THE ELECTRIC POWER SECTOR INFORMATION INVESTIGATION FOR DEVELOPING COUNTRIES

FINAL REPORT

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Japan International Cooperation Agency

Tokyo Electric Power Services Company, Ltd.

CONTENTS

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Abbreviation List

Abbreviation	English
ADB	Asian Development Bank
APEC	Asia-Pacific Economic Cooperation
BOG	Bank of Ghana
BOT	Bank of Tanzania
BTU	British Thermal Unit
CBN	Central Bank of Nigeria
CBU	The Central Bank of the Republic of Uzbekistan
CEB	Ceylon Electricity Board
CEMIG	Companhia Energetica de Minas Gerais
DEWA	Dubai Electricity and Water Authority
ECB	Europian Central Bank
EEH	Egyptian Electricity Holding Company
EDC	Electircite du Cambodge
EDF	Electricite du France
EDL	Electricite du Laos
EGAT	Electricity Generation Authority Thailand
EIA	U.S. Energy Information Administration
ENDESA	Endsa,S.A.
ENEL	Enel SpA
ERA	Electricity Regulatory Authority
ESCOM	Electricity Supply Copporation of Malawi
ESE	Electricity Supply Enterprise
EUAS	Elektrik Uretim A.S
EVN	Electricity of Vietnam
FEA	Fiji Electricity Authority
FEPC	The Federation of Electric Power Companies of Janpan
G	Giga
GDP	Gross Domestic Product
GNI	Gross National Income
GVA	Giga Volt Ampere
GW	Giga Watt
GWh	Giga Watt Hour
HP	Home Page
IEA	International Energy Agency
IMF	International Monetary Fund
J	Joule
JEPIC	Japan Electric Power Information Center
JICA	Japan International Cooperation Agency
k	Kilo
KEPCO	Korea Electric Power Corporation
KESC	Karachi Electric Supply Company
ktoe	Kilo Ton Oil Equivalent
KUA	Kosrae Utilities Authority
KP	Kenya Power Company
kVA	Kilo Volt Ampere
kW	Kilo Watt
kWh	Kilo Watt Hour

M	Mega
MEC	Marshalls Energy Company
METI	Ministry of Economy, Trade and Industry
MIC	Ministry of Internal Affairs and Communications
MJ	Mega Joule
MOFA	Ministry of Foreign Affairs
MPEMR	Ministry of Power, Energy and Mineral Resources
MVA	Mega Volt Ampere
MW	Mega Watt
MWh	Mega Watt Hour
N/A	Not Available
NBE	National Bank of Ethiopia
NBR	National Bank of Rwanda
NEA	
NEPCO	National Electric Power Company
OECD	Organization for Economic Co-operation and Development
OGK-1	The First Generation Company
OLADE	Latin America Energy Organization
P	Point
PT PLN	Perusahaan Umum Listrik Negara (Persero)
SAIDI	System Average Interruption Duration Index
SAIFI	Syetem Average Interruption Frequency Index
SE4ALL	Sustainable Energy for All
PGCB	Power Grid Company of Bangladesh
SAOC	Oman Power and Water Procurement Company
SIEA	Solomon Islands Electricity Authority
SSE	Scottish and Southen Energy
TANESCO	Tanzania Electric Supply Company
toe	Ton Oil Equivalent
TEPCO	Tokyo Electric Power Company
TNB	Tenaga Nasional Berhad
TVA	Tennessee Valley Authority
UEGCL	Uganda Electricity Generation Company
UN	United Nations
URL	Uniform Resource Locator
USAID	Unaited States Agency for International Development
USC	Unaited States Cent
USD	Unaited States Dollar
VA	Volt Ampere
VF	Vatten Fall
VRA	Volta River Authority
W	Watt
WB	World Bank
WEO	World Economic Outlook
Wh	Watt Hour

Equivalent Table

Unit	GW	MW	kW	W
1 GW	1	10^3	10^6	10^9
1 MW	10^{-3}	1	10^3	10^6
1 kW	10^{-6}	10^{-3}	1	10^3
1 W	10^{-9}	10^{-6}	10^{-3}	1

Unit	GWh	MWh	kWh	Wh
1 GWh	1	10^3	10^6	10^9
1 MWh	10^{-3}	1	10^3	10^6
1 kWh	10^{-6}	10^{-3}	1	10^3
1 Wh	10^{-9}	10^{-6}	10^{-3}	1

Unit	GVA	MVA	kVA	VA
1 GVA	1	10^3	10^6	10^9
1 MVA	10^{-3}	1	10^3	10^6
1 kVA	10^{-6}	10^{-3}	1	10^3
1 VA	10^{-9}	10^{-6}	10^{-3}	1

Equivalent	kWh	MJ	toe	BTU
1 kWh	1	3.60	0.0000860	0.00341
1 MJ	0.28	1	0.0000239	0.00095
1 toe	0.01163	41,870	1	39.68
1 M BTU	0.000293	1,060	0.02520	1

Subsidiary Unit	Value	Remarks
G	10^9	
M	10^6	
k	10^3	

1. Investigation Summay

1.1 Investigation Background

Issues of electric power sector in developing countries are increasing diversification and complexity. JICA is engaging in resolving issues of power sector of developing countries with many experiences and knowledges for developing countries.

JICA issued the guidelines on energy sector in May 2013, which is introducing to mean energy development using 5 keys (Figure 1.1.1, Improvement of Related Policy, Improvement of Energy Access, Development Electric Power Station for Toward Targeting Low Carbon Society, Efficient Electricity Transportation and Energy Saving), toward targeting Low Cost, Low Carbon and Low Risk, important developing priorities for achieving sustainable development of developing countries.

For promoting cooperation of power sector of developing countries, this is shown in Figure 1.1.2. At first, the power sector information of developing country is investigated and studied. Secondly, grasping the actual conditions of power sector of developing country, and studying extraction of power sector's issues. Thirdly, planning power sector development policy of developing country and then directionally on the cooperation of Japanese Government.

This time, JICA developed the Electric Power Sector Diagnostic Assistance Tool, the Electric Power Information Database of 50 countries which consist of JICA's Power Sector Prioritized Countires (24 countries) and Reference Countires (26 countries).

This Electric Power Sector Diagnostic Assistance Tool consists of 6 Diagnostic Objects (Energy Access, Low Cost, Low Carbon, Low Risk, Efficiency and Financial Soundness).

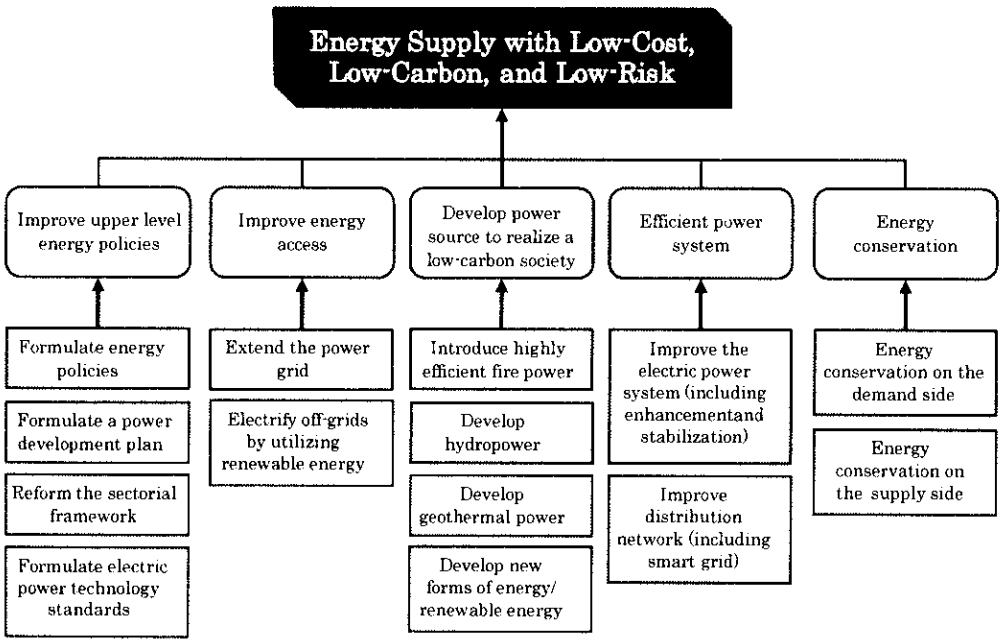


Figure 1.1.1 Issued System of JICA's Energy Sector

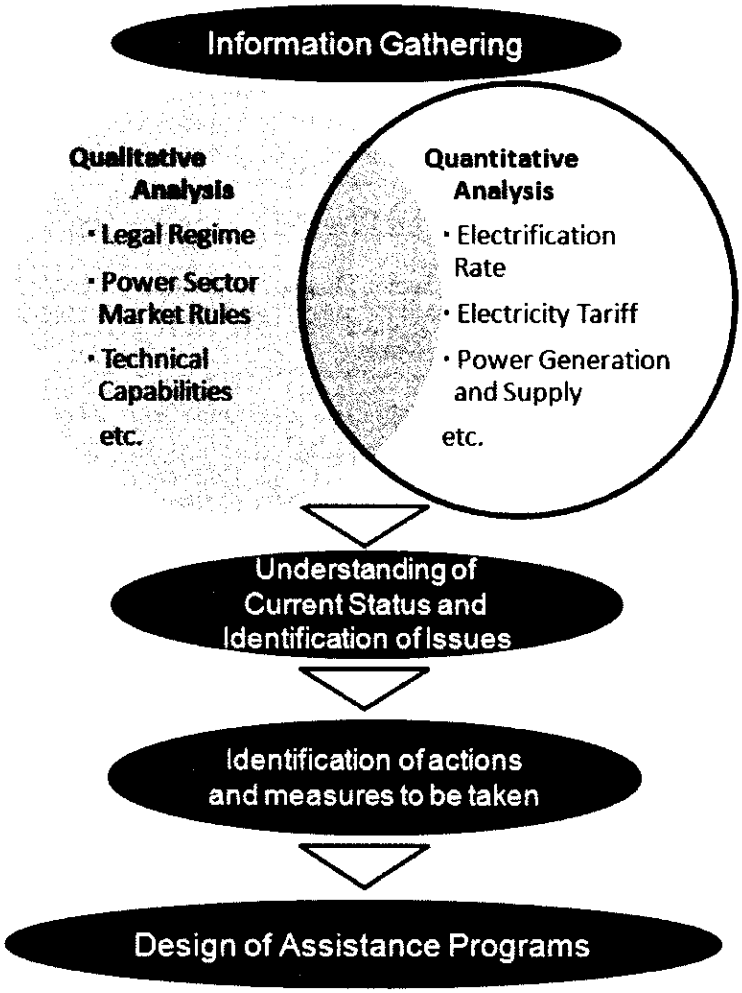


Figure 1.1.2 Functions of the Electric Power Sector Diagnostic Assistance Tool
(This Investigation Scope is within the Red Circle Area)

1.2 Investigation Purpose

This investigation purpose was developed by the Electric Power Sector Daignostic Assistance Tool, the Electric Power Information Database studied against 24 countries (JICA's Power Sector Important developing countries) by the Electric Power Sector Diagnostic Assistance Tool and studied against 50 countires (JICA's Power Sector Prioritized Countires and Reference Countires) by cross country analysis.

2. The Electric Power Sector Diagnostic Assistance Tool

In the investigation of electric power sector information for developing countries, the Electric Power Sector Diagnostic Asssistance Tool was developed, the Electric Power Information Database studied against 50 countries, the Electric Power Sector Diagnostic Assistance Tool studied against 24 countries, while 50 countries are cross country analysis.

2.1 Constitution of the Electric Power Sector Diagnostic Assistance Tool

In the development of the Electric Power Sector Diagnostic Assistance Tool, 2 structures were made. One is indicated for Basic Datas (Country Basic Datas and Electric Power Basic Datas). Another is indicated for Diagnostic Objects Datas.

Constitution of the Electric Power Sector Diagnostic Assistance Tool are shown in Table 2.1.1 (Basic Data) and Table 2.1.2 (Diagnostic Objects Data).

Table 2.1.1 Structure of the Electric Power Sector Diagnostic Assistance Tool (Basic Data)

Item			Contents	Remarks
A.Basic Data	1.Country Basic Data		Population (10^3 Capita)	
			Country Area (km^2)	
			Population Density (Capita/km^2)	
			Capital City	
			Nation	
			Language	
			Currency Unit	
			Geographical Situation	
			GDP (Local Currency)	
			Exchange Rate (Local Currency)	
	2.Electric Power Basic Data	(a)Generation Facilities	Electric Power Capacity (MW)	
			Electric Power Capacity Ratio (%)	
			Electric Power Generation (GWh)	
			Electric Power Generation Ratio (%)	
		(b)Transmission Facilities	Transmission Line Length (km)	
		(c)Substation Facilities	Substation Capacity (MWA)	
		(d)Distribution Facilities	Distribution Line Length (km)	
		(e)Energy Balance	Energy Balance	

Table 2.1.2 Structure of the Electric Power Sector Diagnostic Assistance Tool (Diagnostic Objects Data)

Item		Evaluation Objects			Calculating Formulas
B.Diagnostic Objects Data	1.Energy Access	Electric Power Generation per Capita(kWh/capita)			=Electric Power Generation(GWh)*10^3(kWh/GWh) /Population(capita)
		Electric Power Consumption per Capita(kWh/capita)			=Electric Power Consumption(GWh)*10^3(kWh/GWh) /Population(capita)
		Electric Power Shift(%)			=Electric Power Cunsumption(MJ) /Primary Energy Cunsumption(MJ)*100
		Electrification Ratio(%)			"Input Electrification Ratio data"
	2.Low Cost	Electric Power Supply Cost(million Local Currency)			
		Electric Power Sale Income(million Local Currency)			
		Cost Price Rate(%)			
	3.Low Carbon	Carbon Diocide Emission Unit(g-CO2/kWh)			
		Renewable Energy Power Generation Ratio(%)			
	4.Low Risk	Electiricity Self-Sufficiency Ratio(%)			
		SAIDI			"Input SAIDI data"
		SAIFI			"Input SAIFI data"
	5.Efficiency	Electric Power Generation per GDP(kWh/USD)			
		Electric Power Consumption per GDP(kWh/USD)			
		Electric Power Loss Ratio(%)			
	6.Financial Soundness	a.Electric Power Organization	(1)Fnancial Basic Data	Balance Sheet (Local Currency)	"Input Current Assets, Fixed Assets, Current Liability, Owned Capital, Total Capital and Total Assets"
				Profit Loss Statement (Local Currency)	"Input Sales and Net Income"
			(2)Profitability	Return on Assets	=Net Income(USD)/Total Assets(USD)
				Return on Equity	=Net Income(USD)/Owned Capital(USD)
				Return on Turnover	=Net Income(USD)/Sales(USD)
				Total Assets Turnover	=Sales(USD)/Total Capital(USD)
				Finacing Leverage	=Total capital(USD)/Owned Capital(USD)
			(3)Stability	Current Rate	=Current Assets(USD)/Current Liability(USD)
				Capital Adequacy Ratio	=Owned Capital(USD)/Total Capital(USD)
				Fixed Assets Ratio	=FIXed Assets(USD)/Owned Capital(USD)
		b.Country		Burden Rate	=Subsidy for Electric Power Company /Government Revenue

2.2 Input Data of the Electric Power Sector Diagnostic Assistance Tool

Input data of the Electric Power Sector Diagnostic Assistance Tool is shown in Table 2.2.1.

