CHAPTER 7 INVESTMENT PLAN AND FINANCIAL PROJECTION

Chapter 7. Investment Plan and Financial Projection

7.1 Long Term Investment Plan

7.1.1 Investment Plan based on the Revised 5th M/P (refer to Appendix 7-1-1 in detail)

The JICA Team projected and calculated the investment by EVN and the running costs of EVN during 2003 – 2020 based on the revised 5th M/P. The assumptions, method and results of calculation are described as below.

(1) Investment Statement of the Whole Country : Table 7-1-1

Investments by EVN of each year was estimated based on the power system development plan of revised 5th M/P, using unit construction costs of TPPs & NPP stated by IE and of HPPs informed by PECC1.

Construction unit cost (USD/kW)

Capacity	Oil	Gas	GFCC	GT	Coal	Coal*	Nuclear
200	914	1031		400			
250	849	961		400			
300	800	900			1000	1100	
400					912	1003	
500					853	938	
600			600				
700			600				
1000							2200

Note : Institute of Energe

(2) Generation Statement of the Whole Country : Table 7-1-2

Generated energy of each power plant is estimated to match the power demand forecasted by IE added station own use energy, taking into account the plant factor of peaking power sources (0% – 20%), the plant factor of middle power sources (20% – 60%) and base power sources (60% - 90%). As for the PSPP, annual peak equivalent generation hour is assumed as 800hr and the gross energy loss of PSPP is counted.

(3) Operation and Maintenance Costs Statement of EVN : Table 7-1-3

Operation and maintenance costs of EVN's power plants and power grids were calculated using fixed and variable unit O&M cost of the TPPs and the power grids stated by IE and unit O&M cost of HPP based on Japanese experience. The O&M cost of existing HPP elapsed more than 10 years is applied threefold costs of new HPP.

Fixed O & M cost for each type of power plants (Unit: USD/kW/year)

Capacity	Oil	Gas	GFCC	GT	Coal	Coal*
200	22.3	15.9		22.0	26.5	
250	20.7	14.8		22.0	24.5	
300	19.5	13.9			22.5	27.0
400	17.7	12.6			20.5	24.6
500	18.2	12.8			19.2	23.0
600			21.6			
700			21.6			

Source : Institute of Energy

Variable O & M cost for each type of power plants (Unit: USD/kWh/year)

Capacity	Oil	Gas	GFCC	GT	Coal	Coal*
200	1.69	0.95		3.92	0.18	
250	1.57	0.88		3.85	0.16	
300	1.48	0.83			0.14	2.10
400	1.34	0.75			0.12	1.91
500	1.38	0.77			0.12	1.79
600			0.90			
700			0.90			

Source : Institute of Energy

(4) Fuel Price

Fuel price is based on the revised 5th M/P. The transportation cost of coal from the North to the South is assumed 7US$/ton as stated by Vinacoal.

Fuel Unit Price

Fuel Type	Unit	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
DO	USD/ton	289	291	293	298	304	309	314	320	323	326	328	331	334	337	340	343	346	349
FO	USD/ton	162	164	165	168	171	174	178	181	182	184	186	187	189	191	193	194	196	198
Coal(north)	USD/ton	24.4	25.3	26.2	26.8	27.4	28.0	28.6	29.2	29.9	30.6	31.3	32.1	32.9	33.5	34.3	35.0	35.7	36.5
Coal(south)		28.4	29.3	30.2	30.8	31.4	32.0	32.6	33.2	33.9	34.6	35.3	36.1	36.9	37.6	38.3	39.0	39.7	40.5
Associated Ga	USD/mmBTU	2.20	2.25	2.60	2.68	2.75	2.83	2.92	3.00	3.08	3.15	3.23	3.32	3.40	3.48	3.55	3.63	3.72	3.80
Nonassociated		3.06	3.12	3.60	3.66	3.72	3.78	3.84	3.90	3.99	4.07	4.16	4.26	4.35	4.44	4.52	4.61	4.71	4.80
Nuclear	¢/10^3kcal	0.26	0.26	0.27	0.27	0.28	0.29	0.29	0.30	0.31	0.31	0.32	0.33	0.34	0.34	0.35	0.36	0.37	0.37

Source : Institute of Energy, Vinacoal and Study team estimates

(5) Fuel Cost Statement of EVN : Table 7-1-4

Fuel costs of EVN are calculated based on the assumptions of the above mentioned item (3) and item (4).

(6) Power Purchase Statement of EVN : Table 7-1-5

Power purchase price of every kinds of power sources as of the year 2003 is assumed that HPP's (including import) 4.5 ¢ /kWh, coal TPP（≦100MW） 5.0 ¢ /kWh, coal TPP（≧300MW） 3.6 ¢ /kWh, oil TPP's 6.0 ¢ /kWh, GTCC's 4.2 ¢ /kWh. The escalation of each fuel price was also taken into account.

Table 7-1-1 Investment Statement based on the Revised 5th M/P

Unit : million USD

I Power Plants	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Northern Region	184	657	1,086	1,140	1,122	974	942	1,233	900	836	907	1,167	908	405	351	48	0	0
Hydro	79	320	510	482	508	539	582	718	484	678	602	740	744	405	351	48	0	0
Thermal	105	337	576	657	614	435	360	515	416	158	305	427	164	0	0	0	0	0
Central Region	142	301	513	628	570	475	499	265	346	146	132	124	254	268	104	76	41	51
Hydro	142	301	513	628	570	475	499	265	346	146	132	106	59	48	104	76	41	51
Thermal	0	0	0	0	0	0	0	0	0	0	0	17	194	220	0	0	0	0
Southern Region	777	477	676	652	540	377	341	378	392	633	566	411	295	678	1,623	2,166	2,003	996
Hydro	133	134	209	236	306	219	112	152	39	141	180	158	168	94	117	98	104	116
Thermal	644	343	467	416	234	158	229	225	353	492	386	252	17	254	736	857	578	220
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	110	330	770	1,210	1,320	660
Total Investment	1,104	1,435	2,275	2,419	2,232	1,827	1,781	1,875	1,639	1,615	1,605	1,701	1,457	1,351	2,078	2,290	2,043	1,047

II Power Grids	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
500kV TL & SS	267	279	272	59	46	52	59	49	118	118	118	118	118	118	118	118	118	118
220kV TL & SS	170	186	182	154	121	137	155	128	75	75	75	75	75	84	84	84	84	84
110kV TL & SS	242	280	320	167	131	148	167	138	184	184	184	184	184	205	205	205	205	205
Distribution System	247	258	268	325	255	288	326	269	234	234	234	234	234	261	261	261	261	261
Total Investment	926	1,003	1,042	705	553	625	707	584	611	611	611	611	611	668	668	668	668	668

Grand Total	**2,030**	**2,438**	**3,317**	**3,124**	**2,785**	**2,452**	**2,488**	**2,459**	**2,250**	**2,226**	**2,216**	**2,312**	**2,068**	**2,019**	**2,746**	**2,958**	**2,711**	**1,715**
of which IPP investment	*689*	*679*	*817*	*697*	*146*	*83*	*47*	*55*	*29*	*36*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
of which JV investment	*0*	*34*	*245*	*442*	*489*	*435*	*453*	*315*	*332*	*116*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
of which EVN investment	*1,341*	*1,724*	*2,255*	*1,985*	*2,149*	*1,934*	*1,988*	*2,090*	*1,888*	*2,075*	*2,216*	*2,312*	*2,068*	*2,019*	*2,746*	*2,958*	*2,711*	*1,715*

Table 7-1-2 Generation Statement based on the Revised 5th M/P

Unit : GWh

REGION	Norm\Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
NORTH	DEMAND	15,467	17,451	19,680	21,842	24,233	26,915	29,923	33,339	36,114	39,130	42,408	45,972	49,787	53,333	57,132	61,208	65,652	70,350
	POWER PRODUCTION	15,658	15,548	15,786	18,114	23,235	29,532	35,051	37,934	41,063	44,968	50,027	54,972	61,119	66,110	68,146	73,195	78,160	80,593
	Hydro + Import	*8,481*	*8,481*	*8,481*	*8,627*	*9,652*	*11,924*	*13,545*	*13,800*	*14,520*	*17,155*	*20,944*	*25,246*	*27,801*	*30,894*	*32,931*	*36,403*	*40,317*	*42,750*
	THERMAL	*7,177*	*7,067*	*7,305*	*9,487*	*13,583*	*17,608*	*21,506*	*24,134*	*26,543*	*27,813*	*29,083*	*29,726*	*33,317*	*35,215*	*35,215*	*36,792*	*37,843*	*37,843*
CENTRE	DEMAND	4,124	4,815	5,642	6,391	7,250	8,237	9,373	10,686	11,631	12,669	13,802	15,041	16,394	17,599	18,915	20,330	21,877	23,517
	POWER PRODUCTION	4,194	4,059	4,263	5,284	7,016	8,579	10,729	13,835	16,706	19,096	22,017	25,643	26,686	29,333	34,936	37,450	37,450	38,267
	Hydro + Import	*4,194*	*4,059*	*4,263*	*5,284*	*7,016*	*8,579*	*10,729*	*13,835*	*16,706*	*19,096*	*22,017*	*25,643*	*26,686*	*27,861*	*31,152*	*33,035*	*33,035*	*33,852*
	THERMAL	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,472*	*3,784*	*4,415*	*4,415*	*4,415*
SOUTH	DEMAND	20,242	23,059	26,272	29,376	32,838	36,763	41,171	46,185	50,196	54,574	59,338	64,595	70,207	75,334	80,882	86,842	93,345	100,196
	POWER PRODUCTION	21,301	27,478	33,530	36,296	36,473	36,644	38,563	42,620	45,870	48,607	51,931	56,801	61,876	64,268	69,461	77,459	88,390	100,737
	Hydro + Import	*5,163*	*5,350*	*5,350*	*5,662*	*6,680*	*7,665*	*7,665*	*8,232*	*9,365*	*9,365*	*9,365*	*9,365*	*9,755*	*10,534*	*11,960*	*15,379*	*16,444*	*16,576*
	THERMAL	*16,138*	*22,128*	*28,180*	*30,633*	*29,793*	*28,979*	*30,897*	*34,388*	*36,505*	*39,242*	*42,566*	*47,435*	*52,121*	*53,734*	*57,500*	*62,080*	*69,464*	*74,232*
	NEWCLEAR	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2,482*	*9,928*
Total power production		**41,153**	**47,084**	**53,579**	**59,694**	**66,724**	**74,755**	**84,343**	**94,390**	**103,639**	**112,671**	**123,975**	**137,416**	**149,681**	**159,710**	**172,543**	**188,104**	**204,001**	**219,598**

Table 7-1-3 Operation & Maintenance Cost Statement of EVN based on the Revised 5th M/P

Unit : million USD

Type/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	48	48	48	50	50	55	58	59	65	77	115	115	116	119	134	136	136	136
Coal Fired	43	42	41	46	67	92	116	129	143	162	172	174	191	206	206	212	232	247
FO Fired	6	6	6	6	14	20	20	21	21	21	21	21	21	16	16	16	16	16
Gas	74	85	87	87	86	91	99	100	99	107	123	150	170	164	184	203	222	241
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	44
Powr grids	52	71	90	105	116	128	144	156	167	179	191	201	213	227	240	251	265	278
Total O & M Cost	**223**	**252**	**272**	**294**	**332**	**385**	**437**	**465**	**494**	**545**	**622**	**661**	**711**	**733**	**780**	**818**	**879**	**962**

Table 7-1-4 Fuel Cost Statement of EVN based on the Revised 5th M/P

Unit : million USD

Type/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coal Fired	96	95	94	102	110	134	160	167	198	210	207	212	238	271	276	315	387	435
FO Fired	31	31	31	55	94	112	114	138	140	133	134	136	137	142	144	145	122	123
Gas	331	387	504	531	493	483	552	591	593	680	809	998	1,187	1,285	1,489	1,670	1,873	2,060
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	97
Total Fuel Cost	**458**	**513**	**629**	**687**	**698**	**729**	**825**	**897**	**931**	**1,023**	**1,150**	**1,346**	**1,562**	**1,698**	**1,909**	**2,130**	**2,406**	**2,714**

Table 7-1-5 Power Purchase Statement of EVN based on the Revised 5th M/P

Unit : million USD

Type/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	4	13	13	48	130	164	205	249	249	249	249	249	249	249	249	249	249	249
Coal	0	5	32	85	219	299	381	473	489	525	600	585	601	608	614	652	691	698
Gas	0	232	375	410	491	469	473	568	688	724	732	739	746	785	854	861	870	815
Oil	125	43	91	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	0	0	7	20	40	82	94	173	289	302	328	432	585	701	756
Total Cost	**129**	**293**	**510**	**672**	**840**	**938**	**1,079**	**1,330**	**1,508**	**1,592**	**1,753**	**1,862**	**1,898**	**1,969**	**2,149**	**2,347**	**2,511**	**2,518**

7.1.2 Long-term Investment Plan and Running Cost Projections based on the JICA Study (refer to Appendix 7-1-2 in detail)

The JICA Team projected and calculated the investment by EVN and the running costs of EVN during 2003 – 2020 based on the optimum power system development plan proposed in Session 6.2. The assumptions and method of calculation is the same as in Section 7.1.1, and the calculation results are displayed in from Table 7-1-6 to Table 7-1-10.

The differences between the case of the revised 5th M/P and the case of the JICA Study are stated as below.

a. Investment shown in Fig. 7-1-1 ; The investment based on the JICA Study is larger than that based on the revised 5th M/P in later years, because in the JICA Study the amount of coal TPPs development in the south is greater and the electricity imports from Cambodia and China are excluded.

b. O&M costs shown in Fig. 7-1-2 ; There is no significant difference.

c. Fuel costs shown in Fig. 7-1-3 ; The fuel costs after 2014 based on the JICA study amount to approx. 200 mil. US$/yr less than that based on the revised 5th M/P, because in the JICA Study the coal TPPs development replaces Gas TPPs development in the south.

d. Power purchase costs shown in Fig. 7-1-4 ; The power purchase costs based on the JICA study is around 300 mil. US$/yr less in 2020, due to exclusion of electricity imports from Cambodia and China.

