schedule for raising tariff, because power company tends to easily rely on tariff increase and make less effort to reduce costs in this case. At the same time, people's trust in the Government and power company will diminish, which will result in consumer's negative reaction; for example, illegal use of electricity. It also creates a sense of uncertainty among foreign investors who are considering to build industrial plants in Viet Nam, which discourages future investment and slows down economic growth.

Instead of increasing electricity tariff so often, cost reduction effort should be set as the primary objective of the power industry to improve profitability. There seems to be ample room for cost savings in the power sector. In this regard, cost reduction targets should be established at each department. For example, reducing electricity loss should be eagerly pursued. If Viet Nam can reduce loss ratio from the current 30% to 25%, that would be equal to developing 200MW power plant. The cumulative effect of small cost savings would be enormous and eventually lead to sound and strong financial structure of power companies. At first, it may be difficult to do company - wide cost savings because employees are accustomed to the planned economy where people are supposed to use up preset amount of expense. But this practice must be severely criticized and abandoned. Transforming corporate culture is of vital importance. In pursuing measures to promote such continuous cost reduction, it is recommended to introduce Quality Control (QC) activities in which dedication and participation of every employee is encouraged. Japan's assistance in this area (applying Quality Control in the power sector) deserves serious consideration.

(3) Tax Reform

Another important point to consider is the change in current taxation system. The government now imposes three different taxes, revenue tax (8% on revenue), income tax (25% on profit), fixed asset tax (2.4% on fixed asset) and natural resource tax (2% on revenue from hydropower), on the power industry. The aggregate tax rate accounts for more than 10 % of the total cost. This is pushing up the cost of power companies and also the electricity price. From a macro economic perspective, the government may better levy a tax on added values (industrial products) rather than on raw materials (electricity). The rationale here is that it would be better to keep electricity price level low for the sake of industrial competitiveness and to get tax revenue from industries which are producing more added values. It is recommended to reform the current tax system along this line and reduce tax rate on the power industry.

(4) Introduction of Special Contract System

Apart from the standard and TOU tariff, special contract programs can be introduced to improve the demand curve (DSM) in order to enable power plants to operate more efficiently. This would be applied primarily to large - scale users (cement, steel, fertilizer, etc.) for mutual benefit. Some ideas are shown below:

- Discount for high load factor users
- Premium payment for changing factory hours
- Premium payment for allowing shutdown at power shortage

The rationale here is to reward customers who will benefit the power companies by improving its load factor or increasing its available power supply at peak - time. This is, of course, to help the power industry alleviate financial burden for huge investment, but at the same time heavy industries will benefit from the reduced electricity cost.

Table 13.1-1 Electricity Tariff

		Previous Tariff	New Tariff (from Aug.' 94)	% Change
Industrial				
Over 20kV	Normal Time	450	450	0
	Peak Time	750	710	-5.3
	Off-peak Time	300	280	-6.6
Under 20kV	Normal Time	450	500	11.1
	Peak Time	750	800	6.7
	Off-Peak Time	300	300	0
Under 6kV	Normal Time	480	550	14.6
	Peak Time	800	800	0
	Off-peak Time	320	320	0
Agricultural				
Over 6kv	Normal Time	450	450	0
	Peak Time	750	750	0
	Off-peak Time	300	300	0
Under 6kV	Normal Time	450	450	0
	Peak Time	750	750	0
	Off-peak Time	300	300	0
Commercial and Service		750	950	26.7
Public lighting		400	450	12.5
Residential	(0-150kWh/month)	450	450	0
	(151-250)		600	33.3
	(251-)		800	77.8
Bulk	Rural: Consumers Substation	360	360	0
	Residential; Consumers Substation	400	400	0
	Power Company's Substation	420	420	0
Foreigner				
Production:	Over 20 kV	8 US cent	7 US cent	-12.5
	Under 20kV		7.5US cent	-6.3
	Under 6kV		8 US cent	0
Vusiness and Service	Over 20kV	9US cent	9 US cent	0
	Under 20kV		10 US cent	11.1
	Under 6kV		11 US cent	22.2
Residential	Over 20kV	9US cent	8 US cent	-11.1
	Under 20kV		8.5US cent	-5.5
	Under 6kV		9 US cent	0

Note: Normal Time 4h - 18h
Peak Time 18h - 22h
Off-Peak Time 22h - 4h

Table 13.1-2 Electricity Prices

(cents/kWh)

Country	Residential	Industry
Vietnam	4.0	5.0
China (South China)	3.2	3.6
Indonesia	6.6	6.2
Thailand (MEA)	8.3	6.4

13.2 Accounting System

13.2.1 Transition to New Accounting System

In 1992, new accounting system was introduced in Viet Nam to replace the previous USSR accounting system. The new system aimed at changing the cost accounting from standard unit cost to actual incurred cost. At the same time revaluation of fixed asset took place based on the new exchange rate. As a result of these changes, problems pointed out by the World Bank Report (1993) no longer exist.