Investigating statictics datas were inputted at yellow cell, and setting datas were inputted at green cell.

Table 2.2.1 Input Data of the Electric Power Sector Diagnostic Assistance Tool

Item					Input Data	Input Division
A.Basic Data	1.Country Basic Data				Population(10^3 Capita)	Investigating Data
					Country Area(km^2)	Investigating Data
					Population Density(Capita/km^2)	Investigating Data
					Capital City	Investigating Data
					Nation	Investigating Data
					Language	Investigating Data
					Currency Unit	Investigating Data
					Geographical Situation	Investigating Data
					GDP(Local Currency)	Investigating Data
					Exchange Rate(Local Currency)	Investigating Data
	2.Electric Power Basic Data	a.Electric Power Generation Fasilities		(1)Electric Power Capacity	Thermal Power, Hydropower, Nuclear Power and Renewabale Power(MW)	Investigating Data
				(2)Electric Power Generation (IEA Data)	Coal Thermal Power, Oil Thermal Power, Gass Thermal Power, Hydropower, Nuclear Power, Biofuel Thermal Power, Waste Thermal Power, Tide Power and other Power Generation(GWh)	Investigating Data
				(2)Electric Power Generation (UN or EIA Data)	Thermal Power, Hydropower, Nuclear Power, and other Power Generation(GWh)	Investigating Data
		b.Transmission Facilities			Transmission Line Length(km)	Investigating Data
		c.Substation Facilirties			Substation Capacity(MVA)	Investigating Data
		d.distribution Facilities			Distribution Line Length(km)	Investigating Data
		e.Energy Balance		Energy Balance (IEA Data)	Electric Power Generation, Electric Power Consumption, Import Electric Power Generation, Export Electric Power Generation, Statistics Difference, Energy Industry Own Use and Electric Power Loss(GWh)	Investigating Data
				Energy Balance (UN Data or EIA Data)	Electric Power Generation, Electric Power Consumption, Import Electric Power Generation, Export Electric Power Generation, Energy Industry Own Use and Electric Power Loss(GWh)	Investigating Data
B.Diagnostic Objects Data	1.Energy Access	Electric Power Shift(%)			Energy Equivalent(MJ/kWh)	Setting Data
					Primary Energy Consumption(ktoe)	Investigating Data
						Setting Data
		Electrification Ratio(%)			Electrification Ratio	Investigating Data
		Coefficient			$\alpha, \beta, \gamma, \delta$	Setting Data
	2.Low Cost	Electric Power Supply Cost(USD/kWh)			Electric Power Supply Cost(millionLocal Currency)	Investigating Data
		Electric Power Sale Income(USD/kWh)			Electric Power Sale Income(millionLocal Currency)	Investigating Data
		Coefficient			α, β, γ	Setting Data
	3.Low Carbon	Carbon Dioxide Emission Unit(g-CO2/kWh)			Carbon Dioxide Emission Unit(g-CO2/kWh)(IEA Data)	Investigating Data
					Carbon Dioxide Emission Unit(g-CO2/kWh) (Substitution Evaluation Index)	Investigating Data
		Coefficient			α, β	Setting Data
	4.Low Risk	SAIDI(houre/household)			SAIDI(houre/household)	Investigating Data
		SAIFI(time/household)			SAIFI(time/household)	Investigating Data
		Coefficient			α, β, γ	Setting Data
	5.Efficiency	Coefficient			α, β, γ	Setting Data
	6.Financial Soundness	a.Electric Power Organization	(1)Financial Basic Data	Balance Sheet (Local Currency)	Current Assets, Fixed Assets, Current Liability, Owned Capital, Total Capital and Total Assets	Investigating Data
				Profit Loss Statement (Local Currency)	Sales and Net Income	Investigating Data
			(2)Profitability	Coefficient	$\alpha 11, \alpha 12, \alpha 13, \alpha 14, \alpha 15$	Setting Data
			(3)Stability	Coefficient	$\alpha 21, \alpha 22, \alpha 23$	Setting Data
			(4)Coefficient		$\alpha 1, \alpha 2$	Setting Data
		b.Country		Burden Rate(%)	Government Income(Local Currency)	Investigating Data
					Electric Power Company Subsidy(Local Currency)	Investigating Data
					$\beta 1$	Setting Data
		Coefficient			α, β	Setting Data

3. The Electric Power Information Database

3.1 Target Countries of the Electric Power Information Database

In the study of the Electric Power Information Database, statistics data of 50 countries were investigated, including 24 countries (JICA's Power Sector Prioritized Countires) and 26 countries (Reference Countires).

In the organization of investigating data, data of International Organization, Target Country's Government Organization (for example, Government Statistics Department), and Target Country's Electric Power Company were investigated.

In the procedure of investigating data, at first, International Organization data was investigated, secondly, Target Country's Government, and thirdly, Target Country's Electric Power Company.

In the document of investigating data, documents of IEA-HP, WB-HP, IMF-HP, UN-HP and MOFA-HP were investigated, and JEPIC's documents, becase it was secured for data acquisition easiness, reliability and continuity.

Target countries of the Electric Power Information Database is shown in Table 3.1.1.

Table 3.1.1 JICA's Power Sectur Prioritized Counties and Reference Countitres

Item			Asian Area		African Area		Other's Area		Developed Countries		Subtotal
			Country Name	Number	Country Name	Number	Country Name	Number	Country Name	Number	
GDP /Capita	More Than 20,000	JICA'S Power Sector Important Countries	—	0	—	0	—	0	—	0	0
		JICA'S Reference Countries	Korea	1	[illegible]	2	—	0	Japan USA France Germany UK Spain Italy	7	10
		Subtotal	—	1	—	2	—	0	—	7	10
	Less Than 20,000 More Than 2,000	JICA'S Power Sector Important Countries	Indonesia Sri Lanka Mongolia	3	Nigeria	1	Fiji Marshall islands Micronesia Jordan Peru Bolivia	6	—	0	10
		JICA'S Reference Countries	Iran Turkey Malaysia [illegible]	4	[illegible]	2	Brazil Russia	2	—	0	10
		Subtotal	—	9	—	3	—	8	—	0	20
	Less Than 2,000	JICA'S Power Sector Important Countries	Viet Nam LOA PDR Cambodia Myanma India Pakistan Bangladesh Uzbekistan	8	Etiopia Kenya Tanzania Uganda Malawi	5	Solomon Islands	1	—	0	14
		JICA'S Reference Countries	Nepal	1	Ghana Sierra Leone Ruwanda Zambia Mozambique	5	—	0	—	0	6
		Subtotal	—	9	—	10	—	1	—	0	20
Total			—	19	—	15	—	9	—	7	50

3.2 An Example of the Electric Power Information Database

In case of input data by the Electric Power Information Database, statistics datas were Investigated at yellow cell, and setting datas were investigsted at green cell (For example, Equivalent Value). Datas of blue, orange and pink cell are calculated using data of yellow and green cell.

The Electric Power Information Database is shown in Supporting Document.

An example of the Electric Power Information Database is shown in Table 3.2.1.

Table 3.2.1 An Example of the Electric Power Information Database (a portion of the Electric Power Information Database)

						A. Basic Data											
						A1 Primary Basic Data											
						Investigating Data	Investigating Data	Calculating Data	Investigating Data	Investigating Data	Investigating Data	Investigating Data	Investigating Data	Investigating Data	Investigating Data	Investigating Data	Calculating Data
						A101	A102	A103	A104	A105	A106	A107	A108	B101	B102	B103	
						Population	Country Area	Population Density	Capital City	Nation	Language	Currency Unit	Geographical situation	GDP (Local Currency)	Exchange Rate	GDP (USD)	
						10^6Capita	km^2	人/km^2						million Local Currency	Local Currency /USD	million USD	
								=A101×10^3 /A102								=B101 /B102	
						A-1 B-3-ab	A-1							B-1	B-3-ab B-3-c-(1)-(a) B-3-c-(1)	B-4-ab B-4-aa	
1	1	Republic of Indonesia	Important Country	East-South Asia	1995	194,110	1,890,000	102.7	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	454,514,199	2,248.61	202,131	
2	2	Republic of Indonesia	Important Country	East-South Asia	1996	197,100	1,890,000	104.3	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	532,587,992	2,342.30	227,370	
3	3	Republic of Indonesia	Important Country	East-South Asia	1997	200,000	1,890,000	105.8	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	627,695,277	2,909.38	215,749	
4	4	Republic of Indonesia	Important Country	East-South Asia	1998	202,900	1,890,000	107.4	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	955,753,902	10,013.82	95,445	
5	5	Republic of Indonesia	Important Country	East-South Asia	1999	205,850	1,890,000	108.9	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	1,099,731,911	7,855.15	140,001	
6	6	Republic of Indonesia	Important Country	East-South Asia	2000	208,940	1,890,000	110.6	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	1,389,799,900	8,421.76	165,021	
7	7	Republic of Indonesia	Important Country	East-South Asia	2001	211,970	1,890,000	112.2	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	1,648,322,000	10,260.86	160,647	
8	8	Republic of Indonesia	Important Country	East-South Asia	2002	215,040	1,890,000	113.8	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	1,821,833,400	9,311.18	195,661	
9	9	Republic of Indonesia	Important Country	East-South Asia	2003	218,158	1,890,000	115.4	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	2,013,674,560	8,577.13	234,773	
10	10	Republic of Indonesia	Important Country	East-South Asia	2004	221,290	1,890,000	117.1	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	2,295,329,274	9,038.85	254,037	
11	11	Republic of Indonesia	Important Country	East-South Asia	2005	224,400	1,890,000	118.8	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	2,774,251,100	9,704.74	285,868	
12	12	Republic of Indonesia	Important Country	East-South Asia	2006	227,710	1,890,000	120.5	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	3,339,218,800	9,159.32	364,570	
13	13	Republic of Indonesia	Important Country	East-South Asia	2007	230,970	1,890,000	122.2	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	3,959,693,250	9,141.90	432,917	
14	14	Republic of Indonesia	Important Country	East-South Asia	2008	234,240	1,890,000	123.9	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	4,948,988,357	9,698.96	510,229	
15	15	Republic of Indonesia	Important Country	East-South Asia	2009	237,500	1,890,000	125.7	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	5,908,260,300	10,389.94	568,580	
16	16	Republic of Indonesia	Important Country	East-South Asia	2010	240,600	1,890,000	127.3	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	6,446,057,900	9,090.43	709,191	
17	17	Republic of Indonesia	Important Country	East-South Asia	2011	243,800	1,890,000	129.0	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	7,419,147,100	8,770.43	845,932	
18	18	Republic of Indonesia	Important Country	East-South Asia	2012	246,900	1,890,000	130.6	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	8,229,429,400	9,386.83	876,719	
19	19	Republic of Indonesia	Important Country	East-South Asia	2013	N/A	1,890,000	N/A	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	9,083,972,273	10,461.24	868,248	
20	20	Republic of Indonesia	Important Country	East-South Asia	2014	N/A	1,890,000	N/A	Jakarta	Many Malay Peoples and 300 peoples	Indonesia Language	Rupiah	Island country	N/A	11,865.21	N/A	

4. Results of the Study by the Electric Power Sector Diagnostic Assistance Tool

4.1 Target Countries of the Study by the Electric Power Sector Diagnostic Assistance Tool

Target countries of the study by the Electric Power Sector Diagnostic Assistance Tool is shown in Table 3.1.1.

Indonesia's results of the study are shown in the following. And results of the study of other 23 countries are shown in the Surpporting Documents.

4.2 Indonesia's Results of the Study

Indonesia's results of the study by the Electric Power Sector Diagnostic Tool are shown in Table 4.2.1 - Table 4.2.21, and Figure 4.2.1 - Figure 4.2.29.

Table 4.2.1 Country Basic Datas in Indonesia

Item				Contents	Remarks
Population (10^3 People)	a		*1	246,860	・2012 year data
Country Area (km^2)	b		*2	1,890,000	
Population Density (People/km^2)		=a*10^3/b		130.6	
Capital City			*2	Jakarta	
Nation			*2	Many Malay peoples and 300 peoples (For example, Java and Sunda peoples)	
Language			*2	Indonesia language	
Currency Unit			*2	Rupiah	
Geographical Situation				Island country	

*1 Sorce:IEA-HP(Search Statistics by Country)
*2 Sorce:MOFA(Country/Region)

Table4.2.2 Population, Country Area and Population Density in Indonesia

Year	Population	Country Area	Population Ratio	Population Density	Remarks
	10^3 People	km^2	%	People/km^2	
	a	b		=a*10^3/b	
	*1	*2	*3		
1995	194,110	1,890,000		102.7	
1996	197,100	1,890,000	1.54	104.3	
1997	200,050	1,890,000	1.50	105.8	
1998	202,990	1,890,000	1.47	107.4	
1999	205,950	1,890,000	1.46	109.0	
2000	208,940	1,890,000	1.45	110.6	
2001	211,970	1,890,000	1.45	112.2	
2002	215,040	1,890,000	1.45	113.8	
2003	218,150	1,890,000	1.45	115.4	
2004	221,290	1,890,000	1.44	117.1	
2005	224,480	1,890,000	1.44	118.8	
2006	227,710	1,890,000	1.44	120.5	
2007	230,970	1,890,000	1.43	122.2	
2008	234,240	1,890,000	1.42	123.9	
2009	237,490	1,890,000	1.39	125.7	
2010	240,680	1,890,000	1.34	127.3	
2011	243,800	1,890,000	1.30	129.0	
2012	246,860	1,890,000	1.26	130.6	
2013					
2014					

* Blank : N/A
*1 Source : IEA-HP (Search statistics by country)
*2 Source : MOFA-HP (Country/Region)
*3 "Population Ratio" = ("This Year Population" − "Last Year Population") / "This Year Population" × 100