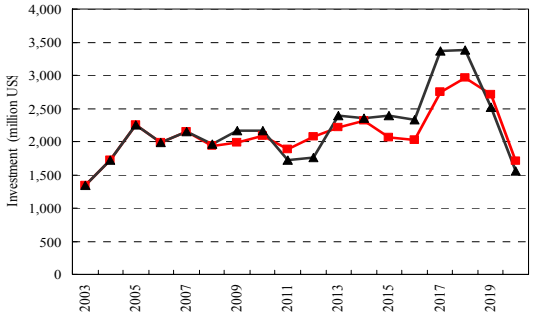


Fig. 7-1-1 Investments of EVN

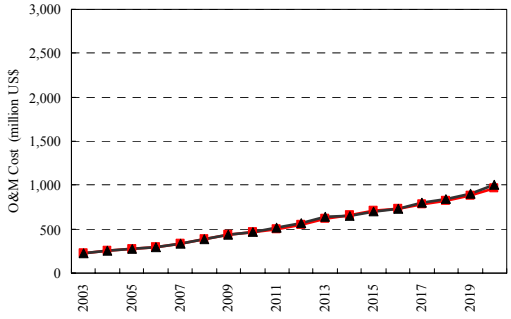


Fig. 7-1-2 O&M Costs of EVN

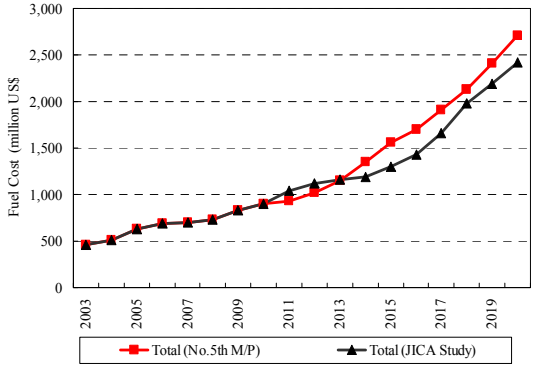


Fig. 7-1-3 Fuel Costs of EVN

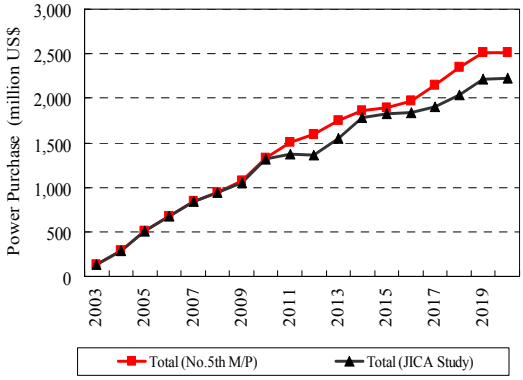


Fig. 7-1-4 Power Purchase costs of EVN

Table 7-1-6 Investment Statement based on the JICA Study

Unit : million USD

I Power Plants	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Northern Region	184	657	1,086	1,140	1,122	1,063	1,471	1,431	640	668	622	778	801	587	1,059	971	445	117
Hydro	79	320	510	482	508	539	574	706	476	668	622	778	801	503	449	117	117	117
Thermal	105	337	576	657	614	524	897	725	164	0	0	0	0	84	610	854	328	0
Central Region	142	301	513	628	570	475	499	265	346	146	132	124	254	268	104	76	41	51
Hydro	142	301	513	628	570	475	499	265	346	146	132	106	59	48	104	76	41	51
Thermal	0	0	0	0	0	0	0	0	0	0	0	17	194	220	0	0	0	0
Southern Region	777	477	676	652	510	311	112	192	350	600	1,025	841	721	800	1,533	1,670	1,364	716
Hydro	133	134	209	236	306	219	112	142	24	106	130	98	93	19	72	83	44	56
Thermal	644	343	467	416	204	92	0	50	326	494	895	743	518	451	690	376	0	0
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	110	330	770	1,210	1,320	660
Total Investment	1,104	1,435	2,275	2,419	2,202	1,850	2,081	1,887	1,337	1,414	1,779	1,742	1,776	1,656	2,695	2,716	1,850	883

II Power Grids	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
500kV TL & SS	267	279	272	59	46	52	59	49	118	118	118	118	118	118	118	118	118	118
220kV TL & SS	170	186	182	154	121	137	155	128	75	75	75	75	75	84	84	84	84	84
110kV TL & SS	242	280	320	167	131	148	167	138	184	184	184	184	184	205	205	205	205	205
Distribution System	247	258	268	325	255	288	326	269	234	234	234	234	234	261	261	261	261	261
Total Investment	926	1,003	1,042	705	553	625	707	584	611	611	611	611	611	668	668	668	668	668

Grand Total	**2,030**	**2,438**	**3,317**	**3,124**	**2,755**	**2,475**	**2,788**	**2,471**	**1,948**	**2,025**	**2,390**	**2,353**	**2,387**	**2,324**	**3,363**	**3,384**	**2,518**	**1,551**
of which IPP investment	*689*	*679*	*817*	*697*	*146*	*83*	*47*	*55*	*29*	*36*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
of which JV investment	*0*	*34*	*245*	*442*	*459*	*429*	*571*	*249*	*203*	*230*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
of which EVN investment	*1,341*	*1,724*	*2,255*	*1,985*	*2,149*	*1,964*	*2,170*	*2,168*	*1,716*	*1,759*	*2,390*	*2,353*	*2,387*	*2,324*	*3,363*	*3,384*	*2,518*	*1,551*

Table 7-1-7 Generation Statement based on the JICA Study

Unit : GWh

REGION	Norm\Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
NORTH	DEMAND	15,467	17,451	19,680	21,842	24,233	26,915	29,923	33,339	36,114	39,130	42,408	45,972	49,787	53,333	57,132	61,208	65,652	70,350
	POWER PRODUCTION	15,658	15,548	15,786	18,114	23,235	29,532	35,051	38,854	40,216	46,501	53,093	58,446	63,017	67,229	70,978	73,979	74,874	73,516
	Hydro + Import	*8,481*	*8,481*	*8,481*	*8,627*	*9,652*	*11,924*	*13,545*	*13,800*	*14,520*	*17,155*	*20,944*	*25,246*	*27,801*	*30,962*	*33,135*	*34,968*	*34,797*	*34,797*
	THERMAL	*7,177*	*7,067*	*7,305*	*9,487*	*13,583*	*17,608*	*21,506*	*25,054*	*25,696*	*29,346*	*32,149*	*33,200*	*35,215*	*36,266*	*37,843*	*39,011*	*40,077*	*38,719*
CENTRE	DEMAND	4,124	4,815	5,642	6,391	7,250	8,237	9,373	10,686	11,631	12,669	13,802	15,041	16,394	17,599	18,915	20,330	21,877	23,517
	POWER PRODUCTION	4,194	4,059	4,263	5,284	7,016	8,579	10,729	13,835	16,706	19,096	20,764	21,612	22,108	24,755	30,358	32,872	32,872	33,689
	Hydro + Import	*4,194*	*4,059*	*4,263*	*5,284*	*7,016*	*8,579*	*10,729*	*13,835*	*16,706*	*19,096*	*20,764*	*21,612*	*22,108*	*23,283*	*26,574*	*28,457*	*28,457*	*29,274*
	THERMAL	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,472*	*3,784*	*4,415*	*4,415*	*4,415*
SOUTH	DEMAND	20,242	23,059	26,272	29,376	32,838	36,763	41,171	46,185	50,196	54,574	59,338	64,595	70,207	75,334	80,882	86,842	93,345	100,196
	POWER PRODUCTION	21,301	27,478	33,530	36,296	36,473	36,644	37,932	41,407	46,426	46,443	48,801	53,869	60,345	64,619	67,831	74,212	82,283	91,867
	Hydro + Import	*5,163*	*5,350*	*5,350*	*5,662*	*6,680*	*7,665*	*7,665*	*8,232*	*9,365*	*9,365*	*9,365*	*9,891*	*11,056*	*11,282*	*10,466*	*10,330*	*10,262*	*10,394*
	THERMAL	*16,138*	*22,128*	*28,180*	*30,633*	*29,793*	*28,979*	*30,267*	*33,175*	*37,060*	*37,078*	*39,436*	*43,978*	*49,289*	*53,336*	*57,364*	*63,882*	*70,159*	*72,165*
	NEWCLEAR	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,862*	*9,308*
Total power production		**41,153**	**47,084**	**53,579**	**59,694**	**66,724**	**74,755**	**83,712**	**94,097**	**103,348**	**112,040**	**122,659**	**133,927**	**145,470**	**156,602**	**169,167**	**181,064**	**190,029**	**199,072**

Table 7-1-8 Operation & Maintenance Cost Statement of EVN based on the JICA Study

Unit : million USD

Type/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	48	48	48	50	50	55	58	59	65	77	115	115	116	119	125	127	134	142
Coal Fired	43	42	41	46	67	92	116	131	167	187	207	214	252	273	292	298	334	373
FO Fired	6	6	6	6	14	20	20	22	22	22	22	22	22	16	16	17	17	17
Gas	74	85	87	87	86	91	99	98	100	101	100	99	99	94	128	146	146	147
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	44
Power grids	52	71	90	105	116	128	144	156	167	179	191	201	213	227	240	252	266	279
Total O & M Cost	**223**	**252**	**272**	**294**	**332**	**385**	**437**	**467**	**522**	**566**	**636**	**652**	**703**	**729**	**800**	**839**	**906**	**1,002**

Table 7-1-9 Fuel Cost Statement of EVN based on the JICA Study

Unit : million USD

Type/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Coal Fired	96	95	94	102	110	134	160	171	189	256	306	360	485	571	634	702	848	930
FO Fired	31	31	31	55	94	112	114	183	185	187	181	182	184	142	144	169	170	172
Gas	331	387	504	531	493	483	552	543	663	679	669	646	628	716	881	1,113	1,155	1,232
Nuclear	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	91
Total Fuel Cost	**458**	**513**	**629**	**687**	**698**	**729**	**825**	**898**	**1,037**	**1,122**	**1,156**	**1,188**	**1,298**	**1,429**	**1,659**	**1,984**	**2,191**	**2,425**

Table 7-1-10 Power Purchase Statement of EVN based on the JICA Study

Unit : million USD

Type/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Hydro	4	13	13	48	130	164	205	249	249	249	249	249	249	249	249	249	249	249
Coal	0	5	32	85	219	299	381	496	479	503	600	627	664	671	715	722	729	698
Gas	0	232	375	410	491	469	445	534	568	516	557	710	717	694	641	738	902	942
Oil	125	43	91	129	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Import	0	0	0	0	0	7	20	40	82	94	145	199	199	225	296	331	331	331
Total Cost	**129**	**293**	**510**	**672**	**840**	**938**	**1,051**	**1,319**	**1,378**	**1,362**	**1,550**	**1,783**	**1,828**	**1,839**	**1,900**	**2,040**	**2,211**	**2,220**

7.2 Study Projections

7.2.1 Study Projection Environment

(1) EVN Reorganization

The methods and situation of the reorganization of EVN may have significant impact on financial projections, but in this projection, it is assumed that there is no impact from the EVN reorganization.

Affects of the reorganization are not assumed in EVN financial projections, either.

EVN reorganization will be proceeded by the October 28, 2003 Decision of The Prime Minister No.219/2003/QD-TTG

The summary of the reorganization stated in the Decision of The Prime Minister is as follows.

a. EVN Reorganization

The business entities, which will comprise EVN, will still be 100% government owned corporations. The Decision of The Prime Minister does not clarify whether the governmental corporations will be placed directly under the government or remain as group companies comprising EVN, as present. EVN's Finance and Accounting Division assumes that there is no difference from an accounting point of view.

If the governmental corporations remain as EVN group companies, the separate financial statements will be combined as consolidated financial statements, and the impact of the reorganization on the financial projections would be insignificant, if any.

Table 7-2-1 EVN Reorganization

	Form of Organization	Name of Company
1.	Independent Accounting Enterprise Total 12 units	PC1,2,3, PC Hanoi, PC HoChiMin, PC Dong Nai, Power Engineering Company1,2,3,4, ElectricTelecommunication Company
2.	Dependent Accounting Enterprise Total 17 units	NLDC, Power Transmission Company1,2,3,4, Thermal Power Plant (:Pha Lai, Ninh Binh, Thu Doc, Ba Ria, Uong Bi) Phu My Power Plamt, Hydoro Electric Power Plant (:Yaly, Tri An, Da Nhim-Ham Thuan Dami, Thac Mo, Thac Ba, Hoa Binh)
3.	EVN Controlled Unit Total 5 units	Institute of Energy, Electrical Engineering College, Electrical Engineering School2,3, Electrical Trainning School

b. Power Sector Reform Schedule

The power sector refom schedule is shown in Table 7-2-2.

Table 7-2-2 Power Sector Reform

	Schedule	Government ownership	Objective business entity
Phase 1 ～2003	Convert to stock company	50% or more	Enterprise of Insulator and 2 others
		Minority	Enterprise of Electrical Construction and 2 others
	One member company	Whole	PC Ninh Binh
Phase 2 2003～2004	Convert to stock company	50% or more	Electrical Machines of Thu Duc Co and 3 others
	One member company	Whole	Hai Duong PC
	Merge	Merged into EVN	Center of Electrical Scientific Technical Information
Phase 3 2003～2005	Convert to stock company	More than 50%	PC Khanh Hoa
	One member company	Whole	Can Tho Thermal Power Company

If the government ownership is intended for EVN to be the owner, the financial statements of those companies, which will be 50% or more owned by the government, should be consolidated with EVN financial statements. Based on the schedule above, most of the objective business entities will be owned by the government, and there will only be three companies, which the government will hold minority shares.

Therefore, like EVN, the study does not consider the impact of sector reform because there probably would not be any impact on overall EVN financial situation.

