The Study on National Power Development Plan for the period of 2006-2015, perspective up to 2025 in Vietnam

Power Demand & Daily Load Curve Forecasting

（CONTENTS）
1. Prefatory Conditions
2. Power Demand Forecasting(PDF)
3. Daily Load Curve Forecasting (DLC)

December 2005

Conditions of Economic Scenario

"ECONOMIC DEVELOPMENT FORECAST SERVING STUDY ON ENERGY DEVELOPMENT FOR THE PERIOD UP TO 2050"

Globalization of Economy
Regional economic development
Developing towards high value added economy

	2010/05	2015/10	2020/15	2025/20	2025/05
High growth	8.5	8.5	8.5	8.0	8.4
Middle growth	7.6	7.2	7.2	7.0	7.3
Slow growth	6.2	7.0	7.0	7.0	6.8

2

Consistency of short term plan

① The Vietnam government has approved the power demand forecasting for the next five years (2006 – 2010).

② For keeping the consistency between the short plan and PDP6th, the power demand are forecasted under the given power demand growth rates of the three years, 2006, 2007 and 2008.

Cases	Power demand in five year plan(2006~2008)	Social Economic Scenarios
High	18%	High growth scenario
Base	17%	High growth scenario
Low	16%	Middle growth scenario

3

Concept of Power Demand Forecasting

① The models linked to social economic plan.
② Power demand forecasted by Region.
③ Power demand affected by Energy price.
④ Power demand forecasted by Business sector.
⑤ Energies to power stations are calculated
⑥ Primary energy consumption should be calculated.
⑦ Daily load curves are forecasted by Regression analysis.
⑧ Load factor are forecasted.

4

Main precondition of PDF

① GDP growth rate

According to the social economy development plan, GDP growth rate are targeted as follows, the growth rates from 2005 to 2015 are rather higher than the further years.

Case	Unit	2005/2000	2010/2005	2015/2010	2020/2015	2025/2020
High	%	7.4	8.5	8.5	8.0	8.4
Base	%	7.4	8.5	8.5	8.0	8.4
Low	%	7.4	7.2	7.2	7.0	7.3

（Source) ECONOMIC DEVELOPMENT FORECAST SERVING STUDY ON ENERGY DEVELOPMENT FOR THE PERIOD UP TO 2050

5

---

② Crude oil price（WTI)

Hearing that the crude oil price keeps high in the next 2 or 3 years, it is considered that WTI crude oil price is kept at the level of $60/bbl from 2005 to 2008 (Vietnam crude oil price is $50/bbl level).

After 2009, the crude oil price is predicted with $40/bbl. (Vietnam crude oil price is $30 - $35/bbl in the years).

Case	Unit	2004	2005	2006	2007	2008	2009		2025
High	bbl/$								
Base	bbl/$	40	60	60	60	60	40	...	40
Low	bbl/$								

6

③ Power ratio of Industry sector

The power ratio in 2005 is 15.9% including renewable energies (RE), and it is 22% excluding RE.
In 2025, the ratio will be expected with 36% including RE.

Case	Unit	2005	2010	2015	2020	2025
High	%	15.9	24.3	31.1	35.3	38.7
Base	%	15.9	23.4	29.6	33.8	36.1
Low	%	15.9	23.2	29.3	33.5	35.6

Power ratio = Power demand / Energy demand * 100

7

<Power ratios in the neighboring countries>

The power ratios of Industry sector in the other countries are as follows. The 32% in Philippines and the 26% in Japan and Taiwan are outstanding. %

	1995	1996	1997	1998	1999	2000
Japan	26.5	26.8	27.1	27.4	26.7	26.6
Taiwan	22.1	22.2	22.9	23.3	24.4	26.2
Australia	20.3	19.9	20.0	21.4	21.9	22.0
Indonesia	12.4	11.9	14.3	13.8	13.9	12.9
Korea	19.0	19.6	19.4	19.2	19.4	20.0
China	5.1	5.3	5.5	5.8	6.0	6.1
Thailand	22.7	20.6	22.5	22.4	23.9	25.4
Malaysia	18.0	19.8	21.4	21.4	23.1	22.2
Philippines	19.7	19.7	20.2	26.9	20.4	31.7

④ Power ratio of Commercial sector

Big demand is predicted in commercial sector in future. Commercial sector will use many appliances like air conditioner in their office and building, then the power ratio of the sectors becomes higher.