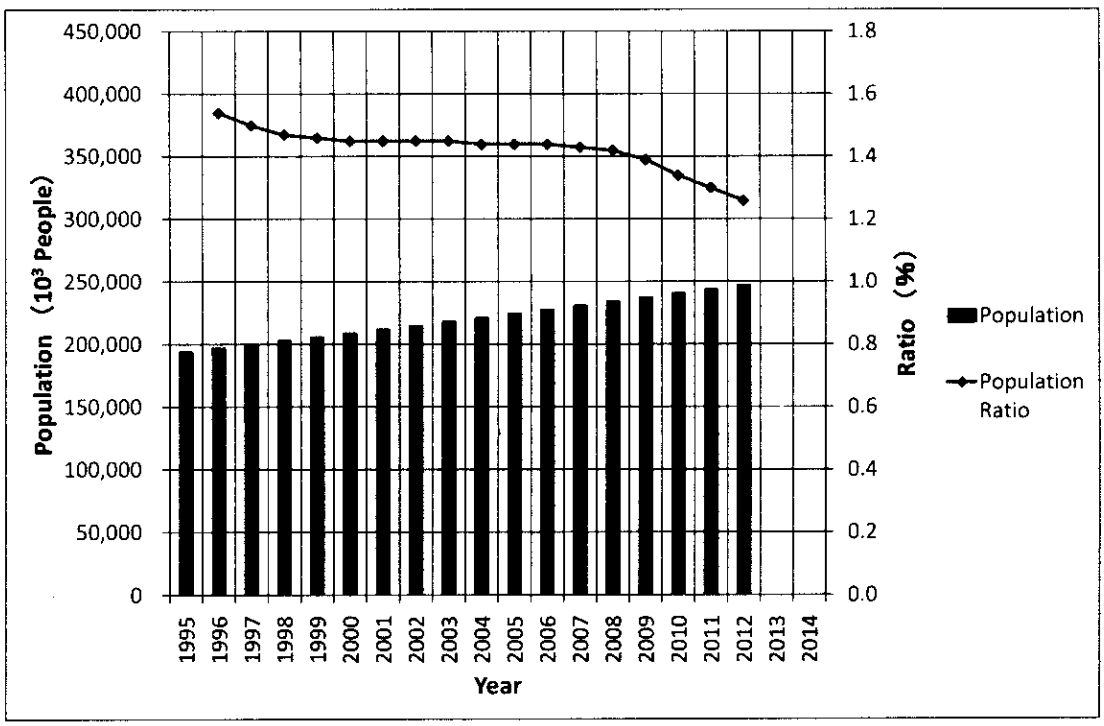


Figure 4.2.1 Change of Population in Indonesia

Table 4.2.3 GDP and Exchange Rate in Indonesia

Year	GDP	Exchange Rate	GDP	GDP Ratio	Ratio of Exchange Rate	Remarks
	million Local Currency	Local Currency /USD	million USD	%	%	
	a	b				
			=a/b			
	*1	*1	*2		*2	
1995	454,514,109	2,248.61	202,131			
1996	532,567,992	2,342.30	227,370	12.5	4.2	
1997	627,695,377	2,909.38	215,749	-5.1	24.2	
1998	955,753,502	10,013.62	95,445	-55.8	244.2	
1999	1,099,731,611	7,855.15	140,001	46.7	-21.6	
2000	1,389,769,900	8,421.78	165,021	17.9	7.2	
2001	1,646,322,000	10,260.85	160,447	-2.8	21.8	
2002	1,821,833,400	9,311.19	195,661	21.9	-9.3	
2003	2,013,674,560	8,577.13	234,773	20.0	-7.9	
2004	2,295,826,274	8,938.85	256,837	9.4	4.2	
2005	2,774,281,100	9,704.74	285,869	11.3	8.6	
2006	3,339,216,800	9,159.32	364,570	27.5	-5.6	
2007	3,950,893,200	9,141.00	432,217	18.6	-0.2	
2008	4,948,688,397	9,698.96	510,229	18.0	6.1	
2009	5,606,203,366	10,389.94	539,580	5.8	7.1	
2010	6,446,851,900	9,090.43	709,191	31.4	-12.5	
2011	7,419,187,100	8,770.43	845,932	19.3	-3.5	
2012	8,229,439,400	9,386.63	876,719	3.6	7.0	
2013	9,083,972,273	10,461.24	868,346	-1.0	11.4	
2014		11,865.21			13.4	

* Blank : N/A
*1 Source : WB-HP (Data)
*2 Ratio = ("This Year Value" − "Last Year Value") / "Last Year Value" × 100

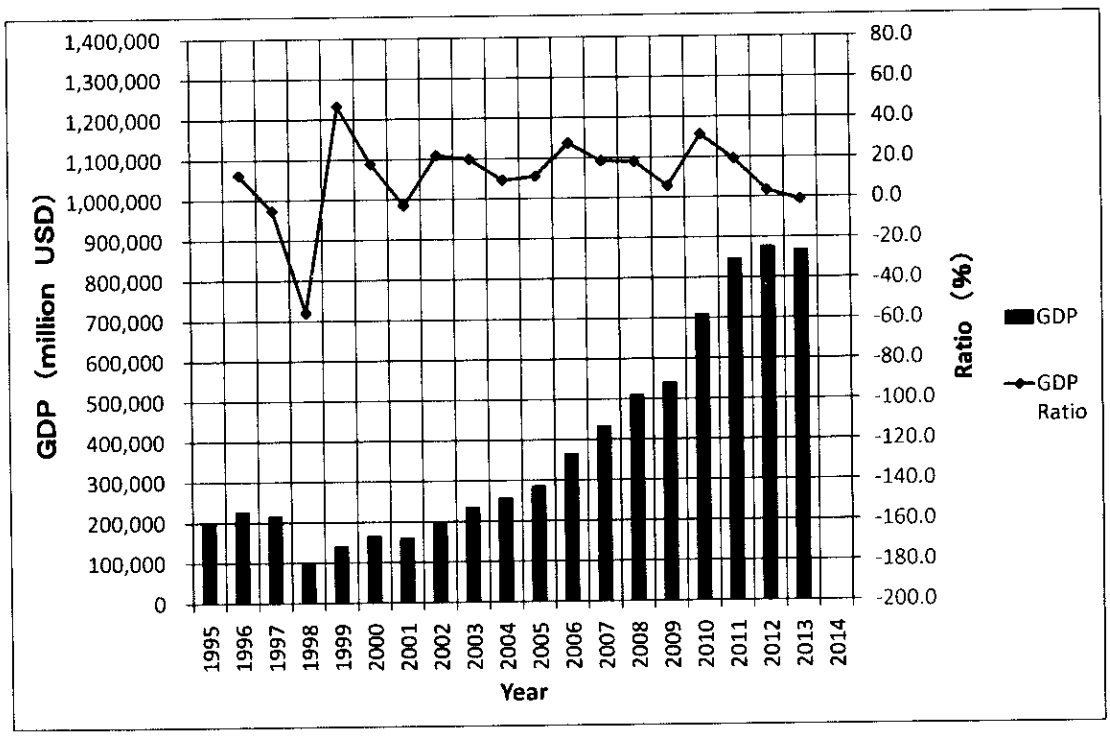


Figure 4.2.2 Change of GDP in Indonesia

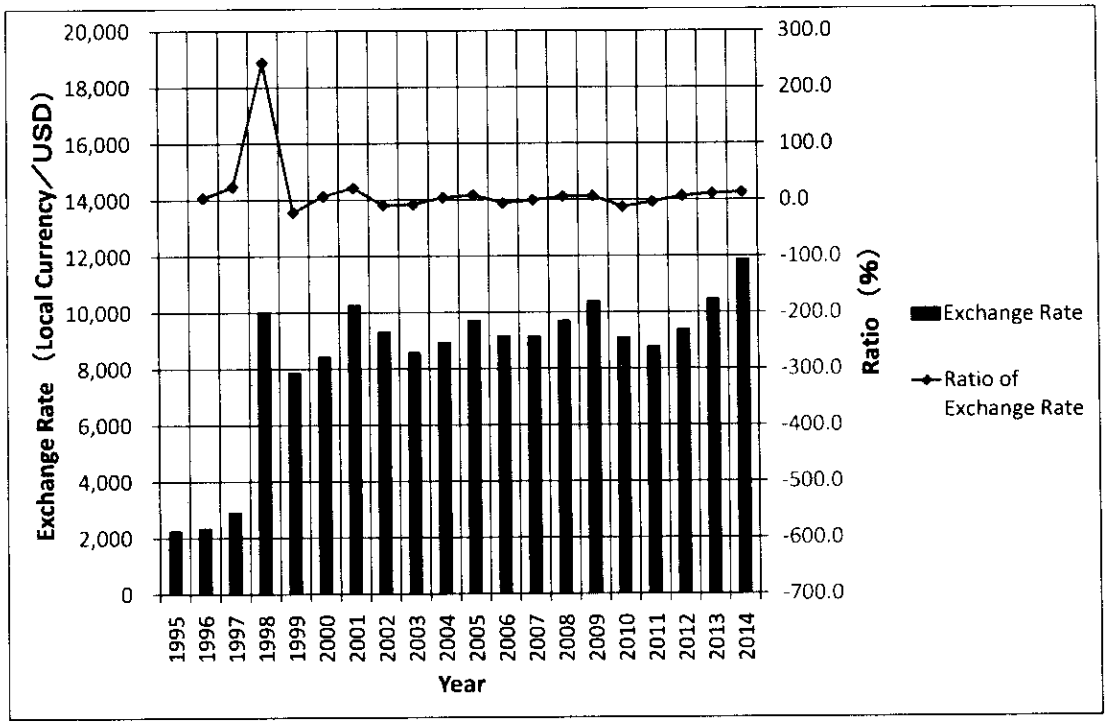


Figure 4.2.3 Change of Exchange Rate in Indonesia

Table 4.2.4 Electric Power Capacity and Ratio in Indonesia

Year	Electric Power Capacity						Electric Power Capacity Ratio				
	Thermal Power	Hydropower	Nuclear Power	Renewable Energy (Except Hydropower)	Total	Total Ratio	Thermal Power	Hydropower	Nuclear Power	Renewable Energy (Except Hydropower)	Total
	MW	MW	MW	MW	MW	%	%	%	%	%	%
	a	b	c	d	e		f	g	h	i	
					=Σ (a~d)		=a/e*100	=b/e*100	=c/e*100	=d/e*100	=Σ (f~i)
	*1	*1	*1	*1		*2					
1995	15,496	3,342		308	19,146		80.9	17.5		1.6	100
1996	15,886	3,361		308	19,555	2.1	81.2	17.2		1.6	100
1997	17,400	3,638		305	21,343	9.1	81.5	17.0		1.4	100
1998	20,164	4,344		360	24,868	16.5	81.1	17.5		1.4	100
1999	20,430	4,373		360	25,163	1.2	81.2	17.4		1.4	100
2000	20,652	4,393		360	25,405	1.0	81.3	17.3		1.4	100
2001	20,541	4,383		360	25,284	-0.5	81.2	17.3		1.4	100
2002	20,541	4,383		720	25,644	1.4	80.1	17.1		2.8	100
2003	20,989	4,533		1,000	26,522	3.4	79.1	17.1		3.8	100
2004	21,099	4,570		1,000	26,669	0.6	79.1	17.1		3.7	100
2005	21,266	4,588		1,000	26,854	0.7	79.2	17.1		3.7	100
2006	21,280	4,897		1,000	27,177	1.2	78.3	18.0		3.7	100
2007	21,527	4,869		933	27,329	0.6	78.8	17.8		3.4	100
2008	25,003	5,059		1,052	31,114	13.8	80.4	16.3		3.4	100
2009	26,251	5,063		1,190	32,504	4.5	80.8	15.6		3.7	100
2010	27,972	5,078		1,190	34,240	5.3	81.7	14.8		3.5	100
2011	34,743	3,945		1,211	39,899	16.5	87.1	9.9		3.0	100
2012											
2013											
2014											

* Blank : N/A
*1 Source : JEPIC Document (Overseas Electric Business Statistics)
*2 "Total Ratio" = ("This Year Total" - "Last Year Total") / "This Year Total" × 100