(2) Financing Environment (ODA, Commercial Borrowings)

a. International Donor Institutions

As stated in section 2.3 “Related Measures” of Chapter 2, the major donor institutions such as WB, ADB, and JBIC will continue their assistance to the power sector in Vietnam. The use of ODA loans is assumed for some projects in EVN financial projections. Similar assumptions are made in the study as well.

b. Issue of Bonds

Petro Vietnam plans to issue bonds worth 300 billion VND (approximately, US$20 million) as of December 2003. In the future, as the bond market develops, major governmental corporations such as EVN may issue bonds. Additionally, there are also plans for a government guarantee

system regarding bonds issued by governmental corporations for nationally important projects. Thus, bonds are focused as a way for governmental corporations to raise funds.

Governmental guarantee has not been placed on the bonds to be issued by Petro Vietnam. The bond conditions are as follows.

Bond term (until redemption) : 5 years

Interest expense : 8.7% in 1st year, annual average deposit interest rate of four major commercial banks + 0.5% for 2nd year and after.

As stated above, funds may be raised by issuing bonds, but it is not considered in the study projection, as it is not so different from borrowings.

Bonds are not considered in EVN financial projections, either.

c. Initial Public Offering (IPO)

Funds may be raised from the stock market by IPO of EVN itself or its affiliate companies after the reorganization of EVN in relation to the power sector reform. However, it is still difficult to judge the feasibility and stock market value, as present.

Therefore, funds from the stock market are not considered in the study financial projections. IPO is not considered in EVN projections, either.

7.2.2 Financial Projections

The financial projections have been conducted according to the following steps.

(1) Projected Period

Ten years from 2003 to 2012. The reason for 10-year projection is the following.

- The wholesale competition market model will be implemented in the power market according to the roadmap of Vietnam's power sector reform prepared with the assistance of ADB. However, it is difficult to consider the impact of the market model on EVN financials.
- Financial projections based on financial statements are usually prepared for mid and long-term (three to five years) as they will be affected by the company's sorrounding environment. As this study is not intended to prepare detailed financial projections, the projected period is long-term (10 years). However, projections for 20 years would not be effective as there would be more variables and contingencies.
- EVN financial projections are projected for six years (2003 ~ 2008).

(2) Prepared Statements

Prospective income statement and prospective cash flow statement are prepared.

Strictly speaking, prospective balance sheet should also be prepared. However, the balance sheet changes are disregarded, as the projected period is only ten years.

(3) Projected Cases

Two cases are assumed for financial projections.

・Case 1：

The same financing conditions used in EVN's financial projections are applied in preparing the projections.

・Case 2：

Based on the results of Case 1, the financing conditions are revised so that the investment plan of the study may be sufficiently implemented.

7.2.3 Projected Results

(1) Case 1 (with EVN financing conditions)

The same financing conditions used in EVN's financial projections are applied in preparing the projections.

a. Major Assumptions

1) Electricity Tariff

Adopted EVN tariff schedule.

2) Annual Electiricty Sales Volume

For 2003～2008, adopted volume used in EVN financial projections.

For 2009～2012, improvement of system loss is assumed as follows.

Table 7-2-3 Annual Electricity Sales Volume

(Unit: GWh)

	2003	2004	2005	2006	2007	2008
1.Generation & Purchase	40,932	46,535	53,303	59,056	66,648	74,490
2.Sales Volume	34,510	39,454	45,093	50,228	56,964	63,953

	2009	2010	2011	2012
1.Generation & Purchase	82,870	93,000	101,074	109,775
2.Sales Volume	71,426	80,486	87,754	95,694

3) Fuel cost, O&M Cost, Power Purchase Cost

Adopted data calculated by the study mission.

4) Salaries

In EVN financial projection, the "O&M cost" shown in the study projection seems to be included in "Salary and Insurance". In the study projection, "O&M Cost" is recorded separately. Salaries for administration staff are included in "Administration cost" according to EVN past financial statements.

5) Depreciation

Annual depreciation of current fixed assets (as of 2002) is calculated using depreciation years based on past actual results. The assets, which will be completed in 2003 and after, are depreciated by its useful life as shown in the EVN financial projections.

・Actual depreciation cost of fixed assets (straightline method)

(Unit: Million VND)

	2000	2001	2002
Annual depreciation expense	4,132	4,928	6,864
Average fixed asset balance	44,225	54,830	69,824
Average useful life	10.7	11.1	10.2

*1 Based on acquisition cost

・New assest after 2003

Hydropower : 6.5% (approximately 15 years), thermal power : 8.5%～9% (approximately 12 years), transmission facilities : 8.5% (approximately 12 years). Interest during construction (IDC), which will be included in fixed assets after completion, is calculated as follows.

IDC on power plants : 14-year depreciation based on useful life of hydropower and thermal power plants.

IDC on transmission and distribution facilities : 12-year depreciation.

6) Interest Expense

Adopted same conditions as EVN financial projections. Interest expense incurred on borrowings during construction is included in fixed assets. Interest expense incurred after completion is expensed every year.

7) Fund Source and Financing Conditions

Allocated funds among the projects included in the long-term investment plan according to the

fund sources and financing conditions assumed in EVN financial projections（refer to Chapter 3 section 3.4 EVN financial projection）.

To simplify the simulation, annual investments are assumed to be financed by borrowings. Additionally, the balance of borrowings and repayment schedule of projects, which are currently implemented by EVN, are set according to the actual conditions.

8) Corporate Income Tax

Taxable income is equal to net income before tax and after deducting income appropriated to capital investment, according to EVN financial projections. Tax rate is 32% for 2003 and 28% for 2004 and after according to EVN financial projections.

9) Profit Allocation

Allocated annual profit according to EVN financial projections. Profit is allocated as follows.

Table 7-2-4 Annual Profit Allocation

Account item	Summary
Net income before tax	
△Allocated to capital investment	: *1
a. balance : Targeted income	: EVN's target profit*2
△Income tax	: 32% of targeted income (28% from 2004)
△Capital tax	: 1.8% of government capital
b. balance : Fund allocation	
△Development fund	: 50% of b.
△Welfare fund	: 35% of b.
△Sinking fund	: 10% of b.
△Unemployees' fund	: 5% of b. (until 2003)
c. balance : zero	: a.－b.

*1 : Allocation to capital investment is based on increase of revenue from last year. However, as it is important for EVN to achieve the targeted income, this amount would actually be determined depending on the amount set as targeted income. In EVN financial projection, the amount allocated to capital investment is deductible from taxable income subject to investment tax credit.

*2 : Therefore, the key point would be what amount to set as targeted income. The annual targeted income in the study financial projections is set as follows.

- 2003～2008 : Figures in EVN financial projection
- 2009～2012 : Annual 10% increase based on its increase rate in EVN financial projection

10) Changes in Working Capital

Cash flow will be affected by changes in working capital from the previous year. However, this amount is not considered in the study projections as the amount in the EVN financial statements and its impact is believed to be limited and not significant.

11) Others

Other costs such as administration cost, which is not included in the investment plan, the amount in the EVN financial projection (2003~2008) is adopted. For subsequent years, the amount calculated based on the increase rate during 2003~2008 is applied.

b. Case 1 Analysis Results

The same financing conditions used in EVN's financial projections are applied in preparing the projections.

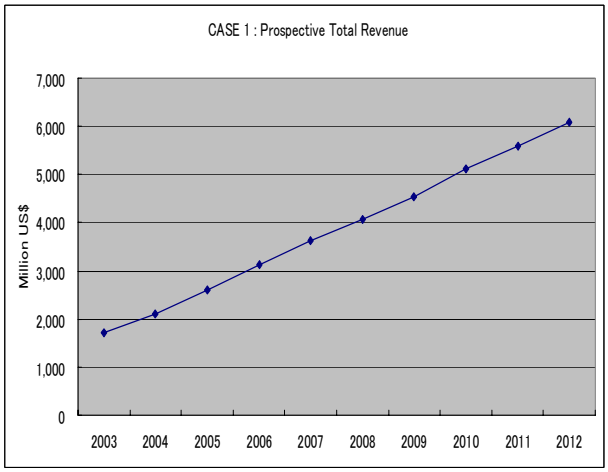
1) Prospective Income Statement

Table 7-2-5 Case 1 : Prospective Income Statement

CASE 1: Financial Condition of EVN
Prospective Income Statement based on JICA Study

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Average Power Price (Uscents/k.Wh)	5.6	5.8	6.4	6.9	7.0	7.0	7.0	7.0	7.0	7.0
At the End of Last Year	5.6	5.6	5.9	6.5	7.0	7.0	7.0	7.0	7.0	7.0
Revised Tariff in the Year	5.6	5.9	6.5	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Time of Adjustment		Apr./04	Apr./05	Apr./06						
Net Average Price(Except VAT)	4.96	5.30	5.77	6.25	6.36	6.36	6.36	6.36	6.36	6.36
1.Net Revenue	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
-Average Tariff	4.96	5.30	5.77	6.25	6.36	6.36	6.36	6.36	6.36	6.36
-Sales Volume	34,510	39,454	45,093	50,228	56,964	63,953	71,426	80,486	87,754	95,694
2.Unusual Income										
Total Revenue (1.+2.)	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
3.Total Cost	-1,557	-1,942	-2,462	-2,927	-3,451	-3,984	-4,501	-5,169	-5,748	-6,149
-Fuel	-458	-513	-629	-687	-698	-729	-825	-898	-1,037	-1,122
-Material	-58	-66	-75	-84	-95	-107	-121	-137	-155	-175
-Main t enance	-223	-252	-272	-294	-332	-385	-437	-467	-522	-566
-Power Purchase	-129	-293	-510	-672	-840	-938	-1,051	-1,319	-1,378	-1,362
-Depreciation	-511	-587	-702	-851	-1,050	-1,271	-1,446	-1,657	-1,890	-2,129
-Interest	-91	-128	-158	-208	-291	-393	-442	-492	-551	-562
-Hydro Resource Tax	-15	-17	-19	-21	-23	-25	-27	-29	-31	-33
-Administration Cost	-72	-82	-94	-104	-117	-131	-146	-163	-178	-192
-Unemployees' Fund Fee		-4	-4	-5	-5	-6	-6	-7	-7	-8
4.Income before Tax	155	149	140	213	172	83	42	-50	-167	-63
5.Income Tax	-37	-35	-39	-43	-48	-23	-12	0	0	0
6.Net Profit from J/V						20	20	20	20	20
7.Net Income	118	114	101	170	124	80	50	-30	-147	-43
(Proft Rate)	6.9%	5.4%	3.9%	5.4%	3.4%	2.0%	1.1%	-0.6%	-2.6%	-0.7%



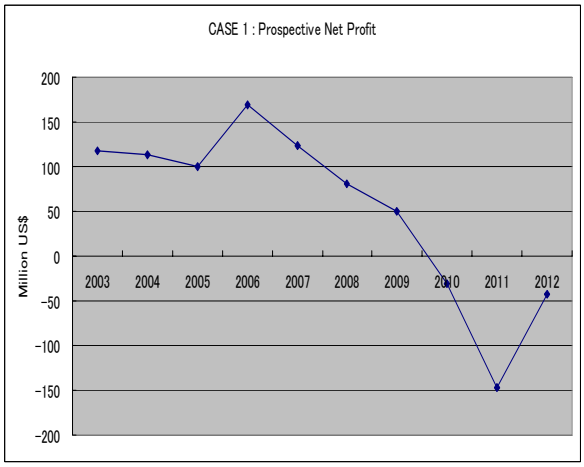


Figure 7-2-1 Case 1 : Revenue and Net Income

(Projected results)

- Electricity sales are expected to continue to grow steadily. But the positive effect of raising the tariff starts diminishing from 2007, and revenue growth rate falls from 20% level to 10% level.

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total Revenue	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
Increasing Rate	-	22.2%	24.4%	20.7%	15.4%	12.3%	11.7%	12.7%	9.0%	9.0%

- Income before tax is expected to continue to be fairly well until 2007. Profit drastically falls in 2008 and loss is incurred from 2010. Profit rate continues to decline until 2011.
- From the cost aspect, power purchase cost will significantly increase, and in 2012, the amount will become 11 times of that in 2003. Compared to amount of electricity sales which will be multiplied by 3.6 times in 10 years, depreciation expense will be multiplied by 4.2 times, and interest expense by 6.2 times. The major reason for the financially tight situation from 2008 is the significant increase of such costs.

(Summary on profitability)

- Steady profit is expected to continue until 2006. However, the positive effect of raising the tariff to 7 cents starts diminishing from 2007.
- Measures for improving profitability during the second half of the projected period would be to raise the tariff or reduce cost. Although, it is difficult to comment on the possibility

of raising tariff in the current status, possible deficit would be a significant reason for the tariff raise, as it is clearly not a sound financial situation. Reducing cost would not be simple, either, as major costs such as depreciation expense is fixed cost, and cost for power purchses would be not easy to reduce, although it would depend on the contract.

