APPENDIX

CHAPTER 11

WORKSHOP

Appendix 11-1 Presentation Documents for 1st Workshop

The Study on National Power Development Plan for the period of 2006-20015, perspective up to 2005 in Vietnam

Outline of JICA Study

1. *Background*
2. *Purpose*
3. *Scope of the Study*
4. *Study Flow*
5. *Schedule*

Japan International Cooperation Agency (JICA)

Background and Purpose

Background

- Electric power demand growth rate : more than 10% per year for the last 10 years
- Vietnam has prepared 1st~5th MP of power system development every five years.
- The 5th power development master plan has several important issues.

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Background and Purpose

Objectives

- To assist the preparation of PDP 6th
- To improve the capability of Vietnam so that it may possibly prepare the PDP MPs for itself after this Study.

3

Scope of the Study

(1) Review of implementation of 5th master plan
(2) Preparation of PDP 6th
  a. Power demand forecast
  b. Primary energy policy for PDP
  c. Optimization of power generation development plan
  d. Optimization of power network development plan
  e. Financial and economic analysis
  f. Environmental and social considerations
(3) Finalization of PDP 6th
(4) Capacity development

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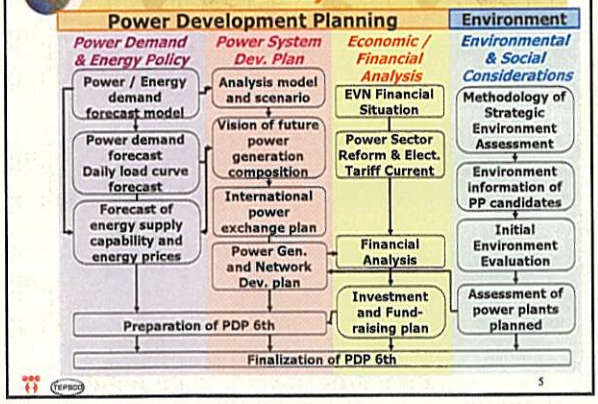
Study Flow



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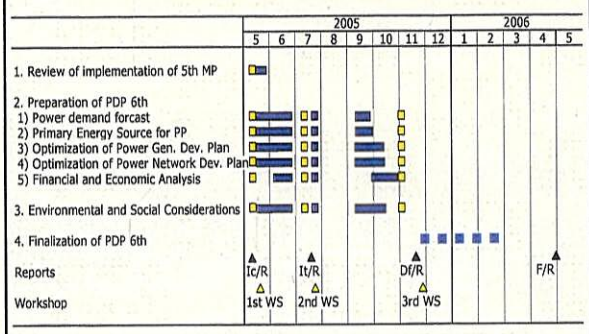
Schedule



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End of Session

Thank you for your attention!

Power demand forecasting for Power Development Master Plan in Vietnam

1. Comments on Power Demand Forecasting
2. Comments on Daily Load Curve Forecasting
3. Conclusion

Japan International Cooperation Agency (JICA)

1. Comments on Power Demand Forecasting

(1)Advantage and disadvantage of Direct method

a. Procedures of direct method

Power demand is forecasted with energy(power) intensities in direct method. The energy(power) intensities are estimated by the actual data in the current situation, and also power consumption data planned.

Power demand in the country-wide is forecasted with summation of sector and sub-sector power demand.

1. Comments on Power Demand Forecasting

b. Advantage

- It can keep continuation between power demand and socio-economic activities.
- It is easy to explain the demand forecasted.
- The concept of direct method is similarly to Input/Output analysis.
- It is said that I/O analysis has prefer to other analysis methods with input and out balance analysis.
- The I/O analysis is useful for measuring the political measurement after implementing it.

1. Comments on Power Demand Forecasting

c. Disadvantage

- Much information and data(Intensities, number of registered facilities, number of factories) are required.
- It is well known that the trends of power consumption intensities keeps their auto correlation. But it is difficult to forecast the trends of them for long term.
- The direct method are used for short term forecasting (max 5 years)
- The direct method is suitable for input and output analysis the same as I/O analysis.