Case	Unit	2005	2010	2015	2020	2025
High	%	11.3	22.3	26.4	30.9	37.1
Base	%	11.3	21.7	25.6	30.0	34.9
Low	%	11.3	20.8	26.0	31.4	37.9

9

<Power ratios of commercial and residential use >

Power ratios of Thailand with 71% and Taiwan with 67% are outstanding. The temperature in these countries is so high that the electricity is consumed for the air-conditioning.

	1995	1996	1997	1998	1999	2000
Japan	43.9	43.9	45.4	47.1	47.8	44.8
Taiwan	64.5	63.6	65.9	66.2	65.8	67.2
Australia	52.3	53.0	53.7	54.4	55.3	55.5
Indonesia	3.8	4.3	4.8	5.3	5.4	5.8
Korea	18.0	19.3	21.0	25.7	24.0	27.6
China	6.3	7.0	8.0	9.5	10.0	10.0
Thailand	70.5	70.3	72.6	75.0	72.2	71.2
Malaysia	55.2	49.7	65.0	68.2	61.0	63.4
Philippines	39.0	40.6	47.2	45.2	43.7	40.0

10

⑤ Power ratio of Residential use

The total energy demand for residential use contains renewable energies (The shares is 70~80%). In 2005, the power ratio excluding renewable energies is 35%.

The power ratio in 2025 is 28% in the following table. However, the power ratio excluding renewable energies is 60 to 70% in 2025.

Case	Unit	2005	2010	2015	2020	2025
High	%	11.3	17.9	23.3	26.5	28.9
Base	%	11.3	17.2	22.3	25.5	27.7
Low	%	11.3	16.7	21.6	24.8	27.1

11
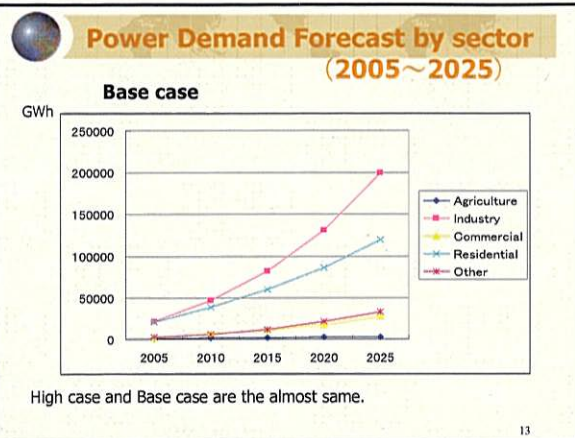
Results of PDF

① The power demand increases with 11.2% in Base case, 11.4% in High case 10.0% in Low case from 2005 to 2025.

② The power demand reaches 381,000GWh in Base case, 399,000GWh in High case and 309,000GWh in Low case in 2025.

Base	2005	2010	2015	2020	2025	25/05
Power Demand	46,000	97,000	165,000	257,000	381,000	
Growth rate	15.2 %	16.1%	11.2%	9.3%	8.2%	11.2%
Elasticity	2.1	1.9	1.3	1.1	1.0	1.3

High	2005	2010	2015	2020	2025	25/05
Power Demand	46,000	101,100	172,400	267,600	398,600	
Growth rate	15.2 %	17.2%	11.2%	9.2%	8.3%	11.4%
Elasticity	2.1	2.0	1.3	1.1	1.0	1.4

12

Power Demand Forecast by sector (2005〜2025)

Base case

High case and Base case are the almost same.

13

Comparison of PDF

The power demand forecast of PDP6th, PDP5th and Revised PDP5th are compared as follows.