Another revaluation is planned for 1995, but no guideline has been issued by the government so far. It is recommended to keep consistency in accounting practices so that comparison of financial data over long time can fairly reflect the actual situation. It must be noted that frequent change in accounting system will result in distorted financial information (Refer to Table 13.2-1).

Table 13.2-1 Role Model of Government and Power Industry

Government	Power Industry
Develop a long-term plan (master plan) to identify priority projects together with power industry	Prepare a detailed investment plan for the next few years
Legislate necessary rules and set up guidelines to show the rules to be followed	Responsible for day-to-day operations complying with rules and regulations
Implement necessary measures to help the power industry grow into sound entity and to build industrial infrastructure	Develop managerial capabilities by introducing modern management practices to improve efficiency, reliability and profitability
e.g. financial support program (foreign aid, public loan, subsidy on interest, direct subsidy)	Develop technical capabilities for construction and maintenance
Reform tariff structure paying attention to public opinion and international competitiveness	
Coordinate other government organizations to speed up processing of various projects	

13.3 Institutional Development and Human Resource Management

13.3.1 Relationship between Government and Utility Company

Given that Viet Nam is now undergoing the transition to the market economy, it is premature to implant those systems which are common in the free market mechanism directly. Particularly, the power industry, which is playing a critical role for the economic growth by providing an important basic item and also by investing huge amounts of long - term capital, should be nurtured carefully based on a well - designed long - term strategy. The rapidly expanding Viet Nam's economy needs the sound power industry and to this end the Ministry of Energy still must play a leading role. The long - term strategy should focus on how to make the power industry grow financially strong enough with fulfilling its social responsibility to supply electricity to the request of customers.

The nature of power industry can be viewed as public and monopolistic entity, whose function does not fit in the pure context of free market mechanism. It is, therefore, understandable that many countries still have state - owned power companies. Even after privatization, the government must share responsibilities with the power industry when the country's economy is not well developed. Government regulations for the industry are far more necessary than in case of other industries. For example, it is important to control the electricity tariff to rectify social imbalance and to prevent the abuse of monopoly , or to implement safety standards to maintain key economic infrastructures in a good condition.

The power industry is typically capital - oriented requiring a large amount of money for its long - term investment. Not only in Viet Nam but also in most of the developing countries, it is the case that only the central government can secure this size of long - term capital. The government and the power industry, therefore, must work very closely to achieve their common goal, growth of state economy and power industry, and the relationship between the two parties should not be the one of commanding and following. Developing trustful and interactive relationship between the government and the power industry is strongly required so that the government can provide necessary supporting measures in a timely manner to help the industry achieve its sound growth. The official long - term plan (or master plan) of power industry, therefore, must be prepared and made open so that government staff and power company people can share their common goal and collaborate in many different occasions to achieve it. The more sound enough the power sector has grown, the more the government can loosen its control over the industry.

13.3.2 Management of EVN

A united generation and transmission company, EVN, which will serve the whole Viet Nam was established in January 1995. After the first quarter of 1995, when preparation work was carried out, EVN formally started its operation in April, 1995. This is a logical step to resolve the problem of demand/supply imbalance between the north and the south Viet Nam. The interconnecting 500kV transmission line enabled the consolidation of the previous three regional power companies; PC1, PC2 and PC3. These power companies will continue their operation only in electricity distribution. In addition, Hanoi and Ho Chi Minh City will have separate distribution companies; PC Hanoi and PC Ho Chi Minh City.

There would be many advantages resulting from the new EVN. The financial and technical capability will be strengthened and the close coordination with the central government along the long - term national development plan will become possible. Under EVN there are many companies which have independent accounting systems. This means that these companies will operate as profit centers with full autonomy. If properly managed, the new organizational framework will be able to operate with high efficiency. However, there might be some risk that the new big entity leads to bureaucratic and inefficient organization because of its multilayered structure. EVN management needs to consider delegation of authorities as much as possible.