1. Comments on Power Demand Forecasting

(2) Advantage and disadvantage of Indirect method

a. Procedures of Indirect method

Indirect method called in Vietnam is "Elasticity forecasting method". The elastic value used in Indirect method is "Power demand to GDP".

$$\rho = \frac{\text{Growth rate of power demand}}{\text{Growth rate of GDP}}$$

1. Comments on Power Demand Forecasting

b. Advantage

- Elasticity method is useful for many experts to discuss the future power demand due that the method is easy to understand. Especially, when the experts want to make brain storming, the method is sometimes convenient for the discussion.
- In the past year of Japan, many experts of business sectors discussed their future business by using elasticity. They used their elasticity to private consumption, investment, export and population besides GDP.

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1. Comments on Power Demand Forecasting

b. Disadvantage

- Elastic value can not be included any economic meaning. In other words when you are requested to explain the meaning of the future power demand, you can not explain the meaning by using the elastic value.
- Especially, GDP elastic value means that demand is in proportion to their national income. It is economic principle. But we can not know that where the power is consumed and how it is consumed.
- By using the method, it is difficult that you want to make some policies on demand side management (DSM), energy conservation, industrial restructuring, energy conversion and analysis of power tariff impact to industries.

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1. Comments on Power Demand Forecasting

(3) Comments for model development for Power demand forecasting in Vietnam

The ultimate purposes of the project are to make power supply, investment and power resource plan and so on. It is required that the results of the power demand forecasting models must be determined by the economic activities, power demand in the regions, increase of electrification rate and energy conservation policy.

The following items are discussed for making future power demand in Vietnam.

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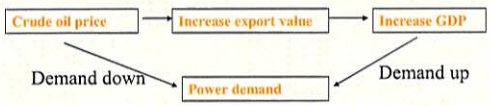
1. Comments on Power Demand Forecasting

- Economic activities and power demand are simultaneous or not.



- Recognize the relation between power demand and power tariffs

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1. Comments on Power Demand Forecasting

- Power demand is decided by the following items. Is it available for getting the data.
  - Economic activity data
  - Energy conservation data (it is impacted by power tariff, technology and efficiency improvement)
  - Electrification (convert to power, electrification in Rural area)
- Power demand forecasting in regional area of Vietnam can be estimated from power demand in the whole country. For sharing the total power demand, we can select some indicators such as investment, GDP and GDP per capita in the region.

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1. Comments on Power Demand Forecasting

(4) Technical comments for demand forecasting model building

- Normally some forecasting equations are made in the partial test stage and examined for its reliability and stabilization by using statistic values (Correlation coefficient, t-values and D.W. ratio) from regression analysis.
- The setting of High, Base and Low should be distinguished by the difference of the exogenous variables, and desirably the same forecasting equation should be used for each of High, Base and Low.
- Residual item is useful for explaining the actual terms, but need not be inserted in the items in the forecasting equation, because it is nearly zero in the future terms.

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1. Comments on Power Demand Forecasting

• When the value of elasticity is given 1.0 or higher, the future trends increase rapidly in proportion with the future years. Good attention should be paid when making forecasting values for more than 20 years. The following table contains future values of elasticity.

2000-2005	2006-2010	2011-2015	2016-2020	2021-2025
2.00	1.80	1.60	1.40	1.20

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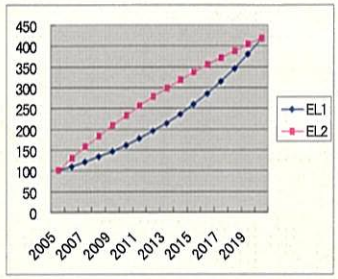
1. Comments on Power Demand Forecasting



Y=aX ^ 2.0

Y= a/GDP+ b

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1. Comments on Power demand Forecasting

< Difference between **Y=aX ^ 2.0 and Y=a/GDP**+ b >

年	GDP	Y= a * G D P ^2.0	Y = a/GDP+ b	倍
2005	2,000	100	100	1.0
2006	2,100	110	129	1.2
2007	2,205	121	157	1.3
2008	2,315	133	184	1.4
2009	2,431	146	209	1.4
2010	2,553	161	233	1.4
2011	2,680	177	256	1.4
2012	2,814	195	278	1.4
2013	2,955	214	298	1.4
2014	3,103	236	318	1.3
2015	3,258	259	337	1.3
2016	3,421	285	355	1.2
2017	3,592	314	372	1.2
2018	3,771	345	388	1.1
2019	3,960	380	404	1.1
2020	4,158	418	418	1.0

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1. Comments on Power Demand Forecasting

•The reliability of the forecasting years are half of the actual data used for regression analysis. If you prepare the actual data for 10 years, the forecasting term is 5 years.