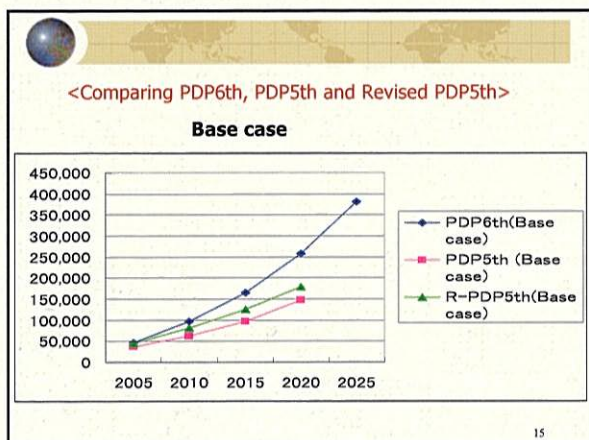<Power Demand Forecasting in PDP5th, R-PDP5th, PDP6th > (GWh)

Base	2005	2010	2015	2020	2025
PDP6th(Base case)	46,000	97,100	165,000	257,300	381,200
PDP5th(Base case)	37,100	61,600	95,700	146,600	
R-PDP5th(Base case)	44,900	80,500	124,200	178,600	

Times	2005	2010	2015	2020	20/05
PDP6th(Base case)	1.02	1.21	1.33	1.44	12.2%
R-PDP5th(Base case)	1.00	1.00	1.00	1.00	9.6%

14

<Comparing PDP6th, PDP5th and Revised PDP5th>

Base case

15

Simulation

(1) Energy conservation simulation

<Energy conservation in Base case>

Sectors	2005-2010	2011-2025
Agriculture & Fishery	0	−1
Industry	0	−1
Transportation	0	0
Commercials & Service	0	−1
Residentials	0	−1

<Energy conservation in Alternative case>

Sectors	2005-2010	2011-2025
Agriculture & Fishery	0	0
Industry	0	0
Transportation	0	0
Commercials & Service	0	0
Residentials	0	0

16

Simulation results of Energy conservation effect

Cases	Sectors	Unit	2005	2010	2015	2020	2025	25/05
Base	Manufacturing	GWh	20,909	46,325	81,559	131,066	199,296	12%
	Commercials	GWh	2,022	6,168	10,528	17,319	27,550	14%
	Residentials	Gwh	20,173	38,042	59,777	85,629	119,109	9%
	Total	GWh	45,997	97,118	164,975	257,286	381,223	11%
Alternative	Manufacturing	GWh	20,909	46,325	85,762	144,923	231,724	13%
	Commercials	GWh	2,022	6,168	11,070	19,150	32,032	15%
	Residentials	Gwh	20,173	38,042	62,858	94,682	138,489	10%
	Total	GWh	45,997	97,118	172,885	282,245	437,938	12%

17

---

(2) Energy price (FO linked to $40 oil price) Simulation

<Energy prices in Base case>

Case	Energy prices	Unit	2005	2010	2015	2020	2025	25/05
Energy price in Base	WTI crude oil	US$/bbl	60	40	40	40	40	-2.0
	Crude oil : VN	1000Dn/bbl	884	617	676	741	741	-0.9
	Fuel oil : VN	Dong/kg	3,492	4,022	4,634	5,337	5,609	2.4

<Energy prices linked to $40 crude oil price>

Case	Energy prices	Unit	2005	2010	2015	2020	2025	25/05
Energy price Depend to $40	WTI crude oil	US$/bbl	60	40	40	40	40	-2.0
	Crude oil : VN	1000Dn/bbl	884	969	1,062	1,164	1,164	1.4
	Fuel oil : VN	Dong/kg	3,492	4,022	5,002	5,338	5,338	2.1