2) Prospective Cash Flow Statement

Table 7-2-6 Case 1 : Prospective Cash Flow Statement

CASE 1: Financial Condition of EVN
Prospective Cash Flow Statement based on JICA Study

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
a. Internal Sources	317	152	-21	-131	-359	-590	-799	-922	-1,053	-676
1.Total Revenue	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
2.Total Cost(exc. Dep. and Interest)	-955	-1,227	-1,603	-1,867	-2,110	-2,321	-2,613	-3,020	-3,308	-3,458
-Fuel	-458	-513	-629	-687	-698	-729	-825	-898	-1,037	-1,122
-Material	-58	-66	-75	-84	-95	-107	-121	-137	-155	-175
-Maintenance	-223	-252	-272	-294	-332	-385	-437	-467	-522	-566
-Power Purchase	-129	-293	-510	-672	-840	-938	-1,051	-1,319	-1,378	-1,362
-Hydro Resource Tax	-15	-17	-19	-21	-23	-25	-27	-29	-31	-33
-Administration Cost	-72	-82	-94	-104	-117	-131	-146	-163	-178	-192
-Unemployees' Fund Fee	0	-4	-4	-5	-5	-6	-6	-7	-7	-8
3.Tax Payment	-37	-35	-39	-43	-48	-23	-12	0	0	0
4.All. to Funds (Use of Fund)	-24	-26	-31	-34	-39	-12	0	0	0	0
-All.to Welfare Fund	-17	-20	-24	-26	-30	-9	0	0	0	0
-All.to Sinking Fund	-5	-6	-7	-8	-9	-3	0	0	0	0
-All.to Unemployees' Fund	-2									
5.Principle Repayment and Interest	-379	-651	-951	-1,326	-1,785	-2,302	-2,717	-3,021	-3,327	-3,304
-Principle Repayment	-237	-410	-591	-840	-1,186	-1,606	-1,938	-2,185	-2,489	-2,499
-IDC	-51	-113	-202	-277	-308	-304	-337	-344	-287	-244
-Interest Charge	-91	-128	-158	-208	-291	-393	-442	-492	-551	-562
b. Application Fund										
-Net Investment	-1,505	-1,764	-2,499	-2,428	-2,609	-2,393	-2,741	-2,419	-1,919	-1,990
-Investment from Internal Sources										
c. a.-b.	-1,188	-1,612	-2,520	-2,559	-2,968	-2,983	-3,540	-3,341	-2,972	-2,666
d. Financing Activities										
-Bond Issue										
-Borrowing	1,505	1,764	2,499	2,428	2,609	2,393	2,741	2,419	1,919	1,990
e. Net Cashflow	317	152	-21	-131	-359	-590	-799	-922	-1,053	-676
f. Beg. of Year	719	1,036	1,187	1,166	1,035	676	86	-713	-1,635	-2,689
g. End of Year	1,036	1,187	1,166	1,035	676	86	-713	-1,635	-2,689	-3,365

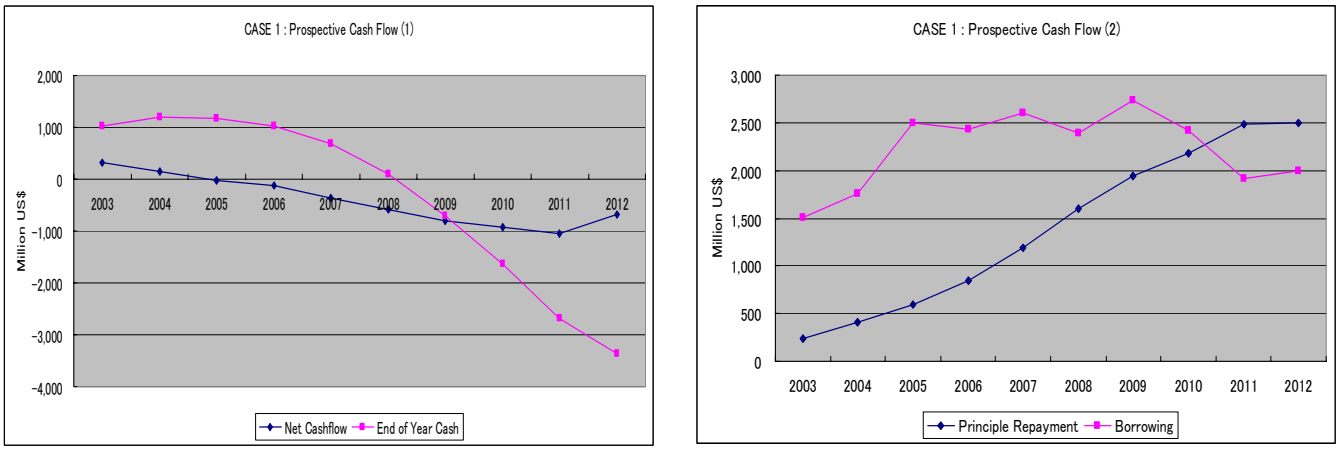


Figure 7-2-2 Case 1 : Cash Flow Trend

（Projected results）

- Net cash flow turns negative from 2005, and cash balance turns negative in 2009.
- Cash flow from operating activities, which is calculated as revenue net of costs, is expected to continue steadily as shown below.

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1.Total Revenue	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
2.Total Cost*	-955	-1,227	-1,603	-1,867	-2,110	-2,321	-2,613	-3,020	-3,308	-3,458
3.Net	757	864	999	1,272	1,513	1,747	1,930	2,099	2,274	2,628

*Excluded Depreciation & Interest

These funds will be used for capital investment and repayment of borrowings. In the simulation, the amount needed for principle repayment (1,326 million US$) becomes higher than cash flow from operating activities in 2006, and shortage of cash occurs.

- Especially, the amount of principle repayment significantly increases throughout the projected period, and it the reason for the shortage of cash in the second half of the projected period (refer to Appendix 7-2-1 for details on the repayment plan).

（Summary on cash flow）

- Cash flow turns negative in 2009, which shows that the study investment plan cannot likely be implemented with the same financing conditions as assumed in EVN financial projections.
- The major reason for the cash shortage is the substantial amount of annual repayments of borrowings.

(2) Case 2 (with Revised Financing Conditions)

Based on the results of Case 1, the financing conditions are revised so that the investment plan of the study may be sufficiently implemented.

a. Revision of Financing Conditions

1) Long-term Investment Plan

The projection is based on the long-term investment plan of the study and therefore, reducing or postponing investment is not considered.

2) Financing Conditions

Based on the results of Case 1, financing conditions are revised below, as substantial annual repayment of borrowings was the reason for net cash out flow.

- Extended repayment periods of additional 5 years for projects, which EVN plans to implement with ODA loans.
- Changed fund source from commercial borrowings to ODA loans for those projects, which EVN preferred to conduct using ODA loans but did not reflect in their projections, as it has not yet been decided.
- Extended repayment period for network related borrowings to 20 years from 15 years.
- Based on the results shown in Case 1, relatively ample internal source funds are used for investment in the first half of the projected period.
- Changed fund source from commercial borrowings to ODA loans for 110kV transmission and distribution line projects are planned for the second half of the projected period, when the amount of ODA loan decreases.
- Same conditions as Case 1 are adopted for others.

b. Case 2 Analysis Results

1) Prospective Income Statement

Table 7-2-7 Case 2 : Prospective Income Statement

CASE 2 : Revised Financing Condition
Prospective Income Statement based on JICA Study

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Average Power Price (Uscents/k.Wh)	5.6	5.8	6.4	6.9	7.0	7.0	7.0	7.0	7.0	7.0
At the End of Last Year	5.6	5.6	5.9	6.5	7.0	7.0	7.0	7.0	7.0	7.0
Revised Tariff in the Year	5.6	5.9	6.5	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Time of Adjustment		Apr./04	Apr./05	Apr./06						
Net Average Price(Except VAT)	4.96	5.30	5.77	6.25	6.36	6.36	6.36	6.36	6.36	6.36
1.Net Revenue	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
-Average Tariff	4.96	5.30	5.77	6.25	6.36	6.36	6.36	6.36	6.36	6.36
-Sales Volume	34,510	39,454	45,093	50,228	56,964	63,953	71,426	80,486	87,754	95,694
2.Unusual Income										
Total Revenue(1.+2.)	1711.7	2091.1	2601.9	3139.3	3622.9	4067.4	4542.7	5118.9	5581.2	6086.1
3.Total Cost	-1,552	-1,926	-2,438	-2,894	-3,406	-3,928	-4,456	-5,125	-5,675	-6,098
-Fuel	-458	-513	-629	-687	-698	-729	-825	-898	-1,037	-1,122
-Material	-58	-66	-75	-84	-95	-107	-121	-137	-155	-175
-Maintenance	-223	-252	-272	-294	-332	-385	-437	-467	-522	-566
-Power Purchase	-129	-293	-510	-672	-840	-938	-1,051	-1,319	-1,378	-1,362
-Depreciation	-511	-586	-700	-847	-1,043	-1,260	-1,433	-1,643	-1,870	-2,108
-Interest	-86	-113	-135	-180	-253	-347	-410	-462	-498	-532
-Hydro Resource Tax	-15	-17	-19	-21	-23	-25	-27	-29	-31	-33
-Administration Cost	-72	-82	-94	-104	-117	-131	-146	-163	-178	-192
-Unemployees' Fund Fee		-4	-4	-5	-5	-6	-6	-7	-7	-8
4.Income before Tax	160	165	164	245	217	139	87	-7	-94	-12
5.Income Tax	-37	-35	-39	-43	-48	-39	-24	0	0	0
6.Net Profit from J/V						20	20	20	20	20
7.Net Income	123	130	125	202	169	120	83	13	-74	8
(Proft Rate)	7.2%	6.2%	4.8%	6.4%	4.7%	3.0%	1.8%	0.3%	-1.3%	0.1%

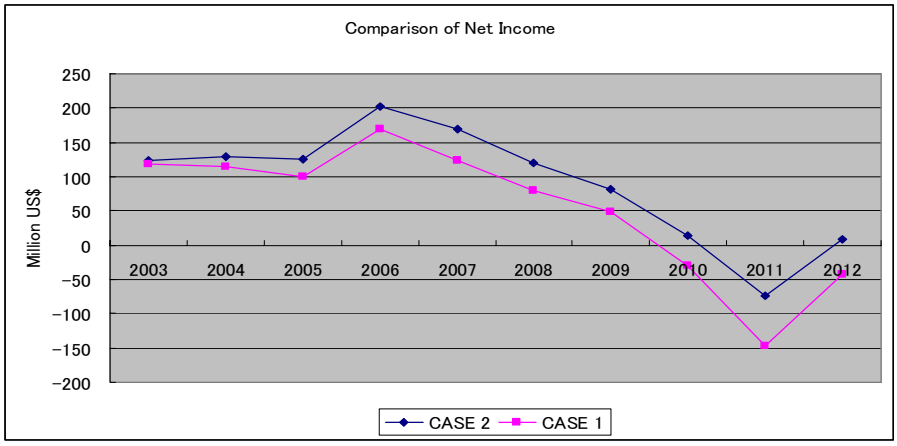


Figure 7-2-3 Annual Net Income

(Projected results)

- Net income will be derived in all years except 2011. However, as shown above in the graph above, trend of net income will remain similar to Case 1.
- Profitability will slightly improve and interest expense will be reducted by changing to ODA loans and using internal source funds for network investments from 2003 to 2007. Total interest expense in the 10-year projected period is 3,315 million US$ and 3,016 million US$ for Case 1 and Case 2, respectively.

(Summary on profitability)

- Profitability will be slightly better than Case 1 but the trend is the same.
- The change of assumptions for Case 2 focuses on financing conditions, and does not fundamentally resolve issues regarding profitability.
- Consideration may also need to be given to raising the tariff after 2007, or otherwise profit rate will remain low.

2) Prospective Cash Flow Statement

Table 7-2-8 Case 2 : Prospective Cash Flow Statement

CASE 2 : Revised Financing Condition
Prospective Cash Flow Statement based on JICA Study

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
a. Internal Sources	331	261	207	209	97	-73	-123	-197	-255	53
1.Total Revenue	1,712	2,091	2,602	3,139	3,623	4,067	4,543	5,119	5,581	6,086
2.Total Cost(exc. Dep. and Interest)	-955	-1,227	-1,603	-1,867	-2,110	-2,321	-2,613	-3,020	-3,308	-3,458
-Fuel	-458	-513	-629	-687	-698	-729	-825	-898	-1,037	-1,122
-Material	-58	-66	-75	-84	-95	-107	-121	-137	-155	-175
-Maintenance	-223	-252	-272	-294	-332	-385	-437	-467	-522	-566
-Power Purchase	-129	-293	-510	-672	-840	-938	-1,051	-1,319	-1,378	-1,362
-Hydro Resource Tax	-15	-17	-19	-21	-23	-25	-27	-29	-31	-33
-Administration Cost	-72	-82	-94	-104	-117	-131	-146	-163	-178	-192
-Unemployees' Fund Fee	0	-4	-4	-5	-5	-6	-6	-7	-7	-8
3.Tax Payment	-37	-35	-39	-43	-48	-39	-24	0	0	0
4.All. to Funds (Use of Fund)	-24	-26	-30	-33	-39	-28	-11	0	0	0
-All.to Welfare Fund	-17	-20	-23	-26	-30	-22	-9	0	0	0
-All.to Sinking Fund	-5	-6	-7	-7	-9	-6	-2	0	0	0
-All.to Unemployees' Fund	-2									
5.Principle Repayment and Interest	-365	-542	-723	-987	-1,329	-1,753	-2,018	-2,296	-2,528	-2,575
-Principle Repayment	-235	-335	-417	-575	-816	-1,141	-1,325	-1,542	-1,753	-1,793
-IDC	-45	-93	-170	-232	-261	-264	-283	-292	-277	-250
-Interest Charge	-86	-113	-135	-180	-253	-347	-410	-462	-498	-532
b. Application Fund										
-Net Investment	-1,258	-1,506	-2,231	-2,103	-2,609	-2,393	-2,741	-2,419	-1,919	-1,990
-Investment from Internal Sources	-247	-258	-268	-325						
c. a.-b.	-1,174	-1,503	-2,292	-2,219	-2,512	-2,466	-2,864	-2,616	-2,174	-1,937
d. Financing Activities										
-Borrowing	1,258	1,506	2,231	2,103	2,609	2,393	2,741	2,419	1,919	1,990
e. Net Cashflow	84	3	-61	-116	97	-73	-123	-197	-255	53
f. Beg. of Year	719	803	806	745	629	726	653	530	334	79
g. End of Year	803	806	745	629	726	653	530	334	79	132