• But in many cases, 20 years ahead have to be forecast for making energy and power plans. A good care has to be taken especially in using the value of elasticity of more than 1.0 and multi-dimension equations.

•Generally speaking, value of elasticity of power consumption to GDP in developing countries is approximately from 1.0 to 1.2 for power consumption, and from 0.8 to 1.0 for energy consumption.

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1. Comments on Power Demand Forecasting

• The results of the forecasting are evaluated with the growth rates. The results will be easier to understand with the comparison of the growth rate of the forecasting, selecting a significant starting year and a final year.

Results of the demand forecast (base case) GWh

	2005	2010	2015	2020	2025	20/05
Industry	19.3	35.3	61.8	107.4	179.7	12.1
Residential	21.6	36.6	53.7	75.0	100.6	8.7
Commercial	2.1	3.8	6.1	9.2	13.2	10.3
Agriculture	0.8	1.1	1.5	1.8	2.2	5.6
Others	1.8	3.2	5.0	7.5	10.6	10.0
Total	45.7	80.0	128.1	200.9	306.4	10.4
Power Gen.	53.6	92.9	146.3	226.6	342.0	10.1
Peak load	9.5	16.1	24.8	37.5	56.6	9.6

Peak load MW Growth rate %

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1. Comments on Power Demand Forecasting

(5) Technical comments for elastic value model

•It is useful for many experts to discuss their future. The experts have much information for the future. These are qualitative information, not numeric data. Elastic value is useful for the such kind of working discussion.

• It is useful for international comparison. Different countries have different currencies, economic environment, and relations between GDP and power consumption can be discussed by using elastic value.

•In making a power plan with elasticity, collections of opinions from many experts are required. The counterpart is recommended to exchange discussions with these experts using elasticity. This is more important than making models and database.

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1. Comments on Power Demand Forecasting

(6) Technical comments for intensity model

- Power consumption per GDP is estimated by GDP per capita.

After that, Energy demand is forecasted by E=E/GDP*GDP. The formation of the expressions are follow;

E/GDP=a+b*LN(GDP per Capita)+c*LN(GDP per Capita)

LN(E/GDP)=a+b*LN(GDP per Capita)+c*LN(GDP per Capita)

- Generally speaking, power consumption per GDP increases in proportion with GDP growth in primitive economic stage. But, after GDP level exceeds some point ($3000 / person), E/GDP decreases in proportion with GDP per capita.

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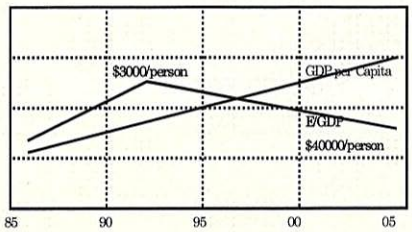
1. Comments on Power Demand Forecasting

<GDP per capita and E/GDP trend>



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1. Comments on Power Demand Forecasting

(7) Judgment criteria for power demand forecasting model
Multi-regression method is the method finally adopted in the report for power demand forecasting in Vietnam, but the following indicators are also required as judgment criteria besides the change of power demand .

- Growth rate
- Power consumption per capita
- Power consumption per GDP
- Power consumption elastic value to GDP
- Power consumption share in the total energy consumption

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1. Comments on Power Demand Forecasting

Judging by the growth rate, almost the same conclusions are obtained from multi-regression, Elasticity, Intensity method and EVN case.