Another important aspect is how to manage the new company where people from different regions, north, central and south, must work together. The management should pay attention to human issues; in short, how to make the employees get along well and collaborate. The psychological distance of the north and the south Viet Nam seems to be quite large. As people is the major driving force of new enterprises, this problem should be carefully dealt with and the sense of teamwork should be emphasized. It would be disastrous if the company ends up with factional confrontation and hence the reconciliation within the new company runs into obstacles.

Together with EVN, five regional distribution companies will provide distribution services, each serving the area of Hanoi, Ho Chi Minh City, PC1 (excluding Hanoi), PC2 (excluding Ho Chi Minh City) and PC3 respectively. These companies will operate as regional monopoly by purchasing electricity from EVN at wholesale price and selling it to customers based on the tariff schedule. According to EVN the wholesale price will be decided by negotiation between EVN and regional distribution companies so that the different profitability of five companies can be adjusted. The cost structure of each distribution company may vary depending on those factors such as differences in demand curve, demand density and loss ratio. More important, the five companies should be given high degree of autonomy so that they have strong incentive to improve productivity, particularly by upgrading the outdated distribution grids.

13.3.3 Human Resource Development

As often stated, the most important management technique is human resource development. Human resource should not be treated as mere labor force. Rather, it should be viewed as a source of creating added value. Typically Japanese management practice is famous for its emphasis on human resource management, which is often characterized by group work, lifetime employment or middle - management driven (unlike top - down) management. The essential point of this management style is that an organization as a whole can create a new value (new product, high quality, cost reduction, etc.) by fully utilizing employee's knowledge and experience. For this, many management practices have been developed and put into use in order to encourage employee's participation and strengthen their commitment.

One of the important tools for human resource development is training. Hiring high caliber people is of course very important, but providing adequate training within company is far more important for creating a strong organization. In this regard, strong emphasis should be placed on providing appropriate training at the power companies. From management practices to electricity engineering, there are many areas which Viet Nam's power companies must learn. Particularly, technical training to get used to the Western style technology is important and urgent. There are a number of upcoming construction projects in Viet Nam in the near future, all of which are to be based on the Western technologies. The need for training is significantly large.

For example, in the area of electricity distribution, where continuous small - scale technical improvement is necessary for loss reduction and higher productivity, it would be highly rewarded to give well - designed training widely to the company staff. The technical training center project of PC1, which is supported by the Australian government is a good example of investment in human resources. Apart from the distribution technology, there are many other areas where training programs supported by foreign countries will play a significant role.

13.4 Rural Electrification

13.4.1 Current Status of Rural Electrification

Rural Electrification (RE) is one of the big energy/economy issues which call for comprehensive planning of the state government. The development of rural energy, electricity in particular, is a first urgent task to develop rural economic infrastructure and to improve peoples' standard of living. In Viet Nam, RE has a long development history. Nevertheless, because of the long war and financial constraint the result of RE has been modest so far. By 1993, the electricity supplied to rural areas had reached 1,243 GWh, 16% of the total electricity consumption in Viet Nam. Over the next ten years, it is expected that the rural electricity consumption will grow, on average, by 14.3% per year. The Government estimates that it would require a 4 billion dollar investment until the year 2000 to meet the demand.

According to the survey of the Institute of Energy, in the North region, 198 of 223 districts and 3,328 of 5,696 communes are electrified. Particularly, in the Red River Delta all of 60 districts have electricity supply. In the Central region, 73 of 111 districts and 553 of 1,357 communes have electricity. The most of the areas which have no electricity supply are in the mountainous provinces in the North and the Central regions. In contrast, in the South region, 145 of 157 districts and 1,061 of 1,952 communes have electricity. As a whole, 416 of 491 districts (84.7%) and 4,942 of 9,005 communes (54.9%) are electrified in Viet Nam.

Like other developing countries, there is a sharp contrast between urban and rural areas in terms of electricity supply. As a result of the economic reform, Vietnamese people living in urban areas can afford electricity and appliances thanks to their growing income. Power companies distribution grids, even though some of them are old and require upgrading, now cover cities, major towns and district centers. Almost all the households in these areas are connected to the grids. On the other hand, outside these areas, RE investment, either extension of distribution grid or construction of microhydro power plant, has been hardly conducted due to economical reasons. The characteristics of rural electricity demand can be summarized as small unit and widely dispersed. According to the estimate of the Institute of Energy, 300 dollars are required as initial RE investment for one family, but the expected revenue by electricity sales is only 8 dollars per year. Thus it is not economically justifiable to invest in RE. Rather, it must be accelerated as a part of social development policy.