18

Results of Energy prices linked to $40

Cases	Sectors	Unit	2005	2010	2015	2020	2025	25/05
Base	Manufacturing	GWh	20,909	46,325	81,559	131,066	199,296	12%
	Commercials	GWh	2,022	6,168	10,528	17,319	27,550	14%
	Residentials	Gwh	20,173	38,042	59,777	85,629	119,109	9%
	Total	GWh	45,997	97,118	164,975	257,286	381,223	11%
Energy price $40	Manufacturing	GWh	20,909	46,325	79,337	130,619	201,629	12%
	Commercials	GWh	2,022	6,168	10,338	17,283	27,770	14%
	Residentials	Gwh	20,173	38,042	59,246	85,549	119,596	9%
	Total	GWh	45,997	97,118	162,015	256,720	384,291	11%
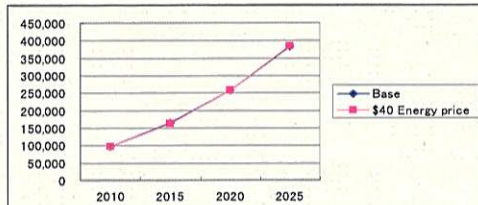
19

---

(3) Energy price (FO linked to $30 oil price) Simulation

<Energy prices in Base case>

Case	Energy prices	Unit	2005	2010	2015	2020	2025	25/05
Energy price in Base	WTI crude oil	US$/bbl	60	40	40	40	40	-2.0
	Crude oil : VN	1000Dn/bbl	884	617	676	741	741	-0.9
	Fuel oil : VN	Dong/kg	3,492	4,022	4,634	5,337	5,609	2.4

<Energy prices linked to $30 crude oil price>

Case	Energy prices	Unit	2005	2010	2015	2020	2025	25/05
Energy price Depend to $30	WTI crude oil	US$/bbl	60	30	30	30	30	-3.4
	Crude oil : VN	1000Dn/bbl	884	441	483	529	529	-2.5
	Fuel oil : VN	Dong/kg	3,492	4,022	3,573	3,813	3,813	0.4

20

Results of Energy prices linked to $30

Cases	Sectors	Unit	2005	2010	2015	2020	2025	25/05
Base	Manufacturing	GWh	20,909	46,325	81,559	131,066	199,296	12%
	Commercials	GWh	2,022	6,168	10,528	17,319	27,550	14%
	Residentials	Gwh	20,173	38,042	59,777	85,629	119,109	9%
	Total	GWh	45,997	97,118	164,975	257,286	381,223	11%
Energy price $30	Manufacturing	GWh	20,909	46,325	86,116	141,779	218,856	12%
	Commercials	GWh	2,022	6,168	10,915	18,247	29,320	14%
	Residentials	Gwh	20,173	38,042	60,866	87,889	122,866	9%
	Total	GWh	45,997	97,118	171,044	271,290	406,532	12%
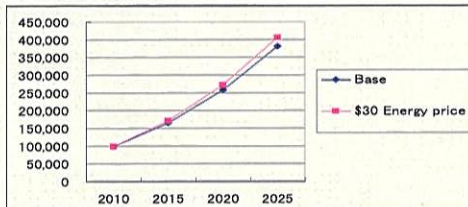
21

---

(4) Energy price(FO linked to $60 oil price) Simulation

<Energy prices in Base case>

Case	Energy prices	Unit	2005	2010	2015	2020	2025	25/05
Energy price in Base	WTI crude oil	US$/bbl	60	40	40	40	40	-2.0
	Crude oil : VN	1000Dn/bbl	884	617	676	741	741	-0.9
	Fuel oil : VN	Dong/kg	3,492	4,022	4,634	5,337	5,609	2.4

<Energy prices linked to $60 crude oil price>

Case	Energy prices	Unit	2005	2010	2015	2020	2025	25/05
Energy price Depend to $60	WTI crude oil	US$/bbl	60	60	60	60	60	0.0
	Crude oil : VN	1000Dn/bbl	884	969	1,062	1,164	1,164	1.4
	Fuel oil : VN	Dong/kg	3,492	4,022	7,860	8,388	8,388	4.5