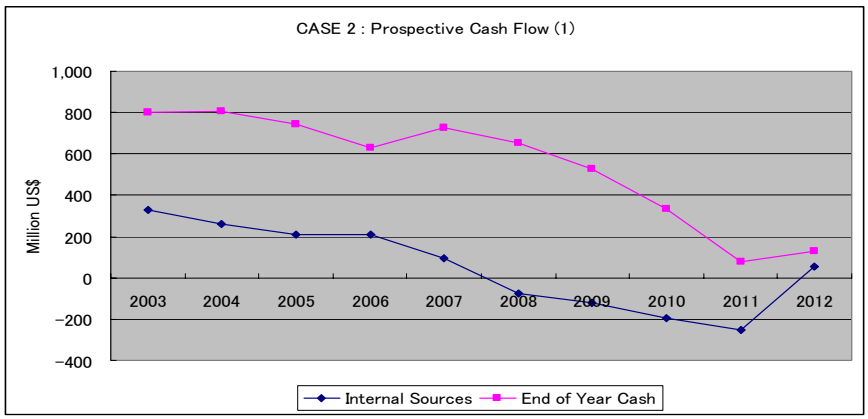


Figure 7-2-4 Case 2 : Cash Flow Trend

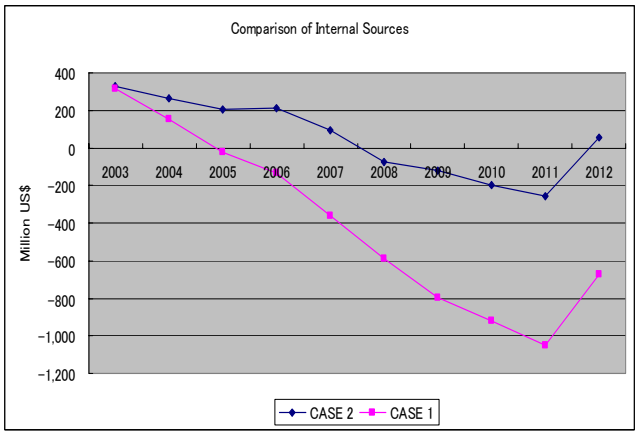


Figure 7-2-5 Annual Internal Source Funds

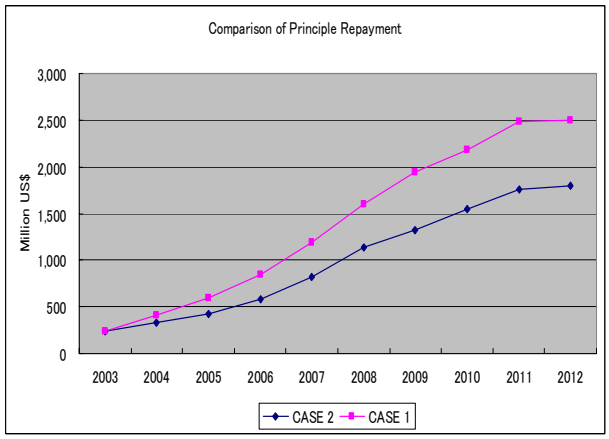


Figure 7-2-6 Annual Principle Repayments

（Projected results）

- Internal source funds will be positive in the first half of the projected period, but will become tight in the second half. The trend will remain similar to Case 1 but will be significantly better as shown in figure 7-2-4.
- Cash flow will improve by changing financing conditions. Principle repayment of borrowings, which was the cause of severe financial situation in Case 1, will be reduced and cash balance would be positive throughout the projected period. Principle repayment of borrowings in the projected period is compared below (refer to Appendix 7-2-2 for details of repayment plan regarding Case 2)

(Million US$)

Account	Case 1	Case 2	Difference
Principle repayment of borrowings	13,918	9,932	△3,986

- Net cash flow will decrease or in some cases the amount of negative cash flow may be expanded, but that would be due to using internal source funds for capital investment.
- Internal source funds may be retained for fund investment, used for capital investment, or used for repayment of borrowings. In this simulation, internal source funds are used for network constructions. As a result, in Case 2, interest expense that will be incurred during the projected period will be less than in the case of not using any internal funds by 476 milion US$ (cash balance will be less by 249 million US$ as the end of 2012 compared to the case of not using the internal funds).

（Summary on cash flow）

- By using ODA loans and extending ODA repayment period for 5 years, annual principle repayments will be reduced and cash shortage will be prevented.
- Cash balance will be the lowest in 2011, and if any contingencies were to occur, there will be a risk of cash shortage. This will be due to internal funds being used in the first half of the projected period to mitigate interest expenses. Alternatively, in the case of not using internal funds and retaining cash in hand, the result would be as follows.

(Unit: Million US$)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Net Cashflow	323	224	141	111	-24	-174	-220	-307	-362	-51
Beg. of Year	719	1,042	1,266	1,407	1,518	1,494	1,320	1,100	793	431
End of Year	1,042	1,266	1,407	1,518	1,494	1,320	1,100	793	431	381

7.2.4 Financing Recommendations

As in Case 2, the long-term investment plan of the study may be implemented without causing cash shortages by changing the financing conditions.

The revised financing conditions in Case 2 are the following.

- Extended repayment period for additional 5 years for projects, which EVN plans to conduct with ODA loans.
- Changed fund source from commercial borrowings to ODA loans for those projects, which EVN preferred to conduct using ODA loans but did reflect in their projections, as it has not yet been decided.
- Extended repayment period on network related ODA loans to 20 years from 15 years.
- Changed fund source from commercial borrowings to ODA loans for 110kV transmission and distribution line projects.
- Used relatively ample internal source funds for capital investment.
- Same conditions as Case 1 are adopted for others.

By changing the financing conditions, the total of new ODA loans during the projected period will be multipled roughly 3 times from 3,216 million US$ (Case 1) to 9,612 million US$ (Case 2).

Based on the results above, the key for implementing the long-term investment plan would be to secure borrowings with not as tight of conditions, such as ODA loans.

In Case 1, the major fund source for network projects is borrowings from commercial banks. The amounts for network investment are substantial compared to power plant projects and also long-term, and therefore, it is important that soft loans be used.

Additionally, for Case 1, the repayment period of most ODA loans is set at 15 years, which may cause cash shortage. Therefore, it is also recommended that the government extend subloan conditions for additional 5 years.

This study considers the measures to smoothly implement the long-term investment plan during the projected period focusing on the financing plan. Therefore, the points below need to be noted.

- Repayment of borrowings will continue after the projected period, as repayment periods will be extended.
- It is important to derive steady profit for stable business operations in the future.

CHAPTER 8 ENVIRONMENTAL CONSIDERATIONS ON THE PROJECT FROM THE GLOBAL PERSPECTIVE

Chapter 8. Environmental Considerations on the Project from the Global Perspective

8.1 Environmental Considerations on Power Development

At an early planning stage of development of power generation plant, the following two points need to be well investigated and studied; 1) necessity of the development and 2) induced impacts on natural and social environments. Related items which are regarded as important are the transparency of the plan, enhancement of accountability and participation of local people and NGOs who may be affected by the plan.

The Study considers an assessment of impacts on natural and social environments as one of the two important criteria when selecting options. The other criterion is evaluation of best – mix option of electricity generation sources and optimization of peaking power generation. From the viewpoint of natural and social environmental considerations, proposed pumped storage power generation sites and characteristics of other power generation sites will be studied adequately and examined through appropriate and adequate evaluation of the Project including on-the-spot investigations.

8.1.1 Strategic Environmental Assessment: SEA

(1) What is SEA?

SEA has been being gradually and steadily introduced to the advanced industrialized nations especially European countries in order to achieve sustainable development and to avoid cumulative effects since the beginning of 1990s. "SEA" is a collective term to describe environmental assessment applied to the decision-making stages (policy level and planning one) before the project starts（Figure 8-1-1）[1]。

[1] "A New Stage of EIA in Japan: Towards Strategic Environmental Assessment" (Sachihiko HARASHINA. BUILT ENVIRONMENT, VOL 27, NO 1)

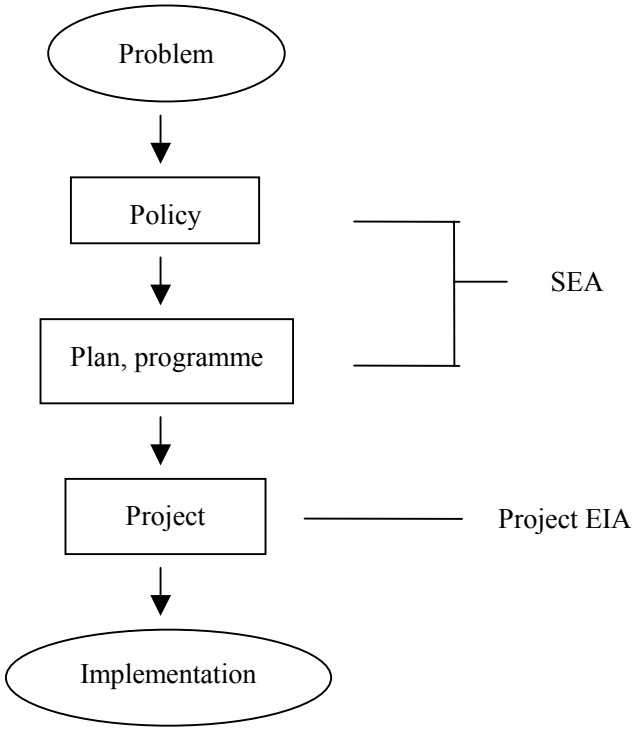


Figure 8-1-1 SEA and Project Process

The most important essence of SEA is to enhance transparency in decision-making process of policy and planning stages[1]. By this practice, it is possible to promote efficiency of an entire project (or program), to avoid unnecessary negative effects, to exercise an effective environmental impact assessment and to implement adequate mitigation measures. All of them are not easy to be realized by a normally practiced "project EIA". Through this process, we are able to effectively utilize various resources including human and natural resources, money and time.

(2) Application in this Study

In this Study, a full-scale SEA is not introduced because of various impediments such as time constraints. However, we have applied the concept of SEA in the Study and have practiced environmental considerations accordingly. A "project EIA" cannot cover a wide range of environmental considerations which can be practiced based on the concept of SEA.

The concept of SEA has been applied on the following two exercises of the Study. One is "Environmental considerations on power development" and the other is "Selecting PSPP sites."

[1] "What is Strategic Environmental Assessment?" (Sachihiko HARASHINA. Bulletin of Real Estate Vol. 13, No.3, June 1999. In Japanese)

a. Environmental Considerations on Power Development

One of the objectives of the Study is to propose an optimized power development scenario based on the 5th Master Plan by the Government of Vietnam. In order to practice environmental considerations at this stage, we have listed up the environmental effects of each power development option and have evaluated each option from environmental point of view. This is an evaluation of the project at its planning stage (see Figure 8-1-1).

Major environmental effects of hydropower generation, coal-fired thermal power generation, gas-fired thermal power generation and PSPP are summarized in the following table.

Table 8-1-1 Environmental Effects of Each Power Development Option[1]

Power development option	Effects	
	Social Environment	Natural environment
Hydropower generation	• Involuntary resettlement (large scale)	• Submersion of terrestrial ecosystems • Disruption of aquatic ecosystems
Coal-fired thermal power generation	• Involuntary resettlement • Effects on fisheries caused by cooling water and warm discharged water • Emission of Sox, Nox & CO_2 • Disposal of coal ash: It is necessary to consider its secondary effects.	• It is considered that there are some impacts on terrestrial and aquatic ecosystems.
Gas-fired thermal power generation	• Involuntary resettlement • Effects on fisheries caused by cooling water and warm discharged water • Emission of CO_2	• It is considered that there are some impacts on terrestrial and aquatic ecosystems.
PSPP	• Involuntary resettlement	• Submersion of terrestrial ecosystems • Disruption of aquatic ecosystems

When we evaluated each power development option, we focused on the issue of how we can avoid major negative environmental effects according as seen in Table 8-1-1. We did not consider

[1] Based on the following guidelines; **Environmental Guidelines for Selected Industrial and Power Development Projects** (Office of the Environment, Asian Development Bank, 1993), **Environmental Assessment Sourcebook; Volume II and Volume III** (Environment Department, World Bank, 1991) and **JAPAN BANK FOR INTERNATIONAL COOPERATION GUIDELINES FOR CONFIRMATION OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS** (Japan Bank for International Cooperation, 2003).

detailed mitigation measures of each effect. This is because these mitigation measures are supposed to be different from site to site where each power development option is planned. In the case of PSPP, the Study conducted an in-depth study on the plan and also conducted an initial environmental assessment at selected sites as described later.

Considering local negative impacts, the above-mentioned power development options can be aligned as follows based on their possible scale of impacts. They are aligned by a scale of impact caused by each option from LARGE to SMALL.

LARGE Hydropower (large scale) > hydropower (medium – small) = PSPP > coal-fired thermal > gas-fired thermal SMALL

The issue on CO_2 emission is one of the urgent and crucial global concerns. The Kyoto Protocol of "United Nations Framework Convention on Climate Change" has been put into action, which the Government of Japan pays a great deal of attention to its implementation. Regarding the scale of CO_2 emissions, they can be aligned as the following.

LARGE Coal-fired thermal > gas-fired thermal > hydropower = PSPP SMALL

The above-mentioned environmental considerations were given for evaluating power development scenarios.

Other considerations were also given. It is important to try to reduce total requirement of power development which directly leads to an abatement of unnecessary negative impacts under the condition of achieving the planned goal for "stable power supply". It is also necessary to promote energy saving policy as an essential requirement of the demand side. These two practices are highly effective and realistic from the viewpoints of efficient allocation of resources and of environmental considerations, which were also considered as important criteria when we evaluated each power development option.

b. Selecting PSPP Sites

PSPP is one of the power development options and, under normal circumstances, selection of sites should be conducted after the formulation of the scenario. However, because of various constraints, the Study has concurrently conducted the two exercises; formulation of power

development scenario and selecting of the PSPP sites.

PSPP is considered the most promising source for peaking power generation. The Study carried out surveys on its potential in Vietnam. In order to evaluate the possibility of developing PSPP in Vietnam, we conducted surveys on selecting suitable sites for PSPP and preliminary layout design of PSPP at a selected site.

When we selected sites, we applied the concept of SEA, and implemented appropriate considerations on social and natural environments. However, the Study did not fully disclose information to the public as indicated by HARASHINA[1].

The selection of sites was conducted as in the following flow (Figure 8-1-2). First, from the viewpoint of topographical and technical issues, the desk study selected the first 38 sites. We then verified whether the first 38 sits are within range or close enough to the existing and proposed protected areas, and other globally important natural areas, and we screened them again from the technical point of view. Based on this exercise, ten sites remained.

The first on-the-spot field survey was conducted at all ten sites. These sites were surveyed from a technical and environmental point of view. The assessment of the environments was conducted at each site based on the prepared environmental parameter checklist (refer to Attachment 4-5). The first field survey reduced the remaining ten sites down to four sites.