On the household basis less than 20% of the whole rural population are electrified with an average electricity consumption of 20-30kWh/capita/year, one tenth of that in the urban area. In the rural area, electricity use for irrigation pumping accounts for 43%, handcrafting 23% and lighting 34%. Their income level is low but they long for electricity. This growing imbalance between urban and rural areas has become a serious issue for the central government.

13.4.2 Problems Surrounding RE

Rural electrification is increasingly acknowledged in many developing countries as well as among international development organizations. It is viewed as an important political and social issue as a means of promoting equality and also increasing productivity in agriculture as well as in household or small size industry. The Vietnamese government now has the target of achieving 70% electrification at household level by the year 2010. However, the shortage of funds would be the biggest obstacle in pursuing this goal.

RE is also important from environmental point of view because many people living in rural areas still rely on fuelwood. The effect of deforestation in the long run would be devastating unless some alternative measures are implemented.

The shortcomings of RE program are summarized as follows.

(1) **Financial issue**

There is no policy on electricity tariff and/or tax for RE, which means only insufficient funds are available for implementing RE programs (if any). RE is, by its nature, not economically viable. Therefore, in many areas where local people build their distribution lines or hydropower stations the electricity price per kWh is set at higher level than the government regulation.

In general, the cost of supplying electricity to small and dispersed loads tends to be high and the return on investment is relatively low. Therefore, electric utility companies, either state - owned or private, have little economic incentive to invest in rural electrification. Local people who benefit from electricity supply are expected to bear some of the cost for investment, but in reality that is very difficult because they usually fall in a lower income segment. Without appropriate financial assistance from the state or the local government, RE programs cannot go ahead. The key issue here is finding out a workable financing scheme.

(2) **Technical issue**

There are many kinds of technical problems which make operation and maintenance of RE equipment difficult and costly. Such problems include low reliability of equipment, high electricity loss in distribution grid and low load factor of power stations. The existing rural electricity network built and managed primarily by local people is usually of poor quality and does not satisfy safety standards.

13.4.3 Overview of RE Development

There may be two different approaches for achieving rural electrification. One is to build distribution lines connecting to the existing distribution grid, and the other is to build independent power stations such as mini/micro hydro or diesel power. The areas where the electricity grid is expected to be expanded in the foreseeable future will go for construction of distribution lines connected to the electricity grid. Other areas will have no alternative but to build stand - alone power stations. The type to be developed, hydro, solar or diesel, would be selected based on the result of financial analysis in which local conditions such as climate, topography or hydrological conditions are considered.

In the southern part of Viet Nam where the hydropower potential is limited and the grid network covers most of the areas, grid extension would be the primary method of RE. On the other hand, the northern or central part of Viet Nam, where the coverage of distribution grid has not been large enough, has abundant hydropower resources suitable for mini/micro scale (10-200kW) generation. The planning of future RE starts with the mapping of distribution line expansion plan for the next fifteen years (until 2010) to identify recommendable projects for each districts or communes.

As for the upgrading and expansion of distribution grids in rural areas, the total investment requirement is estimated at 21,634 billion Dong up to 2010. The state government needs to focus on the urgent investment in construction of some main electric transmission lines for mountain areas, especially in the provinces where large-scale hydro power station is operating or planned for the near future.

At the same time, development of mini/micro hydropower in the mountain area should be strongly encouraged choosing appropriate sites and design. The areas where the national electricity grid cannot reach by the year 2010, development of local energy resources would be the only way to achieve RE. According to a preliminary investigation, the small hydropower potential in Viet Nam is about 1500-2000MW. The potential of micro hydro(less than 100kW) is about 2500 sites with a total capacity of around 100-200 MW. Until 1990, only 3 % of the small hydro resources was exploited. The shortcomings are pointed out as follows:

(1) Lack of appropriate subsidization policy
(2) No guideline and program for encouraging micro hydro development
(3) Low quality of locally manufactured equipment
(4) Lack of training program for local people

It would be very effective to establish a scheme in which local people take an initiative in developing micro hydro (for example, less than 5kW) and state and provincial governments provide financial and technical assistance in an appropriate manner.