22

Results of Energy prices linked to $60

| Cases	Sectors	Unit	2005	2010	2015	2020	2025	25/05
Base	Manufacturing	GWh	20,909	46,325	81,559	131,066	199,296	12%
	Commercials	GWh	2,022	6,168	10,528	17,319	27,550	14%
	Residentials	Gwh	20,173	38,042	59,777	85,629	119,109	9%
	Total	GWh	45,997	97,118	164,975	257,286	381,223	11%
Energy price $60	Manufacturing	GWh	20,909	46,325	62,077	102,202	157,762	11%
	Commercials	GWh	2,022	6,168	8,869	14,827	23,824	13%
	Residentials	Gwh	20,173	38,042	55,120	79,592	111,267	9%
	Total	GWh	45,997	97,118	139,025	219,622	327,658	10%
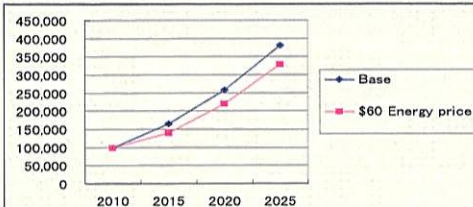
23

Changing Daily Load Curve

(1) Peak shift from night to daytime

Peak demand in Vietnam is going in the middle way from night time to the daytime.

Summer   Winter
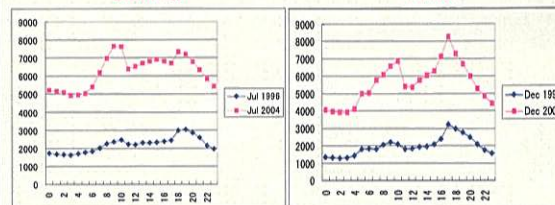
24

(2) DLC of neighbor countries

Vietnam DLC in future might be estimated with referring neighbor countries such as Thailand and Malaysia.

Legend:
- Thailand Mar 1993
- Malaysia Mar 1997
- Indonesia Mar 1997
- Vietnam Mar 2004

25

Daily load curve forecast model

① Collect "Dispatched data" from 1996 to 2004,

② Collect explanation variables（POP, GDP, Temperature , Humidity, Electrification HH),

③ Classify DLC data(Peak, Weekday, Holiday),

④ Make forecasting equations by regression analysis ,

⑤ Adjust DLC by annual power demand from PDF model,

⑥ Estimate load factor by regression analysis,

⑦ Calculate Peak demand.

26

Results of DLC Forecasts

(1) Peak time change

The peak demand in day time becomes higher than in night time year by year.
After 2010, daytime power demand between 14:00 – 16:00 will increase.
Vietnam may approach a developed country type, which indicates two and three peaks on both sides of the noon.
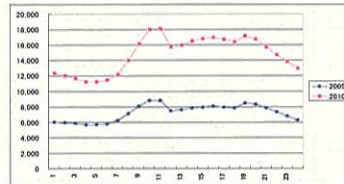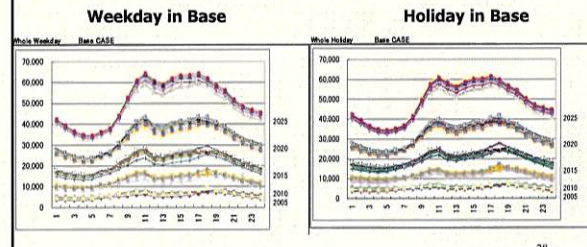

Peak Demand in July, 2005 and 2010 (Base case, :MW)

Legend: 2005, 2010

27

---

(2) Load curve shapes by type(Weekday and Holiday)

Future load curves of weekday and holiday will change.
The demand levels are different, but the load curve shapes are the almost same.