A more detailed survey was conducted at the above-mentioned four sites as the second on-the-spot field survey. The assessment of the environments was again conducted based on the checklist.

The results of the two field surveys are described in detail in “Chapter 4. Finding and Evaluation of Pumping Storage Power Project”.

[1] “What is Strategic Environmental Assessment?” (Sachihiko HARASHINA. Bulletin of Real Estate Vol. 13, No.3, June 1999. In Japanese）

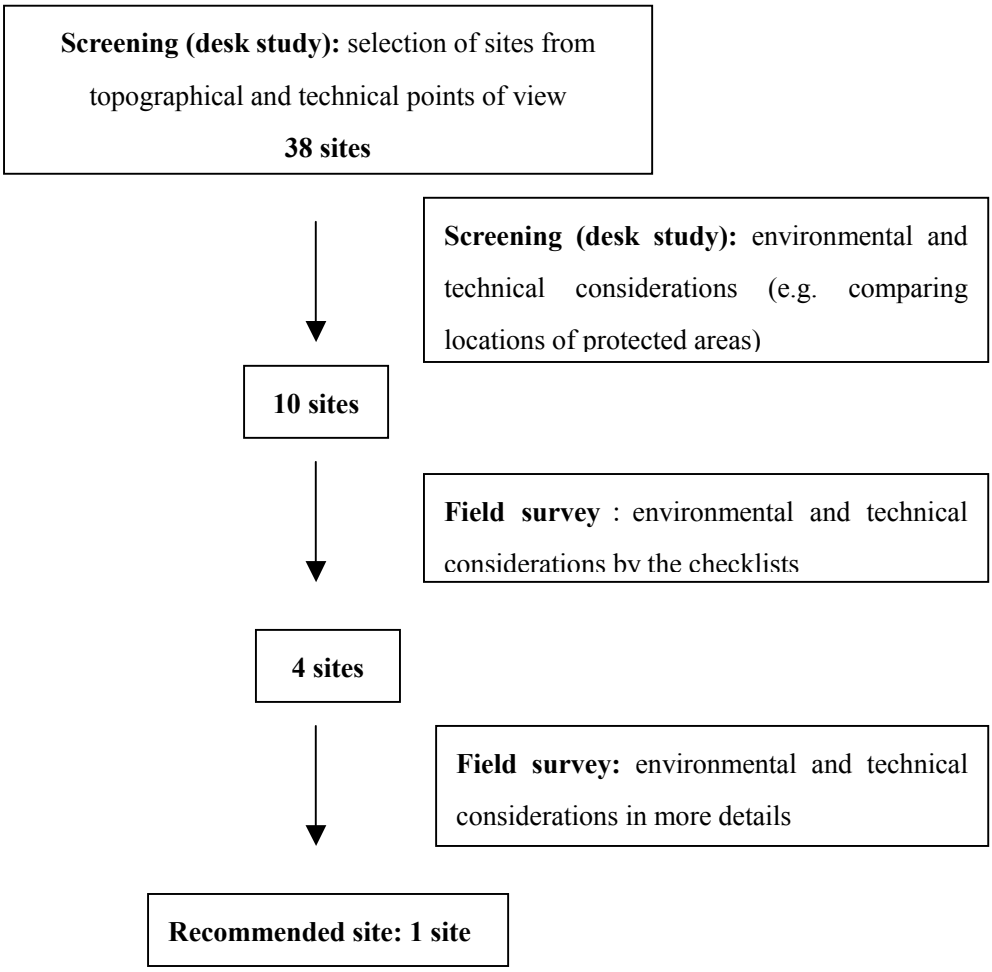


Figure 8-1-2 Flow of Selecting Potential PSPP Sites

8.1.2 Environmental Impact Assessment: EIA

(1) What is EIA?

EIA here implies a "project EIA" in Figure 8-1-1.

In Vietnam, related legislation on EIA has already been established, and EIAs have been conducted in various projects for which EIAs are required under the EIA process according to the legislation (2.3 Relevant measures and policy : 2.3.2 Environmental considerations in Vietnam and for other related projects).

(2) EIA at PSPP Sites

Regarding the environmental considerations on PSPP, in the next stage (e.g. feasibility study), detailed surveys on social and natural environments need to be conducted in order to conduct a full EIA. The following flow of the surveys is suggested as **an example** (Figure 8-1-3).

Meetings at each site should be conducted several times in order to explain the project itself, in addition to any negative and positive impacts and risks and to obtain opinions from the local villagers. It is important to note that it is ideal to obtain opinions from all of the villagers, not just from the village leaders. Opinions from all villagers should be adequately reflected in the plan. If resettlement is inevitable, it is necessary to conduct a study on the natural and social environments of the proposed resettlement area and to propose adequate mitigation measures.

A comprehensive survey on the natural environment of and around each site should be conducted at least for the duration of one year, and then mitigation measures including cancellation of the project should be proposed.

The above-mentioned surveys should be carefully planned in order to use these data for the future monitoring programs.

It also is important to note that even at the recommended PSPP site only an initial environmental assessment was conducted because of time constraints. A full EIA should be conducted in the next stage (e.g. feasibility study). Depending on the results of the EIA, we may have to reconsider the project at the recommended site including possible cancellation of the project.

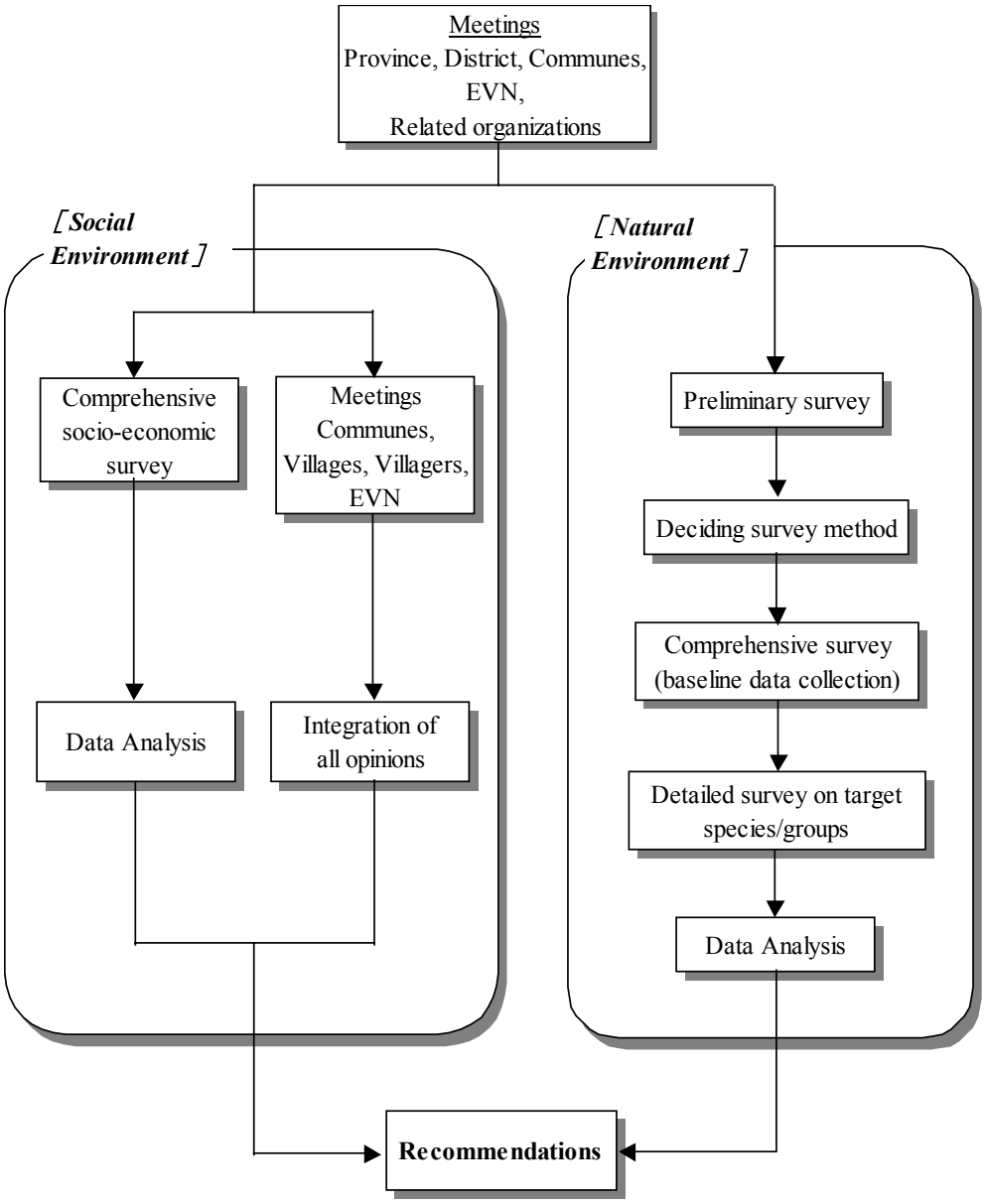


Figure 8-1-3 Flow of Surveys on the Social and Natural Environments

(3) EIA at Other Power Development Sites

The Government of Vietnam should evaluated power development sites recommended in the scenario from the viewpoint of environmental considerations. EIAs will be implemented at some sites on a certain scale as described in the Vietnamese legislation.

However, it has been pointed out that there are various controversial matters over EIA in Vietnam including its implementation and process. For example, regarding natural environment, studies on wildlife (e.g. birds, fishes) and on ecosystems are insufficient, and proposed mitigation measures are inadequate. In terms of the social environment, sufficient consideration has not been

given to local residents who are resettled[1]. It is absolutely necessary for the Government of Vietnam to reflect on the lessons learned from the past cases of EIAs and to implement appropriate and adequate EIAs based on international standards such as the new EIA guidelines of the Asian Development Bank[2] and the report compiled by the World Commission on Dams[3].

Regarding the coal-thermal plant development in the south, although potential sites have been suggested in this report, it should be noted that this selecting exercise is a preliminary one and the SEA concept should be applied in the next stage in order to select the sites. The similar exercise as selecting the PSPP sites in this Study is strongly recommended. A full EIA should then be conducted at each site.

8.1.3 Japanese ODA and Environmental Considerations

Judging from the importance and necessity of the environmental considerations on international cooperation projects, Japan Bank for International Cooperation (JBIC) and Japan International Cooperation Agency (JICA) have been paying special attentions to the considerations on their programmes and projects.

JBIC started to implement the environmental considerations on all its programmes and projects from October 2003 based on their new guidelines, "JAPAN BANK FOR INTERNATIONAL COOPERATION GUIDELINES FOR CONFIRMATION OF ENVIRONMENTAL AND SOCIAL CONSIDERATIONS"[4].

JICA started to revise its existing guidelines from December 2002, and tries to start implementing new guidelines on environmental considerations from April 2004[5].

The both guidelines set down rules to recommend the Government of Japan to reconsider the implementation of project (including cancellation of it) if the project does not meet the guidelines.

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[1] Vietnam Environment & Sustainable Development Center (2000) *STUDY ON PUBLIC PARTICIPATION IN RESETTLEMENT PLAN RELATED TO YALI HYDROPOWER PROJECT*. Hanoi, Vietnam.

[2] Asian Development Bank (2003). *Environmental Assessment Guidelines*. Manila, Philippines.

[3] World Commission on Dams (2000). *Dams and Development – A New Framework for Decision-Making*. Earthscan Publications Ltd., London, U.K. Vietnamese version of the report can be obtained at UNDPHanoi office.

[4] http://www.jbic.go.jp/english/environ/guide/finance/index.php

[5] At http://www.jica.go.jp/english/global/env/pdf/20031222.pdf, "A Draft of JICA Guidelines for Environmental and Social Considerations" (Provisional Translation) can be obtained.

8.2 Demand Side Management（DSM）

8.2.1 Current Situations and Future Plans on DSM in Vietnam

DSM in Vietnam is under the guidance of the DSM Management Board of the MOI. The DSM Management Board is implementing a three-phase DSM program as follows:

① Phase-I（2000-2003）: implementation of TAs and pilot projects

② Phase-II（2003-2005）: implementation of major DSM programs

③ Phase III（2005-2010）: expansion of major DSM programs and implementation of commercial-based energy efficiency programs

Based on the results of Phase-I, Phase-II is currently under implementation in order to expand the use of DSM as a tool to help EVN and its PCs better manage loads, load curves and improve load factors. The second phase would seek to achieve over 120 MW in system peak reduction and annual energy savings of about 64 GWh through the implementation of four major DSM programs as described in Table 8-2-1. The programs would be managed by EVN and implemented with support from its PCs.

Table 8-2-1 Phase-II DSM programs

Program Name	Peak Reduction (MW)	Energy Saving (GWh/yr)	Program Outline
TOU Metering	69.7	－	Installation of 5,600 time-of-use (TOU) meters in about 4,000 large-sized customers to help regulate consumption during peak periods.
Pilot DLC Program	3.1	－	Introduction of a pilot direct load control (DLC) program using ripple control systems to curtail demand in about 2,000 customer end-use loads.
CFL Program	33.4	39.0	Promotion of sales of 1 million compact fluorescent lamps (CFL) to households in areas of high loads by procuring in bulk packages.
FTL Program	14.1	25.2	Provision of a marketing grant to participating manufacturers to support their costs in actively marketing the more efficient lamps.
Total	120.5	64.2	

In addition to the above measures, the “Decree on Thrifty and Efficient Use of Energy” was published in September 2003, targeting industrial and commercial energy consumption. According

to the Decree, major processing, mining, electrical energy production, and thermal energy production companies must register their energy saving norms, keep and report statistics on energy use. In addition, when constructing new buildings, the use of heat-insulation materials and energy-efficient equipment are required.

8.2.2 DSM practices in ASEAN countries and Japan

(1) Thailand

In Thailand, the Energy Conservation Promotion Act was enacted in 1992. In accordance with the Act, the DSM Office was established in EGAT in the same year, and the office started to take on initiatives for DSM promotion. Past DSM measures and achievements in Thailand are summarized in Table 8-2-2 and Table 8-2-3.