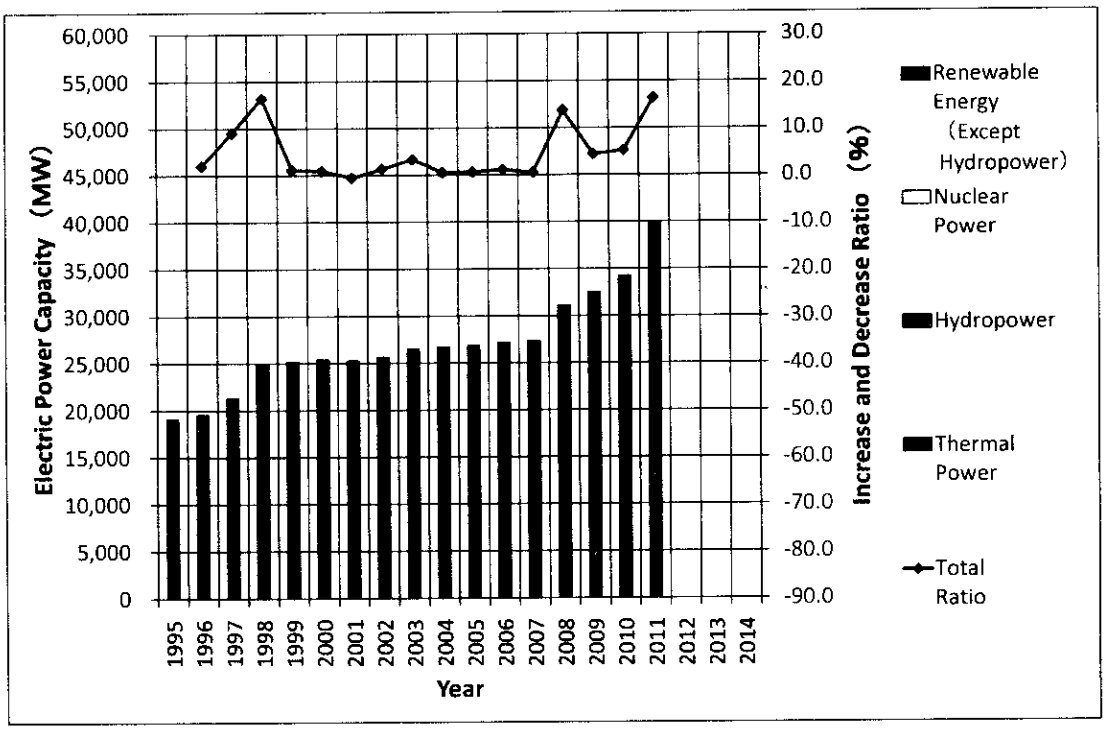


Figure 4.2.4 Change of Electric Power Capacity in Indonesia

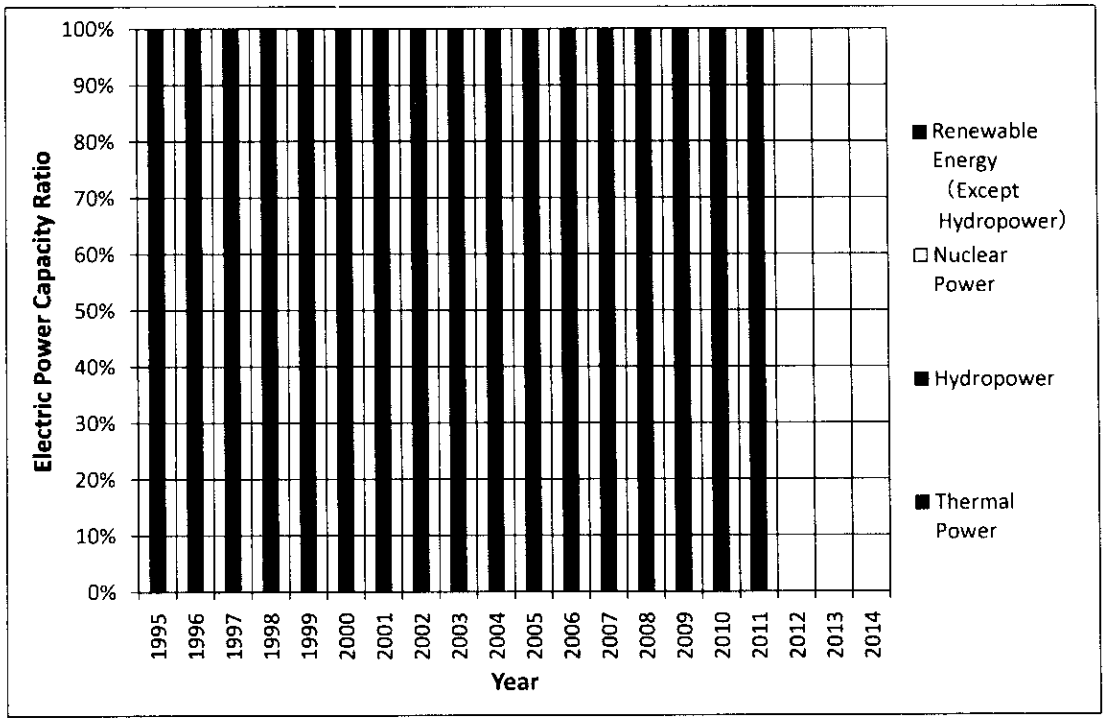


Figure 4.2.5 Change of Electric Power Capacity Ratio in Indonesia

Table 4.2.5 Electric Power Generation in Indonesia

Year	Coal Thermal Power	Oil Thermal Power	Gass Thermal Power	Hydo -power	Nuclear Power	Biofuel Power	Waste Power	Geothermal Power	Solar PV Power	Solar Thermal Power	Wind Power	Tide Power	Others	Total	Total Ratio
	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	GWh	%
	a	b	c	d	e	f	g	h	i	j	k	l	m		
														=Σ(a~m)	
	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1		*2
1995	14,367	9,680	25,401	7,530	0	5	0	2,210	0	0	0	0	0	59,193	
1996	17,038	10,960	29,208	8,161	0	5	0	2,352	0	0	0	0	0	67,724	14.4
1997	20,816	16,142	29,953	5,106	0	5	0	2,605	0	0	0	0	0	74,627	10.2
1998	24,170	14,366	27,199	9,681	0	5	0	2,617	0	0	0	0	0	78,038	4.6
1999	29,365	15,249	29,167	9,401	0	5	0	2,728	0	0	0	0	0	85,915	10.1
2000	34,002	18,342	26,090	10,016	0	6	0	4,869	0	0	0	0	0	93,325	8.6
2001	37,713	19,627	26,220	11,655	0	8	0	6,031	0	0	0	0	0	101,254	8.5
2002	42,929	25,261	23,845	9,933	0	11	0	6,238	0	0	0	0	0	108,217	6.9
2003	46,459	28,190	24,409	9,099	0	15	0	6,294	0	0	0	0	0	114,466	5.8
2004	48,211	35,973	19,629	9,674	0	20	0	6,656	0	0	0	0	0	120,163	5.0
2005	51,793	39,140	19,459	10,725	0	22	0	6,604	0	0	0	0	0	127,743	6.3
2006	58,630	38,717	20,180	9,623	0	32	0	6,658	0	0	0	0	0	133,840	4.8
2007	63,817	37,703	23,612	11,286	0	36	0	7,021	0	0	0	0	0	143,475	7.2
2008	61,392	42,949	26,198	11,528	0	47	0	8,309	0	0	0	0	0	150,423	4.8
2009	65,890	35,358	34,803	11,384	0	63	0	9,295	0	0	4	0	0	156,797	4.2
2010	68,445	34,183	40,247	17,456	0	93	0	9,357	1	0	4	0	0	169,786	8.3
2011	81,000	42,305	38,118	12,419	0	167	30	9,371	1	0	5	0	0	183,416	8.0
2012	95,325	32,672	45,478	12,799	0	144	52	9,417	3	0	5	0	0	195,895	6.8
2013															
2014															

* Blank:N/A
*1 Source:IEA-HP(Search statistics by country)
*2 "Total Ratio"=("This Year Total"-"Last Year Total")/"This Year Total"×100

Table 4.2.6 Electric Power Generation Ratio in Indonesia

Year	Coal Thermal Power	Oil Thermal Power	Gass Thermal Power	Hydo -power	Nuclear Power	Biofuel Power	Waste Power	Geothermal Power	Solar PV Power	Solar Thermal Power	Wind Power	Tide Power	Others	Total	Remarks
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	
	a	b	c	d	e	f	g	h	i	j	k	l	m		
														=Σ(a~m)	
	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1	*1		
1995	24.3	16.4	42.9	12.7	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	100	
1996	25.2	16.2	43.1	12.1	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	100	
1997	27.9	21.6	40.1	6.8	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	100	
1998	31.0	18.4	34.9	12.4	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	100	
1999	34.2	17.7	33.9	10.9	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	100	
2000	36.4	19.7	28.0	10.7	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	100	
2001	37.2	19.4	25.9	11.5	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	100	
2002	39.7	23.3	22.0	9.2	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	100	
2003	40.6	24.6	21.3	7.9	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	100	
2004	40.1	29.9	16.3	8.1	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	100	
2005	40.5	30.6	15.2	8.4	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	100	
2006	43.8	28.9	15.1	7.2	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	100	
2007	44.5	26.3	16.5	7.9	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	100	
2008	40.8	28.6	17.4	7.7	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	100	
2009	42.0	22.6	22.2	7.3	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	100	
2010	40.3	20.1	23.7	10.3	0.0	0.1	0.0	5.5	0.0	0.0	0.0	0.0	0.0	100	
2011	44.2	23.1	20.8	6.8	0.0	0.1	0.0	5.1	0.0	0.0	0.0	0.0	0.0	100	
2012	48.7	16.7	23.2	6.5	0.0	0.1	0.0	4.8	0.0	0.0	0.0	0.0	0.0	100	
2013															
2014															

* Blank:N/A
*1 Value="Power Supply Generation"/"Total Generation"×100

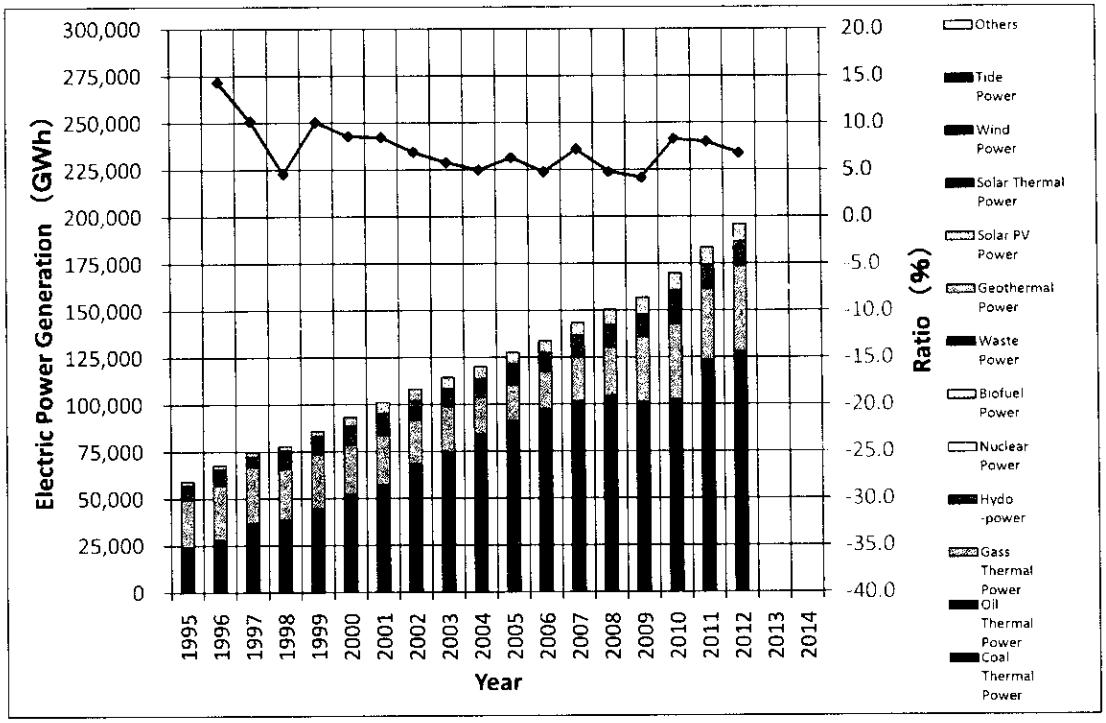


Figure 4.2.6 Change of Electric Power Generation in Indonesia

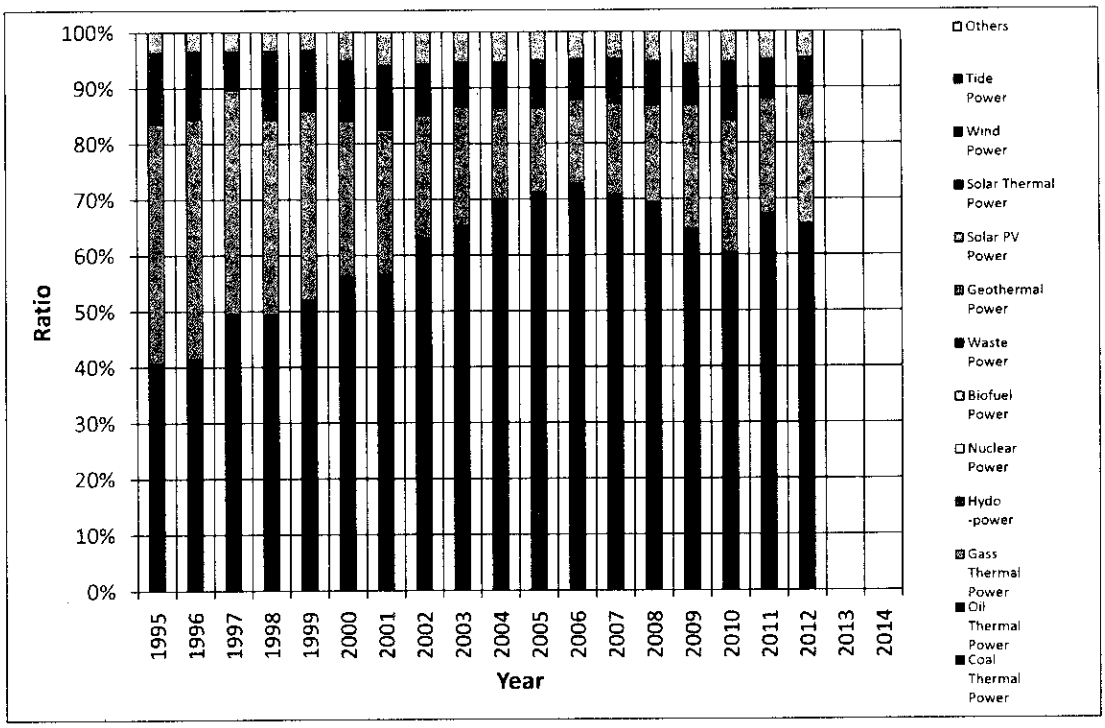


Figure 4.2.7 Change of Electric Power Generation Ratio in Indonesia

Table 4.2.7 Transmission Line Length, Substation Capacity and Distribution Line Length in Indonesia

Year	Transmission Line Length	Substation Capacity	Distribution Line Length	Transmission Line Length Ratio	Substation Capacity Ratio	Distribution Line Length Ratio	Remarks
	km	MVA	km	%	%	%	
	*1	*1	*1	*2	*2	*2	
1995	19,553		325,841				
1996	20,782		374,947	6.3		15.1	
1997	21,690		423,457	4.4		12.9	
1998	23,861		459,344	10.0		8.5	
1999	24,389	46,784	502,532	2.2		9.4	
2000	24,822	49,957	503,751	1.8	6.8	0.2	
2001	25,989	50,485	520,147	4.7	1.1	3.3	
2002	27,570	50,485	535,870	6.1	0.0	3.0	
2003	28,173	55,449	547,217	2.2	9.8	2.1	
2004	30,794	54,128	556,089	9.3	-2.4	1.6	
2005	30,946	53,976	563,838	0.5	-0.3	1.4	
2006	32,917	54,409	573,049	6.4	0.8	1.6	
2007	33,163	54,649	598,498	0.7	0.4	4.4	
2008	34,184	55,989	614,925	3.1	2.5	2.7	
2009	34,949	63,375	639,517	2.2	13.2	4.0	
2010	35,050	65,669	681,762	0.3	3.6	6.6	
2011	36,720	71,615	679,424	4.8	9.1	-0.3	
2012	38,096	77,073	741,957	3.7	7.6	9.2	
2013		81,435			5.7		
2014							

* Blank : N/A
*1 Source : JEPIC Document (Overseas electric Business Statistics)
*2 Ratio = ("This Year Value" − "Last Year Value") / "Last Year Value" × 100