Weekday in Base   **Holiday in Base**

28

---

(3) Comparison of peak demand (Base case)

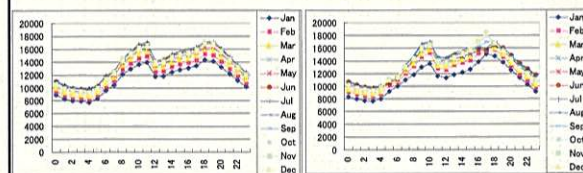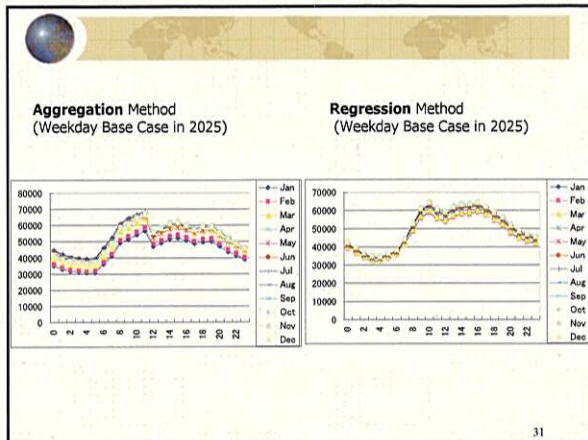|	Plan	Unit	2005	2010	2015	2020	2025
Peak demand	PDP6th	MW	9,859	19,998	32,354	48,298	71,153
	PDP5th	MW	7,797	12,003	18,197	27,204	
	R-PDP5th	MW	9,199	15,256	22,575	31,432	
Growth rate	PDP6th	%	18.7	15.2	10.1	8.3	8.1
	PDP5th	%	10.1	9.0	8.7	8.4	
	R-PDP5th	%	12.0	10.6	8.2	6.8	
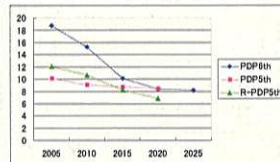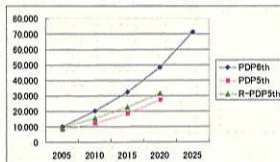
29

DLC forecasting by other methodology

（1) Comparison of DLC forecasting

Aggregation Method
(Weekday Base Case in 2010)

Regression Method
(Weekday Base Case in 2010)

30

5

Aggregation Method
(Weekday Base Case in 2025)

Regression Method
(Weekday Base Case in 2025)

31

	Aggregation	Regression
2005	18:00 Nov 9,512MW	17:00 Nov 9,859 MW
2010	18:00 Nov 19,533MW	17:00 Nov 19,937 M W
2015	11:00 Nov 32,196MW	17:00 Nov 32,255 MW
2020	10:00 Oct 48,972MW	17:00 Nov 48,215 MW
2025	11:00 Nov 71,416MW	14:00 Oct 71,176 MW

32

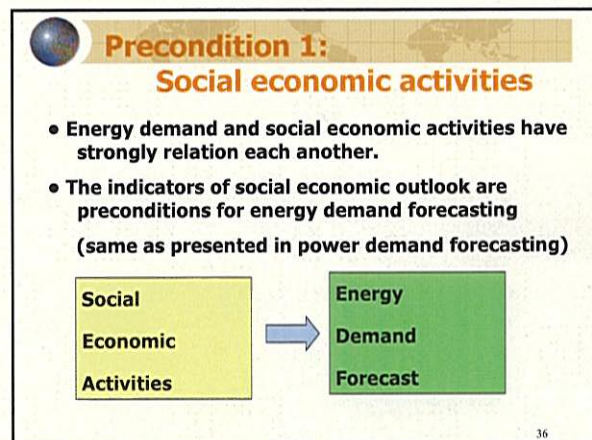## End of Session

Thank you for your attention!

33

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

Primary Energy

December 2005

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Co., Inc. (TEPCO)
Tokyo Electric Power Service Co., Ltd. (TEPSCO)

Contents

1. **Energy Supply-Demand Balance (High case)**

2. **Fuel Prices for Power Generation**

35

Precondition 1:
Social economic activities

- Energy demand and social economic activities have strongly relation each another.
- The indicators of social economic outlook are preconditions for energy demand forecasting

(same as presented in power demand forecasting)