Table 8-2-2 DSM Programs in Thailand

Type	Program Name	Program outline
Residential	Energy Efficient Fluorescent Program	Promotion of a voluntary agreement to produce efficient FLs together with advertising campaigns in mass media to promote new energy saving lamps.
	Energy Efficient Refrigerator/Air-conditioner Program	All participating brands of refrigerators and air conditioners carry a label indicating the efficiency label, annual consumption and expected energy saving.
	Nutritious Brown Rice Program	Promotion of sale of brown rice which is rich in nutrition value and saves energy in milling process.
Commercial	Thermal Energy Storage Program	Reduction of peak load through installation of thermal energy storage systems.
	Green Leaf Program	Education of the public on energy efficiency by awarding energy and environmental conservation efficiency ranking to participating hotels.
	Energy Conservation Consultant Program	Implementation of energy efficiency consulting for office buildings by EGAT.
Industrial	Controlled Factory Consultant Program	Implementation of energy audit followed by suggestions for energy savings.
	High Efficiency Motor Program	Promotion of the implementation of high efficiency motors accounting for 80% of industrial consumption.
	ESCO Pilot Project	Implementation of 4 ESCO pilot projects to promote commercial-based DSM programs.

Source: DSM Thailand 1993-2000, EGAT

Table 8-2-3 DSM Targets and Achievements in Thailand

Item	Initial Target (1993-1997)	Modified Target (1993-1997)	Achievement as of June 2000
Peak Demand Saving	238 MW	700 MW	755 MW
Energy Demand Saving	1,427 GWh	3,403 GWh	3,610 GWh
Investment	6,000 mil. Baht	6,000 mil. Baht	1,814 mil. Baht

Source: DSM Thailand 1993-2000, EGAT

(2) Indonesia

In 1992, the DSM action plan was reported to the Ministry of Mines and Energy which targeted reduction of generation costs and improvement of power supply quality. Based on the action plan, PLN is implementing DSM programs. Past DSM measures in Indonesia focused mainly on promotion of the use of fluorescent lamps and the introduction of load adjustment contracts as summarized in Table 8-2-4.

Table 8-2-4 DSM Measures in Indonesia

Category	Outline
Promotion of fluorescent lamps	・ Promotion of fluorescent lamps in collaboration with Philips, GE, and others. ・ Implementation of public campaign focusing on long-term advantages of fluorescent lamps in terms of energy efficiency and usefulness. ・ Provision of financial support for the purchase of fluorescent lamps (Rap 1,000 for 1 lamp).
Introduction of load adjustment contracts	Promotion of the following load adjustment contracts for large customers. ・ Peak-shift contract Consumption during peak load hours is shifted to off-peak hours. Customers receive the following incentives for the peak shift. { Reduction of peak consumption (kWh) ×25%×(100%－2.5%)× Peak energy charge by PLN (kWh) } ・ Peak-cut contract Designated amount of peak consumption is reduced during severe peak hours. Customers receive the following incentives for the peak shift. { 4×Adjusted load (kava)×(100%-2.5%)×Energy charge(kWh) }

(3) The Philippines

DSM in the Philippines is under the authority of the Department of Energy (DOE). Major DSM programs implemented by DOE are shown in Table 8-2-5.

Table 8-2-5 DSM Programs in the Philippines

Program Name	Program Outline
Energy Management Service	Implementation of energy audit for improvement of energy efficiency of commercial and industrial customers.
Information and Education Campaign	Implementation of DSM seminars and workshops for educating the public on energy efficiency.
Government Enercon Program	Reduction of electricity and fuel consumption by 10% at all the government offices.
Efficiency/Energy Labeling & Standard	Energy efficiency labeling for refrigerators and air conditioners, and establishment of fluorescent lamp standards.

Source: Philippine Energy Plan 2002-2011, DOE

In addition to the above programs, the following DSM measures are discussed in the long-term power development planning of the Philippines.

- Installation of fluorescent lamps for all sectors
- Introduction of load adjustment contracts
- Introduction of high-efficiency and speed-adjustable motors
- Installation of energy efficient electrical appliances for the domestic sector
- Installation of high pressure sodium street lamps

(4) Japan

Table 8-2-6 summarizes DSM practices in Japan with regards to DSM categories (peak-shift, peak-cut, bottom-up, and energy efficiency).

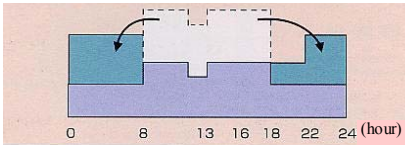
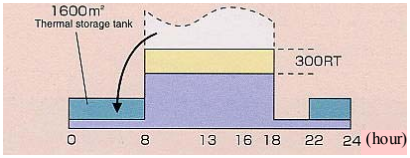
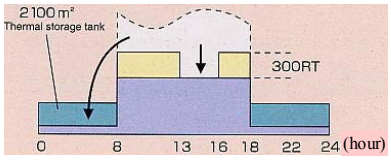
Table 8-2-6 DSM Practices in Japan

Category	Outline
Peak-shift	• Activities for popularization of equipment and other arrangements with customers ➢ Encouraging the use of thermal storage air conditioning system ➢ Load adjustment through changes in industrial production process ➢ Shift of operations by industrial customers to holidays in summer • Rate options conductive to load leveling, subsidy for popularization ➢ Annual load adjustment contract, thermal storage load adjustment contract, time-of-use power service ➢ Financial incentives
Peak-cut	• Activities for popularization of equipment and other arrangements with customers ➢ Peak load adjustment through the use of thermal storage tanks, a shift of lunchtime and minor changes in production process ➢ Load adjustment for major customers in case of strained supply capacity • Rate options conductive to load leveling, subsidy for popularization ➢ Interruptible contract ➢ Financial incentives
Bottom-up	• Activities for popularization of equipment and other arrangements with customers ➢ Encouragement to use electric water heaters and thermal storage floor heaters • Rate options conductive to load leveling, subsidy for popularization ➢ Night-only service
Energy efficiency	• Activities for popularization of energy efficient measures with customers ➢ Provision of information through media, pamphlets, and receipt ➢ Consultation though door-to-door visits to customers ➢ Consulting service on energy efficiency

Among those measures, the following introduce “Load Adjustment Contracts” which require less initial investments and are thus considered to be quite applicable to Vietnam.

Load adjustment contracts (LAC) for large customers reduce electricity rates in return for shifting consumption during peak hours. With regards to the period and method of adjustment, LAC is categorized into annual load adjustment, thermal storage load adjustment, and load management. Outlines of each LAC are summarized in Table 8-2-7.

Table 8-2-7 Load Adjustment Contracts in Japan

Category	Outline	Image
Annual Load Adjustment	• The contract sets forth detailed rates for each season and time, so customers can reduce electricity charges by operating their factories in the period to which lower rates apply. • This option is advantageous for customers who can considerably shift electricity consumption by adjusting factory operations etc.	
Thermal Storage Load Adjustment	• Customers can save energy by using a thermal storage tank which stores thermal energy with low-cost electricity at night and uses the energy in the daytime. • At night, energy can be stored at a rate about 1/8 of that in the daytime and customers can also reduce the demand charge due to a reduction in the required capacity of the heat generating unit.	
Load Management	• Rates are reduced through adjustment of consumption during peak hours by arrangement of production process, a shift of the lunchtime, and the use of thermal storage tanks. • Discounted rates also apply to customers if they significantly adjust their daytime load mainly by setting summer holidays for their factories on the weekdays.	

In addition to the above information, the interruptible contract, which allows customers to reduce or disconnect the load during peak hours, is also available. Under the interruptible contract, any load management action is announced to customers three hours or immediately ahead of the action. Customers receive discount rates when they reduce their consumption in accordance with the request.

CHAPTER 9 RECOMMENDATIONS

Chapter 9. Recommendations

9.1 Recommendations from the View Point of Power Development Plans

9.1.1 Recommendations about Optimum Power Development Plans

(1) Appropriate Power Development Planning

a. Considering Limitations of the Vietnam System

The Vietnam system is extended from north to south, where there are two demand centers. The 500kV transmission line is utilized to supply these demands, but the 500kV transmission line has limitations of its capability.

Furthermore, the reserves of primary energy sources are distributed partially where the north region has hydropower and coal, the south region has hydropower, oil and gas, and the central region just has hydropower. The features of the Vietnam system affect the power development plan largely in long and middle terms. When the power development is planned, the features should be reflected properly.

When the power development plan is established to secure system reliability criteria with the appropriate amount of power development, should contain the following three items:

1. To record the actual operating data of existing plants and to collect the data of water flow of the rivers correctly, in order to reflect the water flow data of rivers on which future hydropower plants will be located
2. To select the proper method to simulate demand and supply balance
3. To revise the power development plan in a timely manner to catch up to the changing conditions

b. Steady Development of Hydropower

The development of hydropower is an economical scenario in middle term in order to meet the rapidly increasing peak demand and electric energy demand.

However, the deep consideration of social and environmental impacts is necessary for hydropower development. The measures should be conducted on the assumption that the hydropower development could be delayed.

1. To get the alternatives ready such as a thermal power and PSPP（conducting the Pre-F/S or F/S）
2. To add the capacity of AFC and the ability of WSS to the coal thermal plants installed in the north system

c. Installation of a Coal Thermal in the South System

The development of a coal thermal power is important to Vietnam. The sufficient reserves of coal are confirmed in the north region. The coal transportation fee from the north to the south will amount to less than 20% of coal prices, but the prices per kWh are still around 40% of that of oil and gas. The low coal prices can reduce the annual fuel costs.

(2) Recommendations on Individual Power Development Plans

a. Implementation of PSPP Development

It can be said that the first priority PSPP has high economic efficiency and low environmental impact. In addition, it is recommended to install the PSPP of 1,500MW in the northern region up to 2020 according to the results of the optimum power development study. However, it will take approx. 14 years to implement the project from start of F/S to commissioning of the PSPP. Therefore, it is recommended to conduct Preliminary feasibility study (Pre-F/S) as soon as possible.

Work flow diagram of Pre-F/S and F/S is described in the Appendix 9-1. Generally, in this step, the best site will be selected out of about three candidates prior to the F/S. For this selection, the development type and scale, project layout plan, preliminary construction cost estimate and preliminary EIA will be studied with the topographical map (1:5,000), hydrological data, site reconnaissance and so on.

It is also recommended to select Phu Yen East, Phu Yen West and one more site (JN6) in the Pre-F/S stage, which are judged to be promising PSPP candidate sites in this study.

b. Peaking Power Supply development by Extension of Existing HPP

According to the result of the preliminary study, high economical efficiency was confirmed for the extension of the Tri An HPP. It is recommended that the feasibility study should be carried out.

Since the Tri An HPP is located in the most downstream of the Dong Nai river system, the extension project should be optimized in full consideration of concerning issues such as prevention of seawater rise to the Dong Nai river and affections of the other hydropower projects planned upstream in the Dong Nai river system etc. Therefore, the feasibility study on the extension project should be carried out as part of the HPP development optimization study in the Dong Nai river system.

c. Development of HPP in the North

The target of this study is to review the optimization of the installed capacity of Ban Chat and

Huoi Quang HPP, which are planned as a cascade development and located in the Nam Mu River. Son La dam is planned to locate downstream of the projects, and Hoa Binh dam lies further downstream in the same river. It is recommended, therefore, that the further study should be done comprehensively to optimize the operation of flood control of the Da river system and power generation of a series of HPPs by simulation of consecutive river system operation.

d. Coal TPP Development in the South

The transportation fee from Haiphong port to the coal TPP's site in the south was estimated based on that to Ho Chi Minh City of 7US$/ton as stated by Vinacoal.

On the contrary, the design of harbor facilities such as the navigation channel, turning basin and berth length was intended for 45,000DWT tanker, which may make transportation cost of coal cheaper in future.

Nevertheless the economical efficiency of promising candidate sites was satisfied. Therefore, it is recommended that further study such as project finding study or pre-feasibility study should be carried out on the promising candidate sites including transmission lines and priority should be put on them based on evaluation in terms of technical, economical and environmental aspects.

9.1.2 Recommendations about Transmission System Expansion Programs

On the basis of the results of the study, implementation and additional studies of transmission system expansion programs are recommended as follows.

(1) Optimum Expansion of the North - South Transmission Lines

Other than "The planed installation of 500 kV transmission lines in 2020 according to EVN" as described in Chapter 3, the installation of the following transmission lines should be implemented in order to connect the north region to the central region with 500 kV two circuits and the central to the south region with three 500 kV circuits.

From Plei Ku substation to Nha Trang substation, 500 kV transmission lines with ACSR 330 mm^2 x 4 x 1cct 300 km (Central to south), the construction costs amount to approx. 82 mil USD.

With the implementation of the above mentioned transmission lines, it will become possible to transmit 1,600 MW from the north region which has a significant amount of base power sources such as hydropower and coal thermal power plants to the central and south region. It will also become possible to transmit power in the central region including mainly hydropower to the south region which has many gas thermal power stations. Therefore, almost the same cost as those concerning the cost of transmission lines can be reduced in the fuel cost of generation, along with

in investments of power plants.

Aside from that, the system reliability between the central and south region can be improved. However, the economical merit could not be clearly estimated so as to conclude the implementation of this case. Therefore, it will be necessary for EVN to carry out a detailed estimation of the effect of economic operations on saving fuel costs and careful examination about the effect of the improvement of system reliability.

EVN should decide whether or not the N-1 criterion is adopted as the reliability criterion of the 500 kV transmission system. In the case of adopting the N-1 criterion, reinforcement is needed for the 500 kV lines in the north region, along with the 500 kV transmission lines with three circuits between the north and central region and the 500 kV transmission lines with four circuits between the central and south region.

(2) Transmission Lines of PSPP

Plans should be made concerning the transmission lines from Son La power station. EVN should study the optimum specifications of transmission lines of PSPP in comparison with the cost of lost power and the construction costs of transmission lines. This should be estimated in consideration with the permissible power drop in generation and pumping operation of PSPP, in addition to the route of the transmission lines from Son La power station and the operation patterns of the generators in the north grid.

(3) Problems of the Power System in Vietnam

EVN should study the following problems regarding the power system in Vietnam.