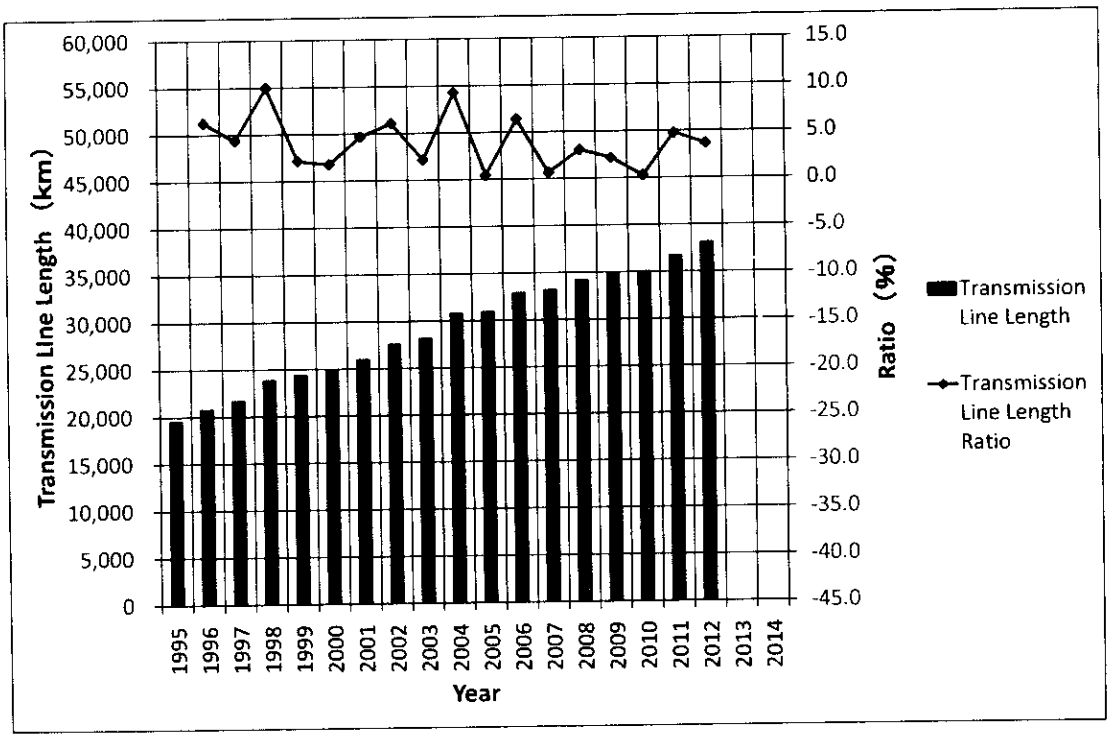


Figure 4.2.8 Change of Transmission Line Length in Indonesia

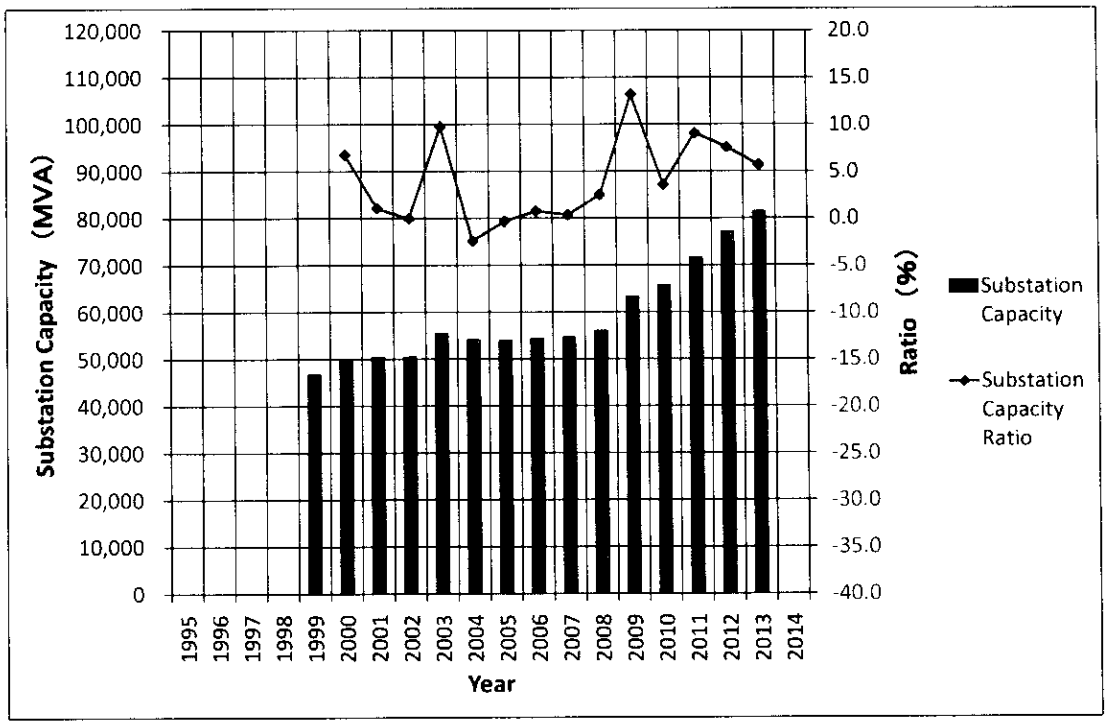


Figure 4.2.9 Change of Substation Capacity in Indonesia

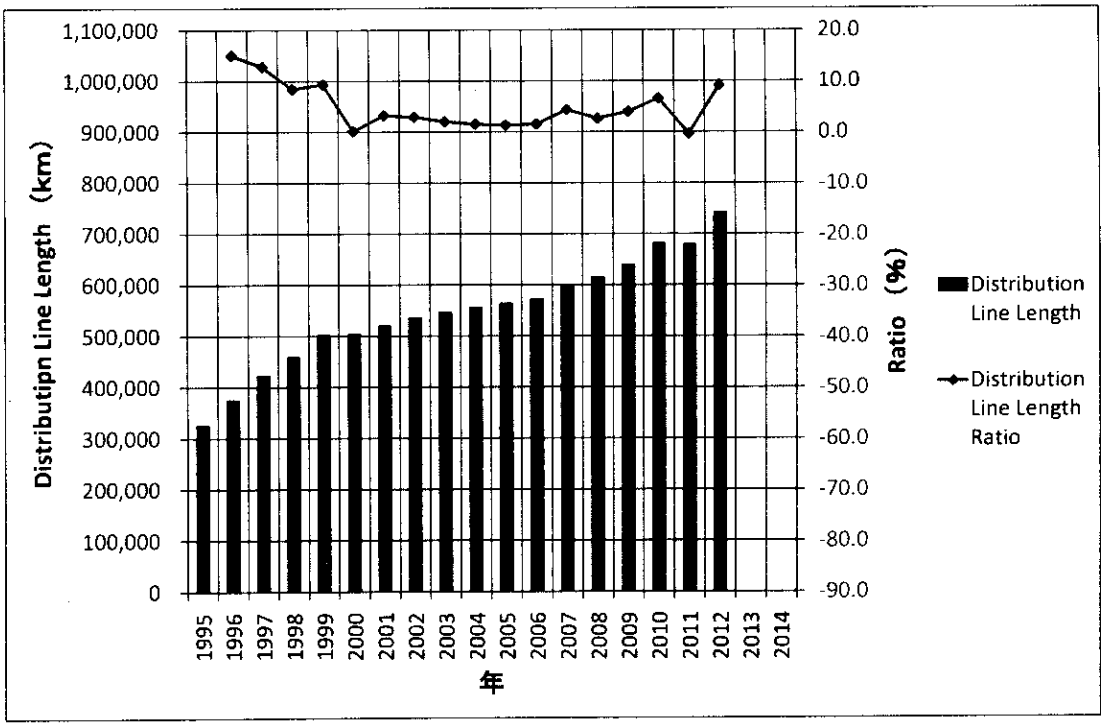


Figure 4.2.10 Change of Distribution Line Length in Indonesia

Table 4.2.8 Enegry Balance in Indonesia
(Export Electric Power Generation : Minus Indication)

Year	Electric Power Generation	Import Electric power Generation	Export Electric Power Generation	Statistics Difference	Energy Industry Own Use	Electric Power Loss	Electric Power Consumption	Remarks
	GWh	GWh	GWh	GWh	GWh	GWh	GWh	
	a	b	c	d	e	f	=a+b+c+d-e-f	
	*1	*1	*1 *2	*1	*1	*1	*1	
1995	59,193	0	0	0	2,167	7,277	49,749	
1996	67,724	0	0	0	2,479	8,313	56,932	
1997	74,627	0	0	0	2,732	7,431	64,464	
1998	78,038	0	0	0	2,857	9,920	65,261	
1999	85,915	0	0	0	3,145	11,435	71,335	
2000	93,325	0	0	0	3,416	10,745	79,164	
2001	101,254	0	0	0	3,710	13,024	84,520	
2002	108,217	0	0	0	3,660	17,471	87,086	
2003	114,466	0	0	0	4,040	19,985	90,441	
2004	120,163	0	0	0	5,824	14,242	100,097	
2005	127,743	0	0	-376	5,425	14,237	107,705	
2006	133,840	0	0	-732	4,957	14,736	113,415	
2007	143,475	0	0	-1,240	5,382	15,239	121,614	
2008	150,423	0	0	-987	5,532	15,094	128,810	
2009	156,797	0	0	1	5,697	15,048	136,053	
2010	169,786	0	0	1	5,861	15,954	147,972	
2011	183,416	0	0	5	6,882	16,672	159,867	
2012	195,895	2,990	0	1,433	7,142	17,847	175,329	
2013								
2014								

* Blank : N/A
*1 Source : IEA-HP (Search statistics by country)
*2 Export Electric Power Generation : Minus Indication

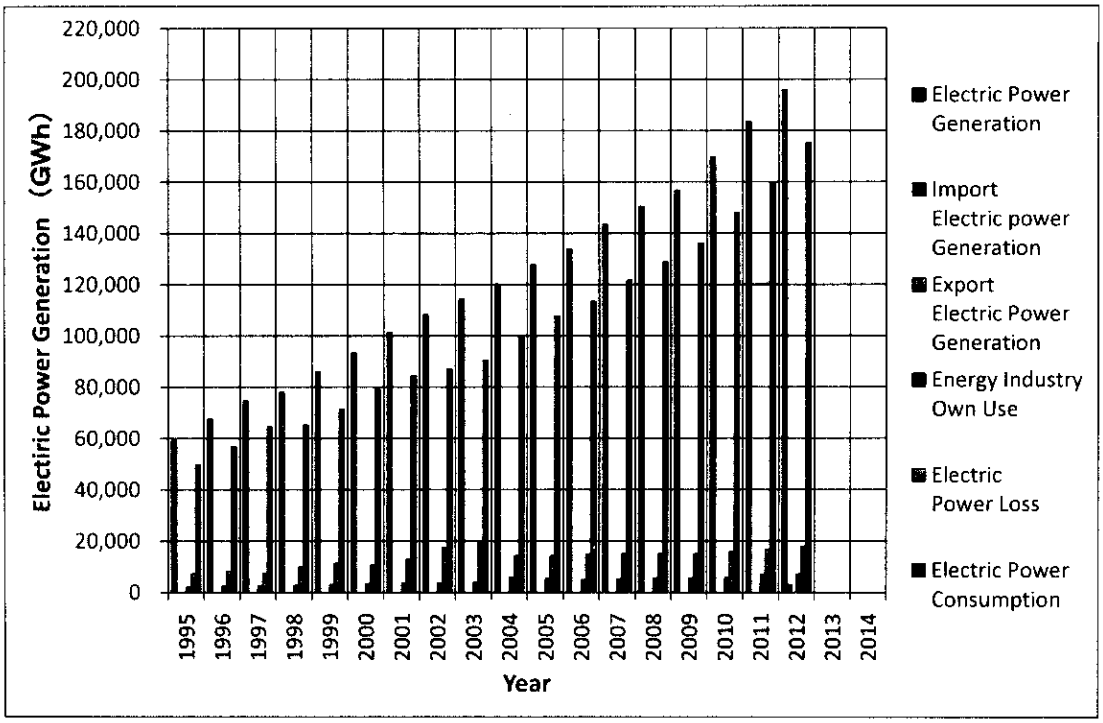


Figure 4.2.11 Change of Energy Balance in Indonesia
(Export Electric Power Generation : Plus Indication)

Table 4.2.9 Electric Power Generation per Capita and Electric Power Consumption per Capita in Indonesia

Year	Population	Electric Power Generation	Electric Power Consumption	Electric Power Generation per Capita	Electric Power Consumption per Capita	Electric Power Generation per Capita Ratio	Electric Power Consumption per Capita Ratio
	10^3 People	GWh	GWh	kWh/Capita	kWh/Capita	%	%
	a	b	c				
				=b*10^6/(a*10^3)	=c*10^6/(a*10^3)		
	*1	*1	*1			*2	*2
1995	194,110	59,193	49,749	305	256		
1996	197,100	67,724	56,932	344	289	12.8	12.9
1997	200,050	74,627	64,464	373	322	8.4	11.4
1998	202,990	78,038	65,261	384	321	2.9	-0.3
1999	205,950	85,915	71,335	417	346	8.6	7.8
2000	208,940	93,325	79,164	447	379	7.2	9.5
2001	211,970	101,254	84,520	478	399	6.9	5.3
2002	215,040	108,217	87,086	503	405	5.2	1.5
2003	218,150	114,466	90,441	525	415	4.4	2.5
2004	221,290	120,163	100,097	543	452	3.4	8.9
2005	224,480	127,743	107,705	569	480	4.8	6.2
2006	227,710	133,840	113,415	588	498	3.3	3.8
2007	230,970	143,475	121,614	621	527	5.6	5.8
2008	234,240	150,423	128,810	642	550	3.4	4.4
2009	237,490	156,797	136,053	660	573	2.8	4.2
2010	240,680	169,786	147,972	705	615	6.8	7.3
2011	243,800	183,416	159,867	752	656	6.7	6.7
2012	246,860	195,895	175,329	794	710	5.6	8.2
2013							
2014							

* Blank:N/A
*1 Source:IEA-HP(Search statistics by country)
*2 Ratio=("This Year Value"−"Last Year Value")／"Last Year Value"×100

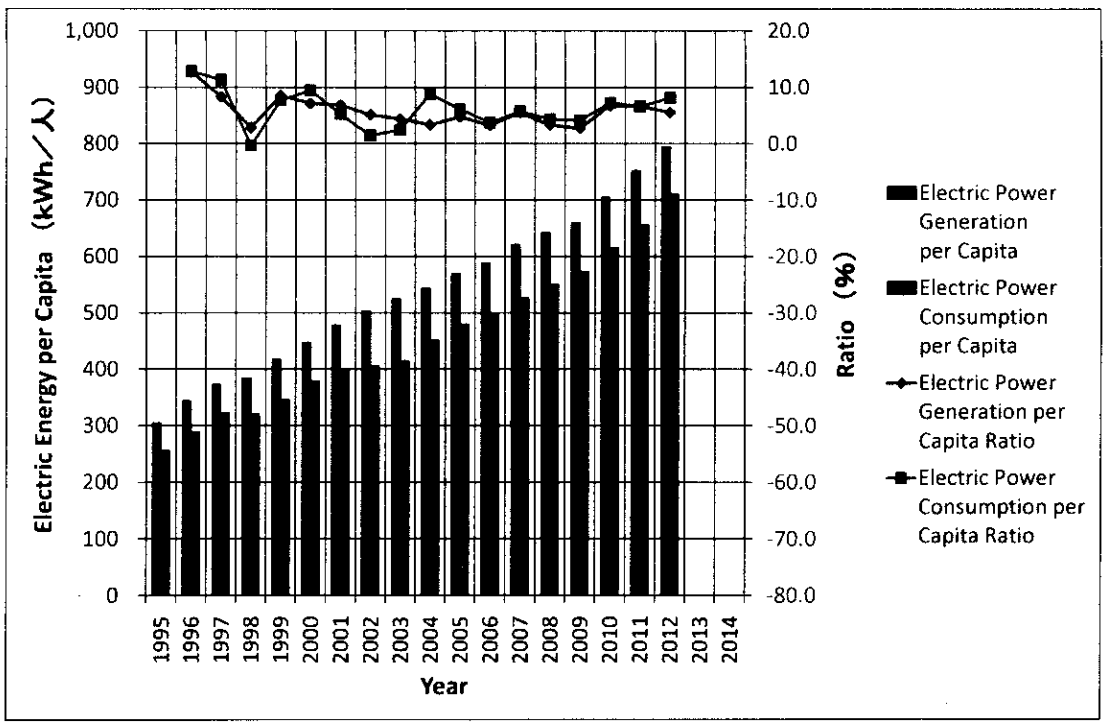


Figure 4.2.12 Change of Electric Power Generation per Capita and Electric Power Consumption per Capita in Indonesia

Table 4.2.10 Electric Power Consumption, Primary Energy Consumption, Electric Power Shift and Electrification Ratio in Indonesia