13.4.4 Development of Financial Assistance Program

In Viet Nam, the central government is, in general, responsible for promoting RE because the electric power industry is being managed as state enterprise and also improving living standards of minority people is one of the priority policy matters. Of course, above all, the people who get direct benefit from RE should take an initiative in securing funds, however, it is often difficult because their financing capability is very limited. The central government is expected to establish a comprehensive RE program, in which the most urgent task is to develop an effective financial assistance program to encourage local people to invest in RE facilities. At present the construction of distribution grids under 20kV is done by each provincial government. But this program alone cannot meet the underlying strong demand for electrification in rural areas.

Low interest loans or direct subsidies are the typical form of financial support. The level of financial assistance needs to be so designed that the electricity price level can be as close as to the regulated residential tariff rate. In either case, the key issue is how to secure necessary funds to facilitate the new program. One idea is to create new funds by adding small amounts of additional surcharge to some categories of the existing electricity charge and use the funds exclusively for RE. If 10 million US dollars can be generated every year by adding 50 Dong/kWh to the commercial rate and the second and third step of residential progressive rate, that would facilitate 1000 micro hydro projects. (Assuming 10kW at each site with construction cost 2,000 US$/kW and 50% subsidy)

13.4.5 RE Master Plan

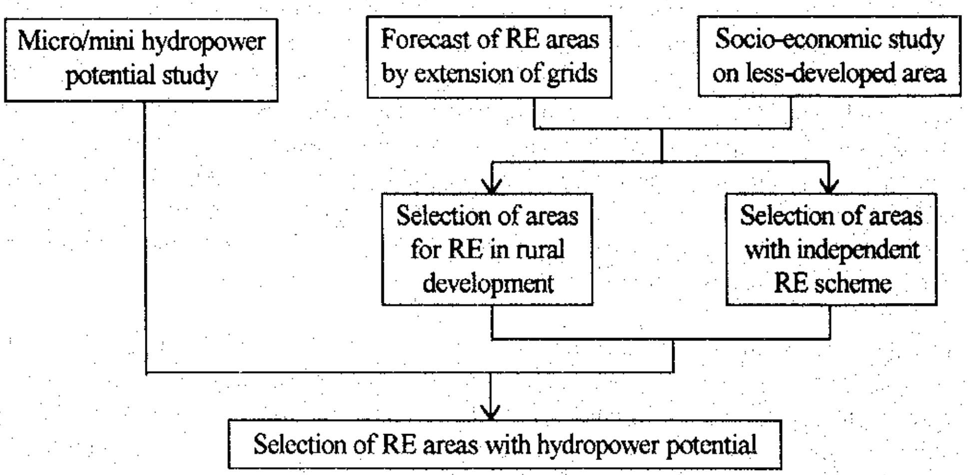
Taking into account the major constraints and regional development pattern of RE, it is recommended to implement the master plan of RE in the whole country. As stated in 13.4.3, the approaches to development of RE are an extension of the existing distribution grids and construction of independent power stations. The newly established PCs (power distribution companies) would probably undertake RE by extending the existing lines to non-electrified areas. Since PCs were requested to establish a certain level of financial autonomy, their projects should be cost-effective and financially viable. Consequently target areas to be covered by PCs will be not less-developed area. The problem is little possibility of RE development in less-developed areas. Those areas are featured by backward and low incomes.

The principal objective of RE is widely recognized to be equity development. The study area of RE master plan should be less-developed region where extension of the existing distribution lines will be hardly expected within a decade more. Lessons from past RE projects in other countries indicate that there would be two scenarios for RE development in less-developed areas. One is the promotion of RE in the framework of rural development. In this case, RE is a project contributing overall rural development. The other is a RE project combined with productive use of electricity. High cost and low load featured by RE with independent power supply scheme often aggravates financial viability of a RE project. Thus productive use of electricity is a crucial element of RE promotion with independent power sources.