- Countermeasures for the overload of 500/220 kV transformers and 220 kV transmission lines and large fault currents in the 220 kV system
- Operation methods for 500 kV system in case of an unexpected large fault
- The effects of phenomena of the shaft-twist vibration caused by 500 kV series capacitors and the countermeasures

9.2 Recommendations on Power Development from the View Point of Environmental Considerations

9.2.1 Power Development Scenario

(1) Global Warming and Power Development Scenario

It is recognized that the global warming is one of the largest issues which human beings confront at the present day. It is also commonly accepted that developing countries urgently need to develop their power supply to meet their rapidly growing electric needs. In order to solve these conflicting issues, hydropower generation is expected to play an important role in these countries. This is because hydropower generation is renewable and considered to be "domestically-produced" energy source.

Judging from this point, the Study has concluded that it is economically feasible to go ahead with developing hydropower in Vietnam until 2020 according to the 5th Master Plan and then to start developing PSPP as peaking power generation source.

On the other hand, as described in "8.1.2 Strategic Environmental Assessment", hydropower generation including PSPP is expected to locally have considerable negative impacts. In order to mitigate these impacts, the Study recommends that:

- The Government of Vietnam should implement appropriate and adequate Environmental Impact Assessments in response to these developments. The EIAs should propose appropriate and realistic mitigation measures to avoid, minimize and compensate for negative impacts on natural and social environments, and should also consider secondary impacts such as induced impacts by resettlement.

(2) Realistic Power Development Scenario

When formulating the power development scenario, "feasibility and economical efficiency" is considered to be an important criterion, which has led to the conclusion to promote developing hydropower generation and coal-fired thermal power generation.

The other important criterion is "environmental considerations". From this criterion, coal-fired thermal power generation is not recommendable because of various negative impacts which it may cause. It is thought that gas-fired thermal power generation is better than coal-fired one. However, the Study has formulated a scenario which includes the development of coal-fired thermal power generation considering its economic effect and resource reserve.

Developing coal-fired thermal power generation, the following are strongly recommended to

pursue from the viewpoint of environmental considerations.

- The Government of Vietnam should implement appropriate and adequate EIAs on these developments. The EIAs should propose appropriate and realistic mitigation measures to avoid, minimize and compensate for negative impacts on natural and social environments, and should also consider secondary impacts such as the ones induced by disposal of coal ash. Regarding the disposal of coal ash, please refer to a JBIC PILOT STUDY "Environment improvement and pollution prevention by effective recycling of industrial and domestic wastes in Vietnam". The report is expected to be published in March 2004.
- Regarding CO_2 emissions, the government should seek international assistance measures such as CDM (Clean Development Mechanism[1]).

(3) Requisite Minimum Development

The Study has made it clear that this goal can be achieved under less development requirements than the one planned in the 5th Master Plan. It is ideal to have less development from the environmental viewpoint, where the Study recommends that:

- The Government of Vietnam should carry out research on efficiency of electricity supply facilities, promote reduction of plant investments and minimize development.

(2) Demand Side Management (DSM)

Since it is important and necessary to strongly promote DSM in order to control power development in a sustainable manner, the Study recommends that:

As discussed in Section 6.1.3, the daily load profile in Vietnam is experiencing continuous growth during the day-time peak, and the profile is expected to shift from the night-peak to the day peak type in the near future. In addition, considering historical records of neighboring countries, differences in daily and seasonal demand are forecasted to increase in accordance with economic

[1] The CDM allows Annex I Parities (e.g. Japan) to implement sustainable development project activities that reduce emissions in non-Annex I Parties (e.g. Vietnam). As well as helping non-Annex I Parties work towards sustainable development, and so to contribute to the ultimate objective of the Convention, the certified emission reductions (CERs) generated by such projects can be used by Annex I Parties to help meet their own emissions targets. (modified from "caring for climate: a guide to the climate change convention and the kyoto protocol". UNFCCC.).

development. Therefore, in Vietnam, it is becoming more important to reduce peak demand through active DSM measures in order to realize reduction in investment for development and improvement in facility utilization.

DSM programs are planned and implemented under DSM Phase-II as described in Section 8.2.1 Represented by the installation of fluorescent lamps, these programs render immediate results and are thus evaluated as appropriate for initial DSM actions. In the future, it is expected to maintain current DSM framework by first evaluating Phase-II results and expanding effective measures, and second by transferring commercially viable DSM measures to private sectors.

In the meantime, DSM practices in ASEAN countries and Japan indicate that the labeling program (labeling of the energy efficiency level for air-conditioners and refrigerators) and energy efficiency consulting for large consumers could be immediately implemented in Vietnam with significant results.

Load adjustment contracts are also applicable in Vietnam as their initial investment requirement is relatively small and considerable effects are expected together with the growth of industrial and commercial demand. In order to realize detailed load management under load adjustment contracts, it is important to have access to real-time demand and supply information as well as to immediately transfer and implement dispatch instructions. Therefore, it is recommended to develop and strengthen information communication systems for the introduction of load adjustment contracts.

9.2.2 Implementation of Environmental Considerations

In order to implement environmental considerations such as practice of an appropriate EIA, the Study recommends that:

- The Government of Vietnam should reflect on the lessons learned from the past cases of various developments in a serious manner and should apply them in the future development plans and mitigation measures.
- The Government should refer to the various references.

  The following references are important.

  - ***Environmental Assessment Guidelines***. Asian Development Bank (2003).
  - ***Dams and Development: A New Framework for Decision-Making.*** World Commission on Dams (2000).
  - ***Hydropower and the Environment: Present Context and Guidelines for Future Action.*** International Energy Agency (2000).

- The Government should allocate enough resources (i.e. human resources, time and money) to implement environmental considerations.

  It is absolutely necessary to take enough time, to assign enough and qualified personnel and to allocate enough money in order to implement appropriate environmental considerations.

- EVN should work together with other ministries and agencies.

  Regarding EIA, she should work closely with MONRE.

  Regarding dam construction, it is crucial for EVN to closely work together with MARD which constructs irrigation dams. MARD has been working with the World Commission on Dams, and is formulating a report on dams in Vietnam[1]。

9.3 Recommendations from Financial Perspective

(1) Investment Plan

EVN's financing plan has been prepared from a financial perspective, and therefore, is different from the investment plan of the revised 5th Master Plan.

Although it is meaningful to consider investment from a financial perspective, for the future of the electricity power sector, it is recommended that the financial projections based on the revised 5th Master Plan be prepared and differentials analyzed, as well as be coordinated with the concerned parties.

(2) Foreign Exchange Risk

EVN has a significant amount of foreign loans in relation to past capital investments, and holding such foreign exchange risk, EVN's financial situation will be impacted by currency fluctuations. The government and EVN should discuss about situations when the currency fluctuates substantially and EVN can no longer cover the losses.

[1] Confluence – Newsletter of the Dams and Development Project, No.3. (July 2003). UNEP / DAMS AND DEVELOPMENT PROJECT.

CHAPTER 10 TECHNOLOGY TRANSFER

Chapter 10. Technology Transfer

10.1 Selection of Candidate PSPP Sites

Identification of candidate PSPP sites based on the topographical, geological and environmental survey is transferred through OJT (On the job training).

10.1.1 Project Investigation

Technologies for series of the study such as project findings, identification of candidate PSPP sites, field investigation, are transferred by OJT through joint works.

Typical examples are the followings.

- Project Planning technology: Detailed explanation about technical investigation items and method for each project is conducted at the joint meeting for evaluation of reconnaissance and narrowing down the projects.
- Site investigation technology: detailed explanation for investigation method, design concept and findings, is carried out at actual site using maps.

10.1.2 Environmental Considerations

During the second field survey, a seminar was held on environmental considerations. The purpose of it was to discuss the environmental considerations on the project and to share the common understandings of the environmental considerations and EIA among the related people. Due to the restructuring of MOSTE to MONRE, an EIA expert from MONRE was not able to come to the seminar and the EIA process was not reviewed by the attendants.

It is important to share understanding among the related people what EIA is and what “environmental considerations” are, and it is also essential to encourage the Vietnamese side to have ownership of the project in order to implement EIA and environmental considerations properly and timely.

10.2 Power Planning and Analysis

In order to transfer power system simulation tools, PDPAT II, RETICS and IMPACT, the Study Team dispatched the developer of each program and held a seminar on the logics and functions of PDPAT II, RETICS and IMPACT as below.

Figure 10-2-1 Seminar Program

Date		Outline
June 5 (Thu)	AM	Logics and functions of RETICS
	PM	Logics and functions of PDPATII and IMPACT Program installation
June 6 (Fri)		Exercise of RETICS, PDPATII, and IMPACT
June 8 (Mon)		Exercise of RETICS, PDPATII, and IMPACT
June 9 (Tue)		Questions and answers

(1) Results of the Seminar

- The number of participants reached 11. Among them, 9 attended the whole seminar.
- Especially, engineers from NLDC and IE actively participated the seminar and explained what they understood to the other attendants.

(2) Preparation of the Seminar

- From the Vietnamese side, 6 PCs were prepared for the seminar.
- As half of the attendants speak English, the seminar was conducted basically in English.

(3) Technical Transfer

- The attendants understood essential logic behind the tools and familiarized themselves with the general use of the programs.

(4) Transfer of the Programs

- PDPAT-II, RETICS, and IMPACT, were transferred to the counterpart with End User License Agreement as shown in Appendix 10-1.

10.3 Workshop

10.3.1 Preparing and Holding the 1st Workshop

To explain and discuss the result of the investigation, Workshop is organized by EVN. Contents of the Workshop, such as dates, topics and participants, are decided through consultation with C/P.

The 1st workshop on the Master Plan Study on Pumped Storage Power Project and Optimization for Peaking Power Generation in Vietnam was successfully held on Jan 23, 2003 inviting counterparts and relevant organizations. After the positive and constructive discussions, the participants understood that the progress of the study would be carried out in accordance with the approaches and methodologies presented by the Study Team. The agenda of the workshop are described in Appendix 10-2-1.

Main questions and comments raised by the participants are as follows:

- Is the number of power stations modeled in IMPACT limited?
- The Study Team should take into account the previous and under-upgrading Master Plan of EVN.
- The cost-calculating method of pumped storage power plant, especially the energy cost of pumping-up water to the upper reservoir needs more comprehensive consideration.
- What is the method used for screening priority sites of PSPP based on the environmental, technical and economic estimations?
- How to get the daily/weekly data of the power stations planned up to year 2020?
- All the potential PSPPs will be identified without limiting numbers.
- The criteria for finding PSPP potential sites will be made practically for this study.

Materials of the presentation are attached in Appendix 10-2-2.

10.3.2 Preparing and Holding the 2nd Workshop

To explain and discuss the result of the Interim report and the scenario of peaking power sources development, Workshop is organized by EVN. Contents of the Workshop, such as dates, topics and participants, are decided through consultation with C/P.

The 2nd workshop on the Master Plan Study on Pumped Storage Power Project and

Optimization for Peaking Power Generation in Vietnam was successfully held on Aug. 7, 2003 inviting counterparts and relevant organizations. After the positive and constructive discussions, the participants understood that the Study would be carried out in accordance with the approaches and methodologies presented by the Study Team. The agenda of the workshop are described in Appendix 10-3-1.

Main questions and comments raised by the participants are as follows:

(Session 1 & 2)

- When is the most appropriate time for Vietnam to apply or to put PSPP into operation?
- Why does the Study Team set up target years in 2015 and 2020? Why doesn't the Study Team simulate in the period of 2010 - 2015?
- Could the Study Team recommend the appropriate extension capacity and operation duration of the existing and planned hydropower plants?
- Will the Study Team examine the economical efficiency comparing between the extension of conventional hydropower plants and PSPP for peaking power supply in this study?
- At present time the loading curves are very uneven, meaning that the difference between Pmax and Pmin is very big, 2 or 2.5 times. How can PSPP help to balance the loading curves?
- In the North, some potential PSPP sites in the Da river basin are planned to connect to the Substation 500 kV Hoa Binh. But there is no way for this substation to be extended. How to solve this problem?
- Candidate PSPP are selected based on the installed capacity of 1,000 MW and peaking time of 7 hours, etc. After peaking optimization, if the capacity and peaking time are different from the original ones, can the priority list be appropriate?

(Session 3 & 4)

- The impact of the Son La HPP in the whole power system should be examined in 2015.
- Concerning the relation between PSPP & nuclear power projects in Vietnam, whether the timing of nuclear projects affects the installation timing of PSPP or not?

In summary, the participants understood the progress of the Study and the necessity of peaking power generation in Vietnam.

Materials of the presentation are attached in Appendix 10-3-2

10.3.3 Preparing and Holding the 3rd Workshop

To explain and discuss the result of the Draft final report and the draft of master plan, Workshop is organized by EVN. Contents of the Workshop, such as dates, topics and participants, are decided through consultation with C/P.

The 3rd workshop on the Master Plan Study on Pumped Storage Power Project and Optimization for Peaking Power Generation in Vietnam was successfully held on Feb. 25, 2004 inviting counterparts and relevant organizations. After the positive and constructive discussions, the participants understood that the Study would be carried out in accordance with the approaches and methodologies presented by the Study Team. The agenda of the workshop are described in Appendix 10-4-1.

Main questions and comments raised by the participants are as follows:

-Cost of PSPP calculated in the Study is 650US$/kW. It is too cheap in comparison with cost of hydropower, which is normally at over 1,000US/kW. Please explain why?

- Why fuel cost using hydropower pumping energy is 0 cent per kWh?
- When do you plan to install PSPP?
- After nuclear power is supplied to national grid, what role PSPP will play? How does PSPP relate to nuclear power to improve power system efficiency?
- According to EVN, transmission ability of single circuit line is about 800 – 1,000MW; of double circuit line is about 1,600MW. However, the Study said that the optimal power flow of interconnection line is 1,300MW. Please explain more.
- Generally, PSPP causes less negative impacts on environment than conventional hydropower does. It is necessary to install PSPP in Vietnam. However, it is also important to consider carefully economical aspects of PSPP as well.

In summary, the participants understood the results of the Study and the master plan proposed by the Study Team in Vietnam.

Materials of the presentation are attached in Appendix 10-4-2.