Year	Electric Power Consumption		Primary Energy Consumption		Energy Equivalent (MJ/kWh)	Energy Equivalent (MJ/toe)	Electric Power Consumption Ratio	Primary Energy Consumption Ratio	Electric Power Shift	Electrification Ratio
	GWh	$10^6 \times MJ$	ktoe	$10^6 \times MJ$	MJ/kWh	MJ/toe	%	%	%	%
	a	b	c	d	e	f				
		=a*10^6*3.6		=c*10^7*4.187					=b/d*100	
	*1		*1		*2	*2	*3	*3		*4
1995	49,749	179,096	130,808	5,476,931	3.60	41,870			3.3	
1996	56,932	204,955	135,555	5,675,688	3.60	41,870	14.4	3.6	3.6	
1997	64,464	232,070	140,117	5,866,699	3.60	41,870	13.2	3.4	4.0	
1998	65,261	234,940	137,059	5,738,660	3.60	41,870	1.2	-2.2	4.1	
1999	71,335	256,806	143,577	6,011,569	3.60	41,870	9.3	4.8	4.3	
2000	79,164	284,990	155,630	6,516,228	3.60	41,870	11.0	8.4	4.4	
2001	84,520	304,272	159,293	6,669,598	3.60	41,870	6.8	2.4	4.6	
2002	87,086	313,510	165,215	6,917,552	3.60	41,870	3.0	3.7	4.5	
2003	90,441	325,588	165,695	6,937,650	3.60	41,870	3.9	0.3	4.7	
2004	100,097	360,349	176,648	7,396,252	3.60	41,870	10.7	6.6	4.9	
2005	107,705	387,738	179,788	7,527,724	3.60	41,870	7.6	1.8	5.2	
2006	113,415	408,294	184,025	7,705,127	3.60	41,870	5.3	2.4	5.3	
2007	121,614	437,810	183,172	7,669,412	3.60	41,870	7.2	-0.5	5.7	
2008	128,810	463,716	186,806	7,821,567	3.60	41,870	5.9	2.0	5.9	62.4
2009	136,053	489,791	199,992	8,373,665	3.60	41,870	5.6	7.1	5.8	63.8
2010	147,972	532,699	209,427	8,768,708	3.60	41,870	8.8	4.7	6.1	66.5
2011	159,867	575,521	205,335	8,597,376	3.60	41,870	8.0	-2.0	6.7	74.3
2012	175,329	631,184	213,587	8,942,888	3.60	41,870	9.7	4.0	7.1	76.2
2013					3.60	41,870				80.8
2014					3.60	41,870				

* Blank : N/A
*1 Source : IEA-HP (Search statistics by country)
*2 Source : Energy and Recouces Data Book
*3 Ratio = ("This Year Value" − "Last Year Value") / "Last Year Value" × 100
*4 Source : PT PLN-HP (Annual Report), "Electrification Ratio" = "Electrification Ratio of Population"

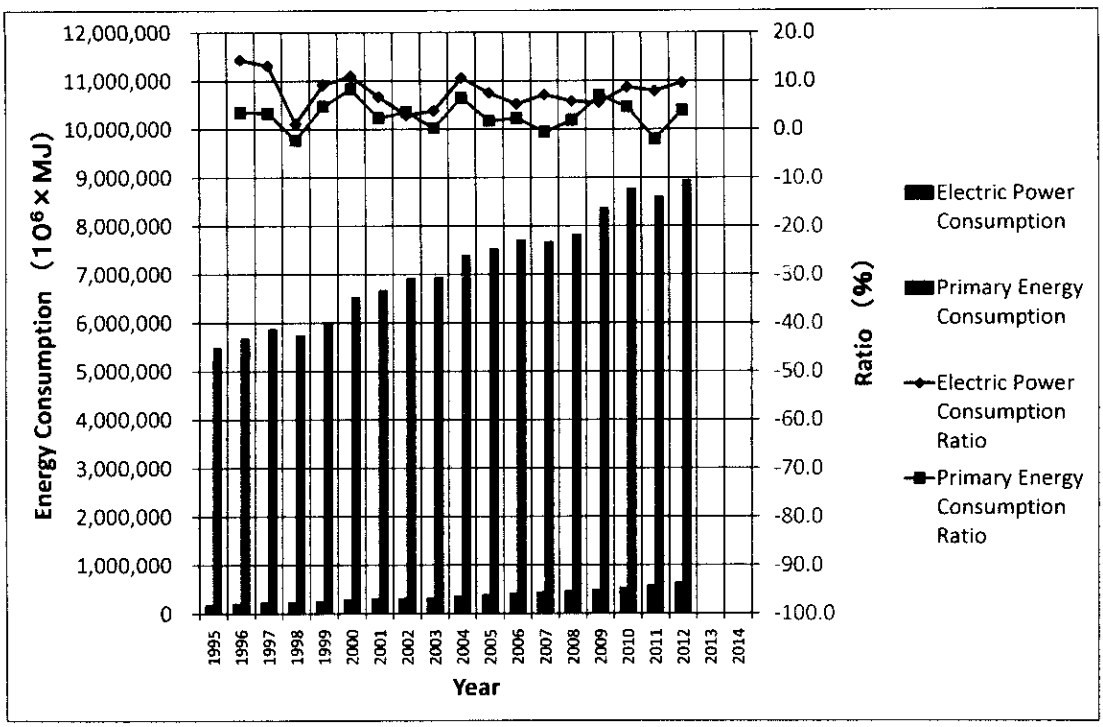


Figure 4.2.13 Change of Electric Power Consumption and Primary Energy Consumption in Indoneisa

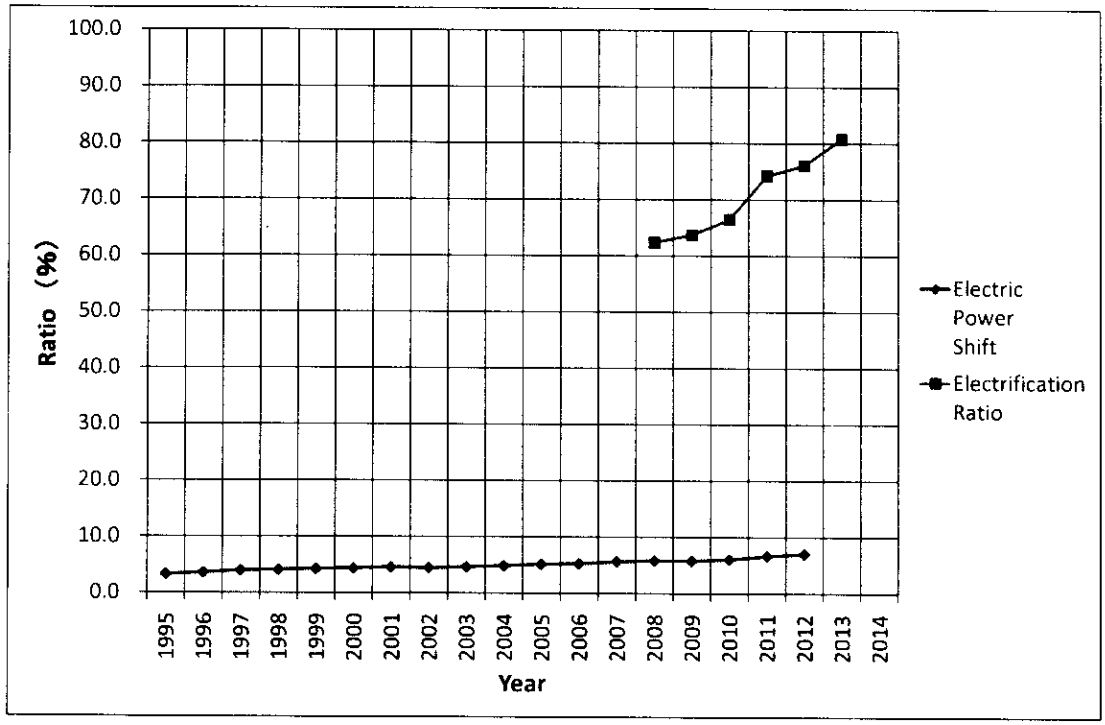


Figure 4.2.14 Change of Electric Power Shift and Electrification Ratio in Indoneisa

Table 4.2.11 Electric Power Supply Cost, Electric Power Sale Price and Cost Price Rate in Indonesia

Year	Electric Power Supply Revenue	Electric Power Sale Income	Electric Power Consumption	Exchange Rate	Electric Power Supply Cost	Electric Power Income Price	Electric Power Supply Cost Ratio	Electric Power Sale Income Ratio	Cost Price Rate
	million Local Currency	million Local Currency	GWh	Local Currency /USD	USC/kWh	USC/kWh	%	%	%
	a	b	c	d	e	f			
					=a*10^6/d *100USC/USD /(c*10^6)	=b*10^6/d *100USC/USD /(c*10^6)			=e/f*100
	*1	*1	*2	*3			*4	*4	
1995			49,749	2,248.61					
1996			56,932	2,342.30					
1997			64,464	2,909.38					
1998			65,261	10,013.62					
1999			71,335	7,855.15					
2000			79,164	8,421.78					
2001	31,939,387	35,359,958	84,520	10,260.85	3.68	4.08			90.2
2002	52,345,592	44,183,353	87,086	9,311.19	6.46	5.45	75.5	33.6	118.5
2003	55,877,205	54,430,778	90,441	8,577.13	7.20	7.02	11.5	28.8	102.6
2004	59,710,767	62,273,062	100,097	8,938.85	6.67	6.96	-7.4	-0.9	95.8
2005	76,023,601	76,543,324	107,705	9,704.74	7.27	7.32	9.0	5.2	99.3
2006	105,228,150	104,726,536	113,415	9,159.32	10.13	10.08	39.3	37.7	100.5
2007	111,505,955	114,042,687	121,614	9,141.00	10.03	10.26	-1.0	1.8	97.8
2008	160,597,751	164,208,510	128,810	9,698.96	12.85	13.14	28.1	28.1	97.8
2009	135,275,969	145,222,144	136,053	10,389.94	9.57	10.27	25.5	-21.8	93.2
2010	149,108,071	162,375,294	147,972	9,090.43	11.09	12.07	15.9	17.5	91.9
2011	193,397,299	208,017,823	159,867	8,770.43	13.79	14.84	24.3	22.9	92.9
2012	203,115,450	232,656,456	175,329	9,386.63	12.34	14.14	-10.5	-4.7	87.3
2013	220,911,147	257,404,581		10,461.24					
2014				11,865.21					

* Blank:N/A
*1 Source:PT PLN-HP(Financial Statements)
*2 Source:IEA-HP(Search statistics by country)
*3 Source:WB-HP(Data)
*4 Ratio=("This Year Value"-"Last Year Value")/"Last Year Value"×100

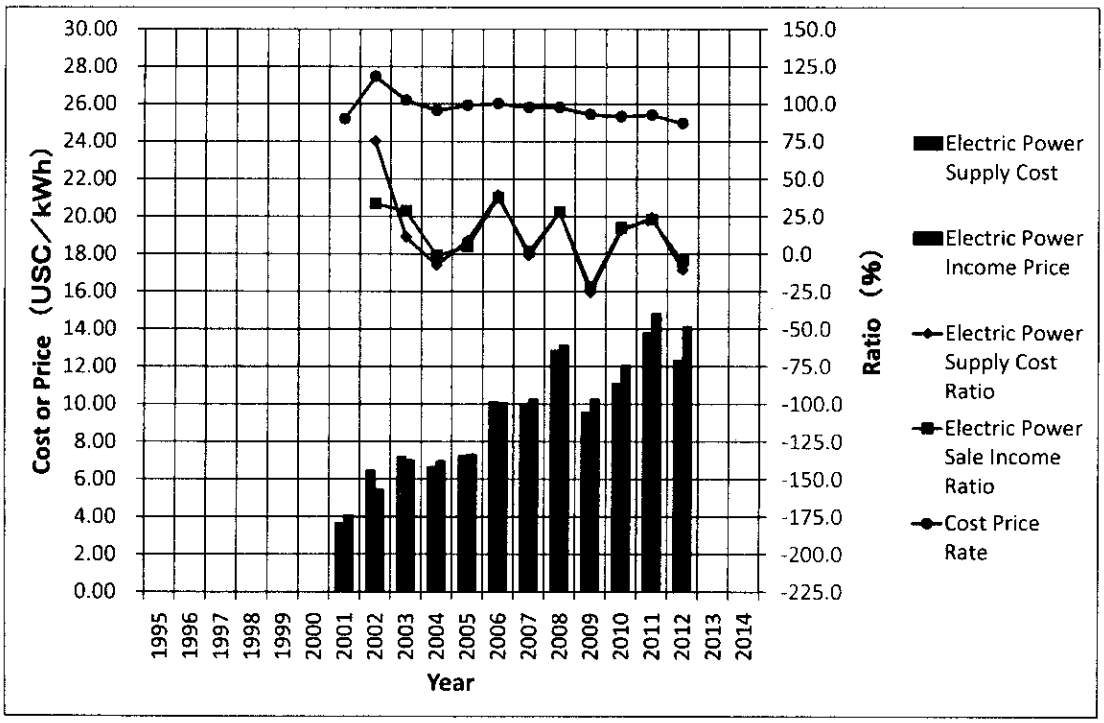


Figure 4.2.15 Change of Electric Power Supply Cost, Electric Power Sale Price and Cost Price Rate in Indonesia

Table 4.2.12 Carbon Dioxide Emission Unit in Indonesia

Year	Carbon Dioxide Emission Unit (per All kWh)	Electric Power Generation	Carbon Dioxide Emission	Thermal Power Generation	Thermal Power Generation Rate	Carbon Dioxide Emission Unit (per Thermal kWh)	Carbon Dioxide Emission Unit Ratio (per All kWh)	Carbon Dioxide Emission Unit Ratio (per Thermal kWh)	Carbon Dioxide Emission Ratio
	g-CO2/kWh	GWh	Mt-CO2	GWh		g-CO2/kWh	%	%	%
	a	b	c	d	e				
			=a*b*10^6 /(10^6*10^3 *10^3)		=d/b	=a/e			
	*1	*1		*1			*2	*2	*2
1995	592.292	59.193	35.060	49.448	0.835	709.332			
1996	608.697	67.724	41.223	57.206	0.845	720.351	2.8	1.6	17.6
1997	668.081	74.627	49.857	66.911	0.897	744.795	9.8	3.4	20.9
1998	636.404	78.038	49.664	65.735	0.842	755.824	4.7	1.5	-0.4
1999	653.410	85.915	56.138	73.781	0.859	760.664	2.7	0.6	13.0
2000	654.179	93.325	61.051	78.434	0.840	778.785	0.1	2.4	8.8
2001	682.196	101.254	69.075	83.560	0.825	826.904	4.3	6.2	13.1
2002	678.269	108.217	73.400	92.035	0.850	797.964	-0.6	3.5	6.3
2003	716.455	114.466	82.010	99.058	0.865	828.272	5.6	3.8	11.7
2004	707.885	120.163	85.062	103.813	0.864	819.311	1.2	-1.1	3.7
2005	716.485	127.743	91.526	110.392	0.864	829.265	1.2	1.2	7.6
2006	731.935	133.840	97.962	117.527	0.878	833.639	2.2	0.5	7.0
2007	761.020	143.475	109.187	125.132	0.872	872.729	4.0	4.7	11.5
2008	741.970	150.423	111.609	130.539	0.868	854.804	-2.5	-2.1	2.2
2009	745.958	156.797	116.964	136.051	0.868	859.399	0.5	0.5	4.8
2010	711.269	169.786	120.764	142.875	0.842	844.738	-4.7	1.7	3.2
2011	750.484	183.416	137.651	161.423	0.880	852.823	5.5	1.0	14.0
2012	809.188	195.895	158.516	173.475	0.886	913.305	7.8	7.1	15.2
2013									
2014									