Summary of the forecasting results(Base case) GWh %

Year	Multi-regression	Elasticity	Intensity	Average case	EVN's case	Intensity (JICA's case)
2005	45,682	45,228	45,682	45,531	45,682	45,915
2010	78,962	83,155	71,596	77,904	84,454	92,367
2015	123,872	134,622	114,254	124,249	139,169	139,543
2020	186,378	202,569	177,119	188,689	202,464	205,034
2025	271,320	280,563	267,480	273,121	272,094	294,353
25/05	9.3	9.6	9.2	9.4	9.3	9.7

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2. Comments on daily load curve forecasting

(1) Methodologies

- Daily load curve can be estimated to some extent by applying the theory of "Load profiling", which serves in assuming power consumption patterns.
- Load profiling is to measure the power consumption of the classified groups of consumers by using the sample data from data logger that is called "Interval meter".
- By introducing this method, improvement of transparency, neutrality and accuracy of power demand forecasting is sought, as well as electricity charges can be settled with the normal meters (only by measuring monthly consumption) without performing measurement by means of the interval meter, which responds to the time sections for settlements. The table below shows the load profiling performed in some countries.

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2. Comments on daily load curve forecasting

- Load profiling implemented in some countries.

Countries	Interval	Users
USA New Hampshire	60 minutes	All users X< 100kW
USA Ohio	15 minutes	All users 300kW< X <1000kW
England	30 minutes	All users X < 100kW
Germany	60 minutes	All users 30,000kWh X < 100,000kWh

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2. Comments on daily load curve forecasting

- Classification of load profiling performed in certain countries and regions is as stated below.

Static load profiling

The current daily load curve is estimated by the same type of data in the data base of the user.

Dynamic modeling

The current daily load curve is estimated by the estimation model with explanation variables such as temperature, weekday, weekend and other related variables.

Dynamic load profiling

The current daily load curve is estimated by using the current data of the user

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2. Comments on daily load curve forecasting

- daily load curve forecasting models in Vietnam are classified in the following types.

Aggregation model

Static load profiling

Multi-regression model

Dynamic modeling

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2. Comments on daily load curve forecasting

(2) Aggregation model

- Collecting interval load data, classifying data, making daily load curve by sub-sector and sector are processed. For the future daily load curve, the sectoral daily load curve are summed up with their weight in proportion with their power consumption.
- Generally speaking, it is difficult to estimate future daily load curve. Especially in developing countries, peak load moves from night time to day time.
- Aggregation model in Vietnam is significant for their power demand forecasting.
- The method required a lot of data for making the future daily load curve, then if the master plan is revised cyclically, it is difficult to maintain the model.

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2. Comments on daily load curve forecasting

- The following are the procedures of Aggregation model.

1. Measuring interval load data	*Interval 15-30 minutes *Measure kW, Kvar load, Temp, Humid
2. Classifying interval load data	*The data are classified by weekday, weekend * The data are classified by summer and winter
3. Market research	* Send questionnaires to users
4. Making the sample data of TOU	*Customer data base *Select TOU data
5. Making daily load curve by sub-sector	*Making sample data *Collect 30 minute data
6. Making daily load curve by sector	*Making daily load curve by sector *power consumption by sector
7. Making daily load curve in whole country	*Making daily load curve in whole country *Power consumption in whole country
8. Forecasting daily load curve by sub-sector	*The same to actual daily load curve by sub-sector *Forecasted power consumption by sub-sector
9. Forecasting daily load curve by sector	*Estimated daily load curve by sub-sector *T/D loss

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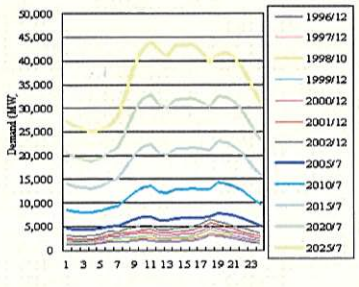
2. Comments on daily load curve forecasting

- The following figure is the daily lord curve forecasted for peak demand day in the whole country.



Whole

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2. Comments on daily load curve forecasting

(3) Multi-regression method

Basic expression for the model is follows;

$$Log(Ei)=ai+bi*X1+ci*X2+di*X3+ei*X4+fi*X5+gi*X6+hi*X7+ii*X8$$

Ei :Electricity consumption at i o'clock (MW)
ai, bi , · · · · · ,ii :Regression coefficient at i o'clock
X1 :GDP Agriculture (bill US$)
X2 :GDP Industry (bill US$)
X3 :GDP Service (bill US$)
X4 :GDP Total (bill US$)
X5 :Population (mill)
X6 :Humidity (%)
X7 :Electrified population (mill)
X8 :Temperature (deg)

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