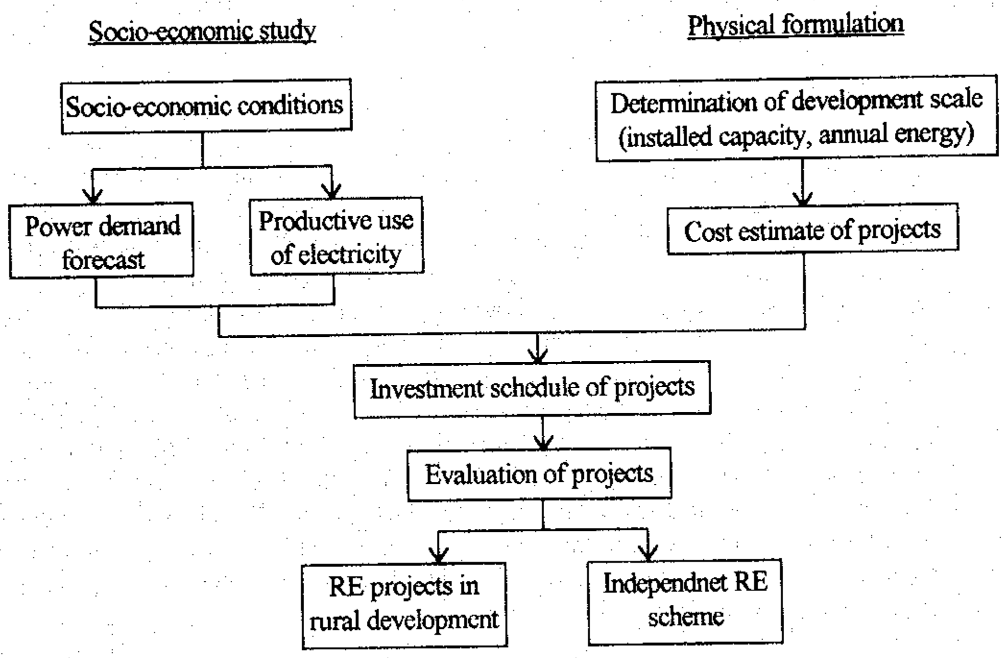
It is highly recommended that Viet Nam should make the best use of her abundant renewable energy source (mnicro/small hydropower potential) for RE in less-developed areas. As stated, the potential of micro hydro (less than 100 KW) is about 2,500 sites with a total capacity of around 100-200 MW. As a result, the objective of RE master plan is defined as RE development with the maximum utilization of micro/mini hydropower potential in less-developed areas.

The work flow of RE master plan is proposed to be as follows.

Phase I Selection of Study Area, Determination of RE Development Framework



Phase II Undertaking of Pre-feasibility Study



Phase III Policy and Institutional Issues

(1) Policy framework for RE projects
(2) Alternative institutional frameworks
(3) Selection of the most appropriate organizational structure for RE projects
(4) Financial programs
(5) Training programs

The work flow of RE master plan shown above is just an example focusing exploitation of hydropower potehntial. The government should take an immediate action of formulating basic framework of RE plan.

13.4.6 Other Programs for Accelerating RE

(1) Standardization and Technical Guidance

They have little knowledge about electricity and cannot make or evaluate the technical issues regarding RE equipment. Furthermore, their capability for maintenance work is limited. In order to make technical problems less significant, it is recommended to standardize equipment used for RE. Particularly, hydropower equipment such as turbine, generator, load controller needs to be standardized to alleviate technical work. Even in case of grid extension, it is extremely important to set up standardized electrical configuration. Standardization contributes to reducing project cost by reducing both design work and equipment cost.

One of the expected roles of power companies is to provide technical assistance to the local people who are planning or operating RE facilities. Without strong cooperation of power companies, it would be unrealistic to install or manage RE projects efficiently. At the same time the power companies will also benefit from this technical cooperation because they can put necessary technical requirements into RE facilities for smooth interconnection with their electric grid in future.

(2) Institutional Development

The big difference between RE and electric facility development by power companies is organizational structure. There are many organizations involved in RE projects. In Viet Nam, each commune has its own people's committee which is vested with decision-making of various commune projects. To make clear the function and responsibility of each organization and to avoid a duplicated process, rearrangement of organizational structure is necessary. In order to control and systemize independent RE projects at commune level, authority and permission with respect to project implementation and electricity price setting should be controlled by a single agency like the Ministry of Energy. It is also recommended that project cycle from plan to implementation should be established. MOE is perhaps responsible for regulation, policy, budget of RE and the short/long term RE development program. PC1 has already established Rural Electrification Development and Management Department to provide consulting and technical support to local RE projects. This department of PC1 should be effectively utilized to take an intermediary action between MOE and local communes.