* Blank:N/A
*1 Source:IEA-HP(Search statistics by country)
*2 Ratio=("This Year Value"-"Last Year Value")/"Last Year Value" x 100

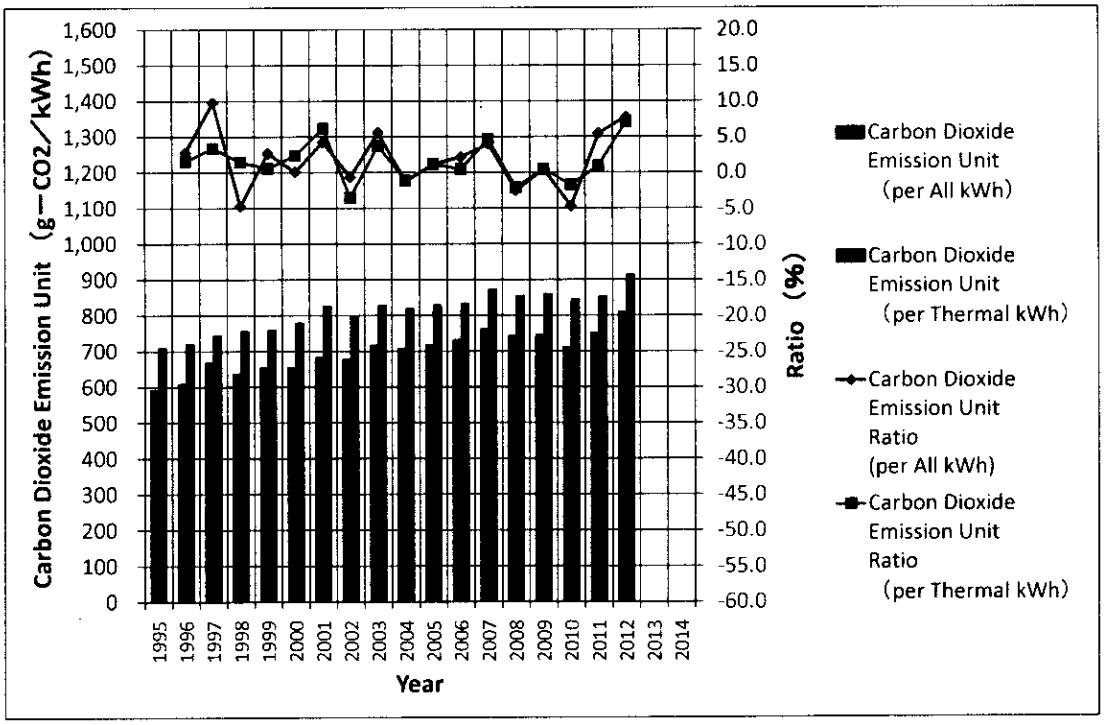


Figure 4.2.16 Change of Carbon Dioxide Emission Unit in Indonesia

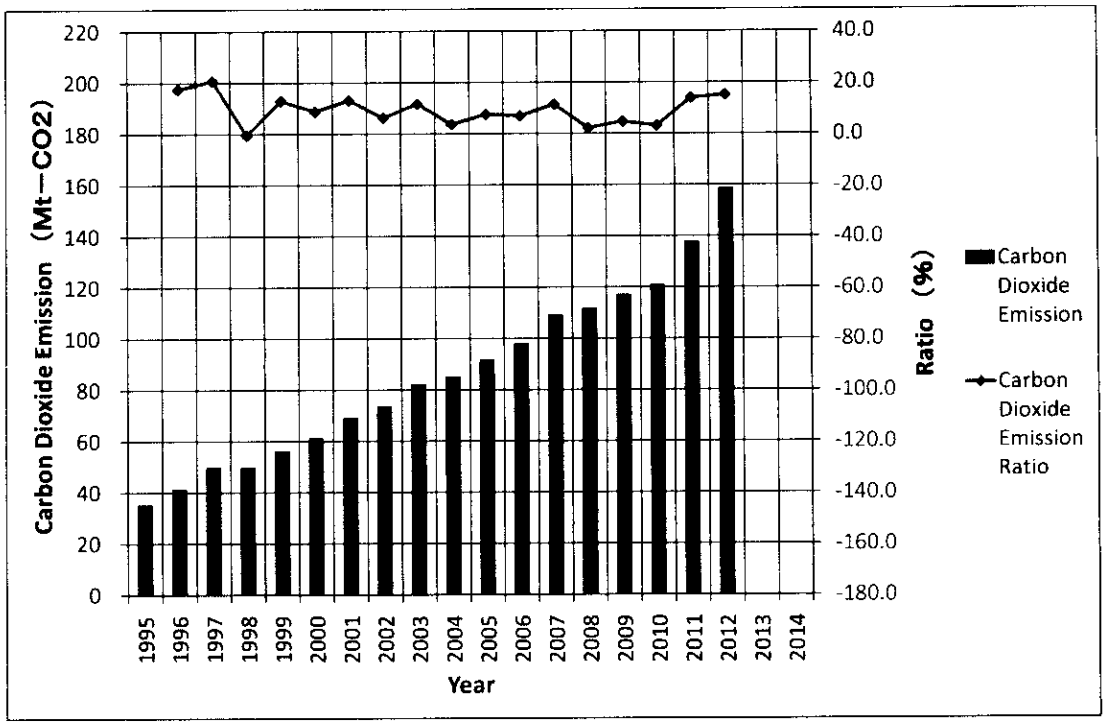


Figure 4.2.17 Change of Carbon Dioxide Emission in Indonesia

Table 4.2.13 Electiric Power Generation and Renewable Energy Power Generation in Indonesia

Year	Electric Power Generation GWh a *1	Renewable Energy Power Generation GWh b *1	Renewable Energy Power Generatio Rate % =a/b*100	Electric Power Generation Ratio % *2	Renewable Energy Generation Ratio % *2	Remarks
1995	59,193	9,745	16.5			
1996	67,724	10,518	15.5	14.4	7.9	
1997	74,627	7,716	10.3	10.2	-26.6	
1998	78,038	12,303	15.8	4.6	59.4	
1999	85,915	12,134	14.1	10.1	-1.4	
2000	93,325	14,891	16.0	8.6	22.7	
2001	101,254	17,694	17.5	8.5	18.8	
2002	108,217	16,182	15.0	6.9	-8.5	
2003	114,466	15,408	13.5	5.8	-4.8	
2004	120,163	16,350	13.6	5.0	6.1	
2005	127,743	17,351	13.6	6.3	6.1	
2006	133,840	16,313	12.2	4.8	-6.0	
2007	143,475	18,343	12.8	7.2	12.4	
2008	150,423	19,884	13.2	4.8	8.4	
2009	156,797	20,746	13.2	4.2	4.3	
2010	169,786	26,911	15.8	8.3	29.7	
2011	183,416	21,993	12.0	8.0	-18.3	
2012	195,895	22,420	11.4	6.8	1.9	
2013						
2014						

* Blank : N/A
*1 Source : IEA-HP (Search statistics by country)
*2 Ratio = ("This Year Value" − "Last Year Value") / "Last Year Value" × 100

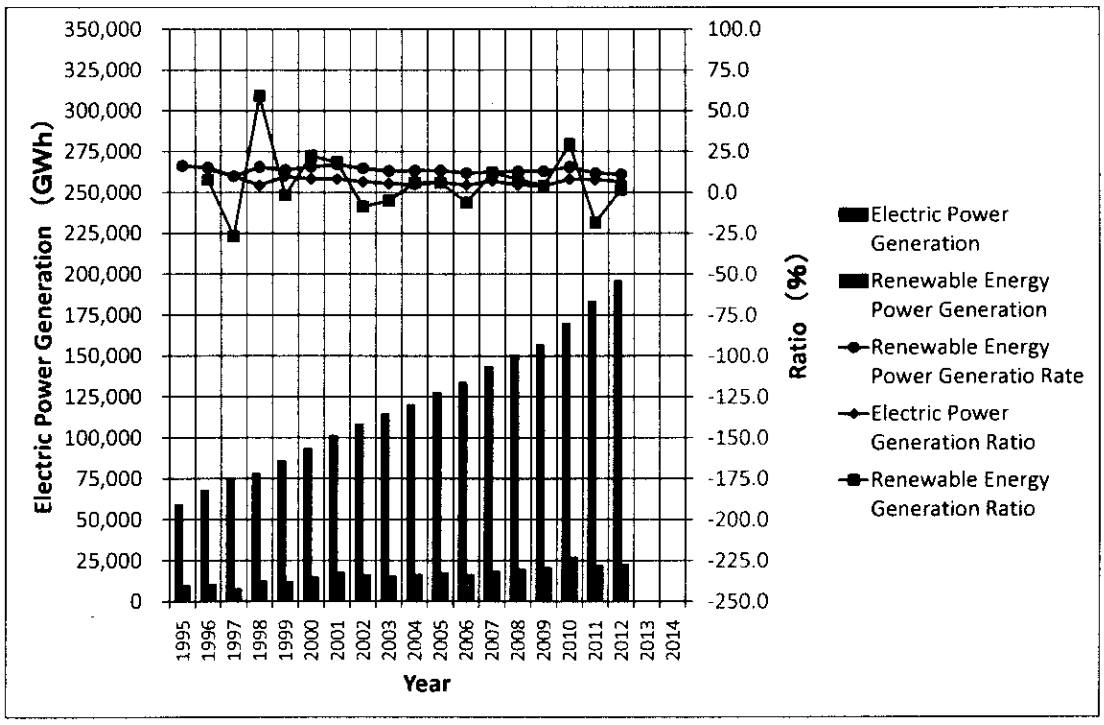


Figure 4.2.18 Change of Electric Power Generation and Renewable Energy Power Generation in Indonesia

Table 4.2.14 Electric Power Generation, Import Electric Power Generation and Electricity Self-Sufficiency Ratio in Indonesia

Year	Electric Power Generation	Import Electric Power Generation	Electricity Self-Sufficiency Ratio	Remarks
	GWh	GWh	%	
	a	b		
			=a/(a+b)*100	
	*1	*1		
1995	59,193	0	100.0	
1996	67,724	0	100.0	
1997	74,627	0	100.0	
1998	78,038	0	100.0	
1999	85,915	0	100.0	
2000	93,325	0	100.0	
2001	101,254	0	100.0	
2002	108,217	0	100.0	
2003	114,466	0	100.0	
2004	120,163	0	100.0	
2005	127,743	0	100.0	
2006	133,840	0	100.0	
2007	143,475	0	100.0	
2008	150,423	0	100.0	
2009	156,797	0	100.0	
2010	169,786	0	100.0	
2011	183,416	0	100.0	
2012	195,895	2,990	98.5	
2013				
2014				

* Blank : N/A
*1 Source : IEA-HP (Search statistics by country)

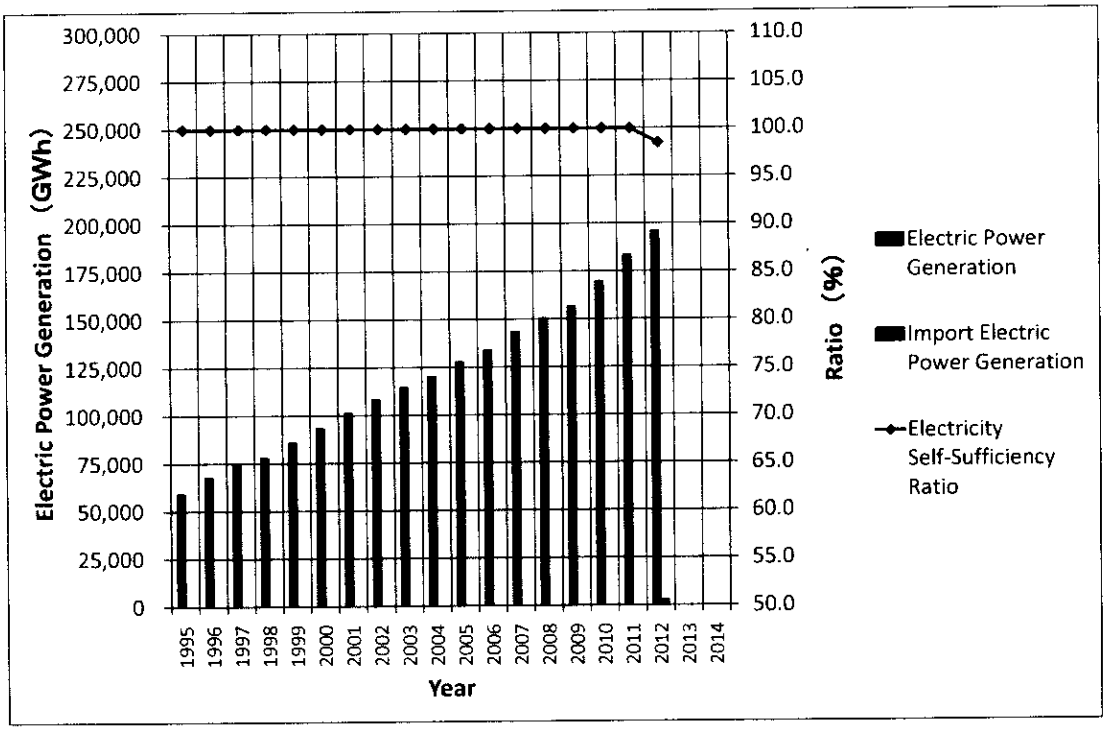


Figure 4.2.19 Change of Electric Power Generation, Import Electric Power Generation, and Electricity Self-Sufficiency Ratio in Indonesia

Table 4.2.15 SAIDI and SAIFI in Indonesia

Year	SAIDI Hour/Household *1	SAIFI Time/Household *1	Remarks
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002	14.35	14.17	
2003	10.90	12.51	
2004	9.43	11.78	
2005	15.77	12.68	
2006	27.01	13.85	
2007	28.94	12.77	
2008	80.90	13.33	
2009	16.70	10.78	
2010	6.97	6.82	
2011	4.71	4.90	
2012	3.85	4.22	
2013	5.76	7.26	
2014			

* Blank:N/A
*1 Source:JEPIC Document(Oversea Electric Business Statistics)