Social Economic Activities	→	Energy Demand Forecast

36

Precondition 2: Power resources consistence

Type	Cap.	2005	2010	2015	2020	2025
Hydro	MW	4,189	9,788	15,167	17,619	19,619
Nuclear.	MW	0	0	0	3,000	8,000
Trade	MW	170	760	1,637	3,544	3,544
Coal	MW	1,547	6,443	8,838	20,838	38,838
Gas	MW	4,251	6,951	12,591	14,751	15,471
Oil	MW	1,113	1,140	664	664	664
Total	MW	11,269	25,082	38,897	59,816	86,136

37

Precondition 3:

Power consumption

Case	2005	2010	2015	2020	2025
Base (Growth rate)	45,682	97,111 (16.3%)	164,960 (11.2%)	257,260 (9.3%)	381,160 (8.2%)
High (Growth rate)	45,682	101,148 (17.2%)	172,355 (11.2%)	267,561 (9.2%)	398,554 (8.3%)

Electricity generation energy

Case	2005	2010	2015	2020	2025
Base (Growth rate)	53,818	112,937 (15.9%)	189,228 (10.8%)	293,024 (9.1%)	433,486 (8.1%)
High (Growth rate)	53,818	117,632 (16.0%)	197,717 (10.8%)	304,757 (9.1%)	453,268 (8.2%)

38

Primary energy supply by Energy type (kTOE)
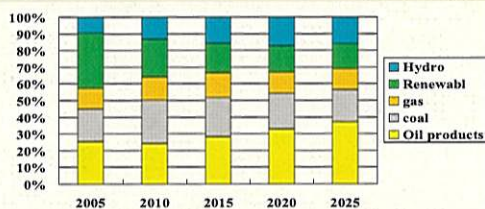
	2005	2010	2015	2020	2025
Fossil fuel	25,596	42,692	60,150	75,353	82,773
Renewable	14,779	15,134	15,985	18,121	18,087
Hydro	4,292	8,856	14,088	19,320	19,320

39

Primary energy demand High case (kTOE)
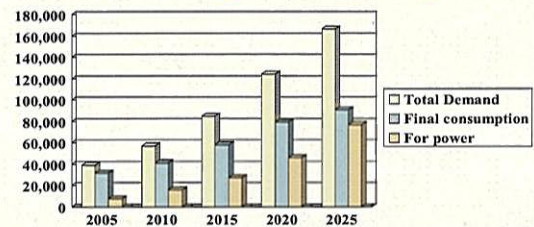
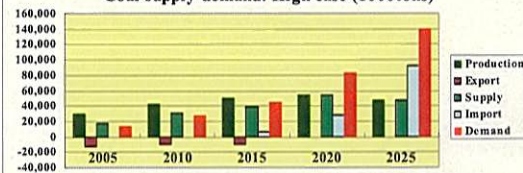|	2005	2010	2015	2020	2025
Total Demand	39,068.50	57,094.50	84,889.50	124,174.20	166,464.90
Final consumption	31,751	41,267	58,157	79,185	91,026
For power	7,317.50	15,827.50	27,323.42	46,030.18	76,881.00

40

Primary energy supply-demand High case (kTOE)
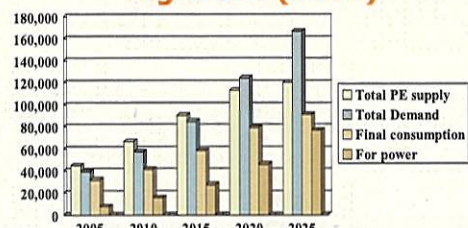
	2005	2010	2015	2020	2025
Total PE supply	44,666	66,682	90,223	112,794	120,180
Total Demand	39,069	57,095	84,890	124,174	166,465
Final consumption	31,751	41,267	58,157	79,185	91,026
For power	7,318	15,828	27,323	46,030	76,881

41

Balance of coal supply-demand

Coal supply-demand: High case (1000tons)

	2005	2010	2015	2020	2025
Production	29,664	41,367	49,266	54,385	47,587
Export	-13,082	-10,500	-10,500	0	0
Supply	16,582	30,867	38,766	54,385	47,587
Import	0	0	5,641	27,965	91,405
Demand	13,579	27,214	44,407	82,350	138,992

42