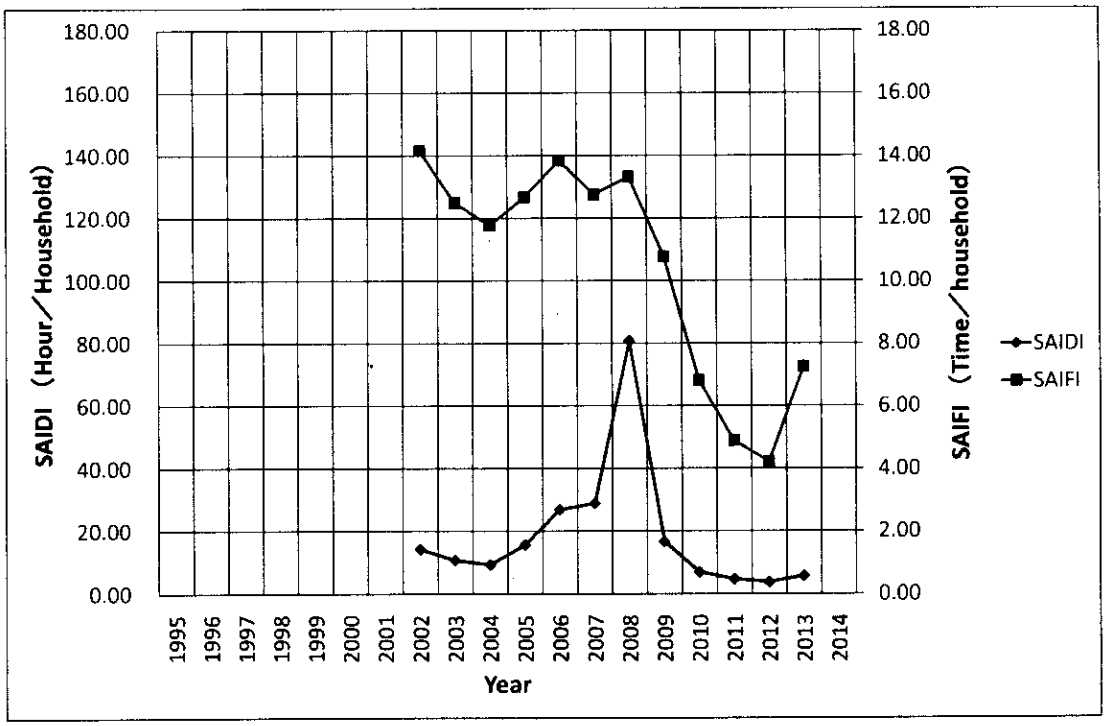


Figure 4.2.20 Change of SAIDI and SAIFI in Indonesia

Table 4.2.16 Electric Power Generation per GDP and Electric Power Consumption per GDP in Indonesia

Year	GDP	Exchange Rate	GDP	Electric Power Generation	Electric Power Consumption	Electric Power Generation per GDP	Electric Power Consumption per GDP	Electric Power Generation per GDP Ratio	Electric Power Consumption per GDP Ratio
	million Local Currency	Local Currency /USD	million USD	GWh	GWh	kWh/GDP	kWh/GDP	%	%
	a	b	c=a/b	d	e	=d*10^6 /(a*10^6)	=e*10^6 /(a*10^6)		
	*1	*1		*2	*2			*3	*3
1995	454,514,109	2,248.61	202,131	59,193	49,749	0.293	0.246		
1996	532,567,992	2,342.30	227,370	67,724	56,932	0.298	0.250	1.7	1.6
1997	627,695,377	2,909.38	215,749	74,627	64,464	0.346	0.299	16.1	19.6
1998	955,753,502	10,013.62	95,445	78,038	65,261	0.818	0.684	136.4	128.8
1999	1,099,731,611	7,855.15	140,001	85,915	71,335	0.614	0.510	-24.9	-25.4
2000	1,389,769,900	8,421.78	165,021	93,325	79,164	0.566	0.480	-7.8	-5.9
2001	1,646,322,000	10,260.85	160,447	101,254	84,520	0.631	0.527	11.5	9.8
2002	1,821,833,400	9,311.19	195,661	108,217	87,086	0.553	0.445	-12.4	-15.6
2003	2,013,674,560	8,577.13	234,773	114,466	90,441	0.488	0.385	-11.8	-13.5
2004	2,295,826,274	8,938.85	256,837	120,163	100,097	0.468	0.390	-4.1	1.3
2005	2,774,281,100	9,704.74	285,869	127,743	107,705	0.447	0.377	-4.5	-3.3
2006	3,339,216,800	9,159.32	364,570	133,840	113,415	0.367	0.311	-17.9	-17.5
2007	3,950,893,200	9,141.00	432,217	143,475	121,614	0.332	0.281	-9.5	-9.6
2008	4,948,688,397	9,698.96	510,229	150,423	128,810	0.295	0.252	-11.1	-10.3
2009	5,606,203,366	10,389.94	539,580	156,797	136,053	0.291	0.252	-1.4	0.0
2010	6,446,851,900	9,090.43	709,191	169,786	147,972	0.239	0.209	-17.9	-17.1
2011	7,419,187,100	8,770.43	845,932	183,416	159,867	0.217	0.189	-9.2	-9.6
2012	8,229,439,400	9,386.63	876,719	195,895	175,329	0.223	0.200	2.8	5.8
2013	9,083,972,273	10,461.24	868,346						
2014		11,865.21							

* Blank:N/A
*1 Source:WB-HP(Data)
*2 Source:IEA-HP(Search statistics by country)
*3 Ratio=("This Year Value"−"Last Year Value")／"Last Year Value"×100

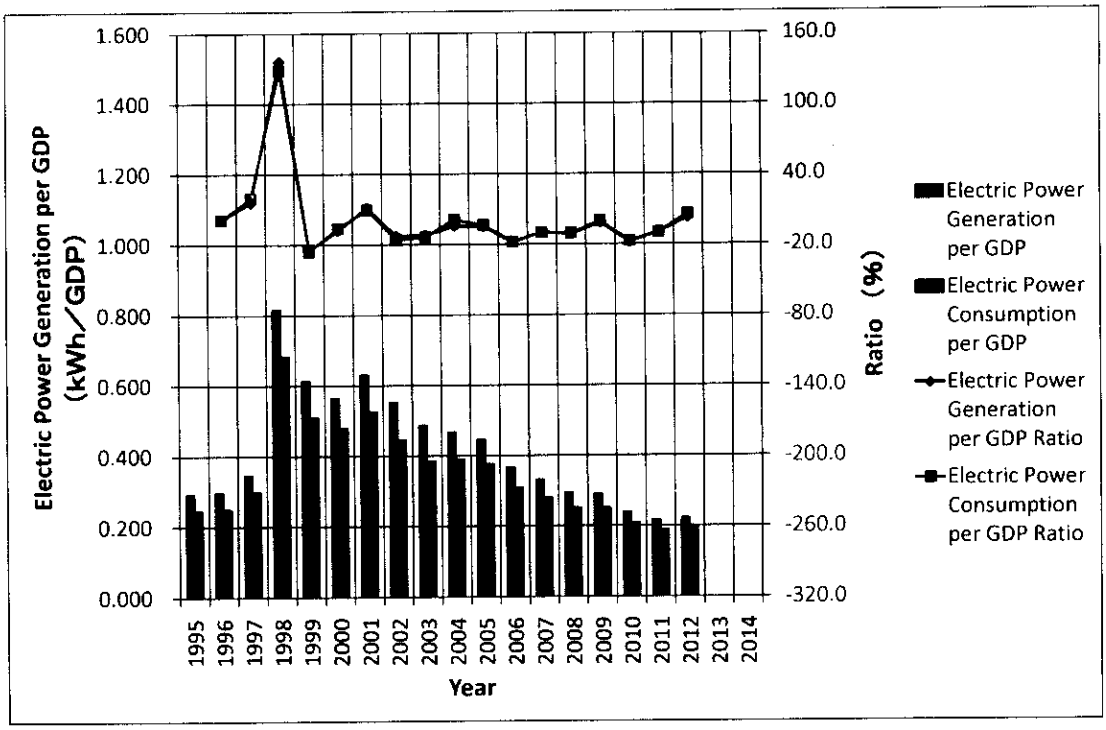


Figure 4.2.21 Change of Electric Power Generation per GDP and Electric Power Consumption per GDP in Indonesia

Table 4.2.17 Electric Power Loss Ratio in Indonesia

Year	Electric Power Generation	Import Electric Power Generation	Electric Power Loss	Electric Power Loss Ratio	Remarks
	GWh	GWh	GWh	%	
	a	b	c		
				=c/(a+b)*100	
	*1	*1	*1		
1995	59,193	0			
1996	67,724	0	8,313	12.3	
1997	74,627	0	7,431	10.0	
1998	78,038	0	9,920	12.7	
1999	85,915	0	11,435	13.3	
2000	93,325	0	10,745	11.5	
2001	101,254	0	13,024	12.9	
2002	108,217	0	17,471	16.1	
2003	114,466	0	19,985	17.5	
2004	120,163	0	14,242	11.9	
2005	127,743	0	14,201	11.1	
2006	133,840	0	14,666	11.0	
2007	143,475	0	15,124	10.5	
2008	150,423	0	15,007	10.0	
2009	156,797	0	15,048	9.6	
2010	169,786	0	15,954	9.4	
2011	183,416	0	16,672	9.1	
2012	195,895	2,990	17,961	9.0	
2013					
2014					

* Blank : N/A
*1 Source : IEA-HP (Search statistics by country)

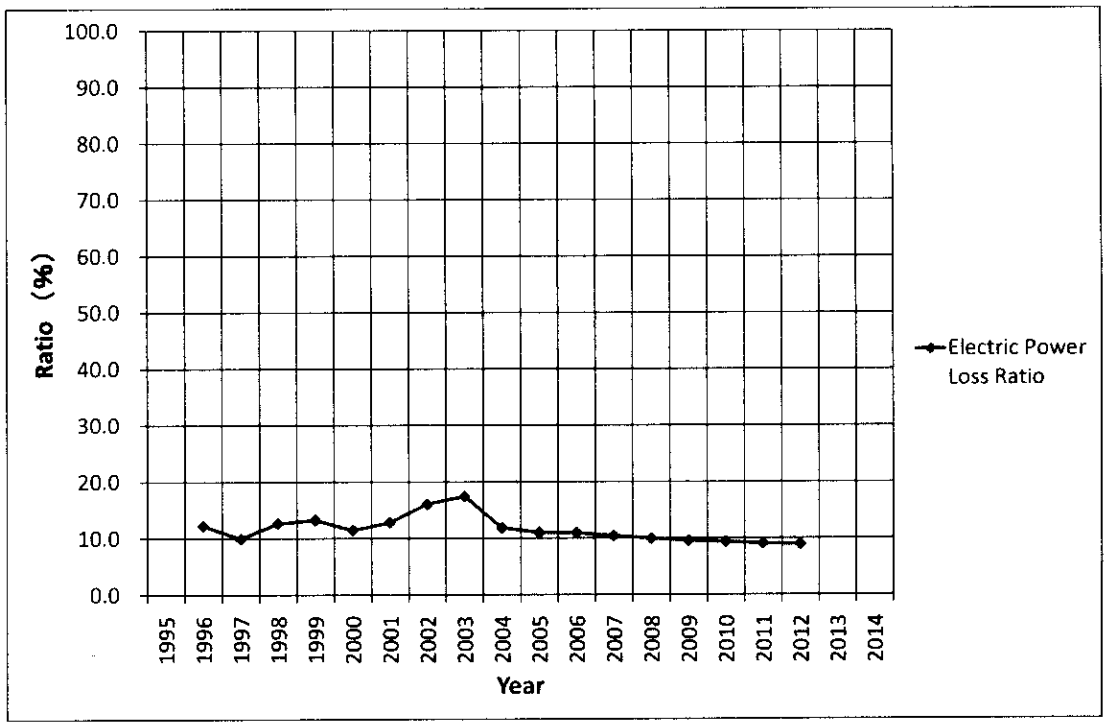


Figure 4.2.22 Change of Electric Power Loss Ratio in Indonesia

Table 4.2.18 Return on Assets, Return on Equity, Return on Turnover, Total Assets Turnover and Financing Leverage in Indonesia

Year	Return on Assets	Return on Equity	Return on Turnover	Total Assets Turnover	Financing Leverage	Remarks
	%	%	%	%	%	
	*1	*1	*1	*1	*1	
1995						
1996						
1997						
1998						
1999						
2000						
2001	0.23	0.94	0.63	35.82	416.22	
2002	-2.83	-3.98	-15.36	18.44	140.64	
2003	-1.71	-2.38	-7.07	24.24	138.65	
2004	-0.95	-1.42	-3.44	27.76	148.78	
2005	-2.23	-3.52	-7.68	28.99	158.02	
2006	-0.78	-1.38	-2.68	28.97	177.29	
2007	-2.06	-4.14	-7.29	28.32	200.48	
2008	-4.23	-9.69	-14.37	29.45	228.94	
2009	3.10	7.33	11.32	27.42	236.35	
2010	2.73	6.74	9.68	28.24	246.65	
2011	1.69	4.63	6.26	26.92	274.55	
2012	0.58	2.01	2.48	23.54	344.93	
2013	-4.96	-22.19	-18.93	26.21	447.25	
2014						

* Blank : N/A
*1 Source : Caluculating Value using Financial Data of PT PLN-HP(Financial Statements)

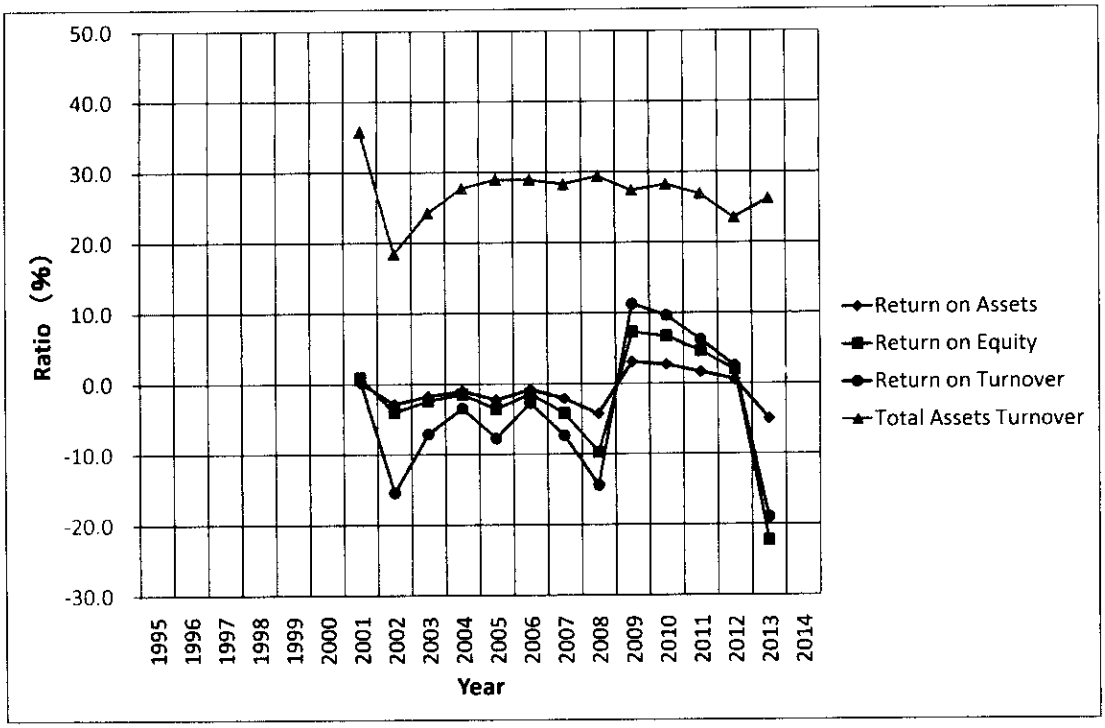


Figure 4.2.23 Change of Return on Assets, Return on Equity, Return on Turnover and Total Assets Turnover in Indonesia

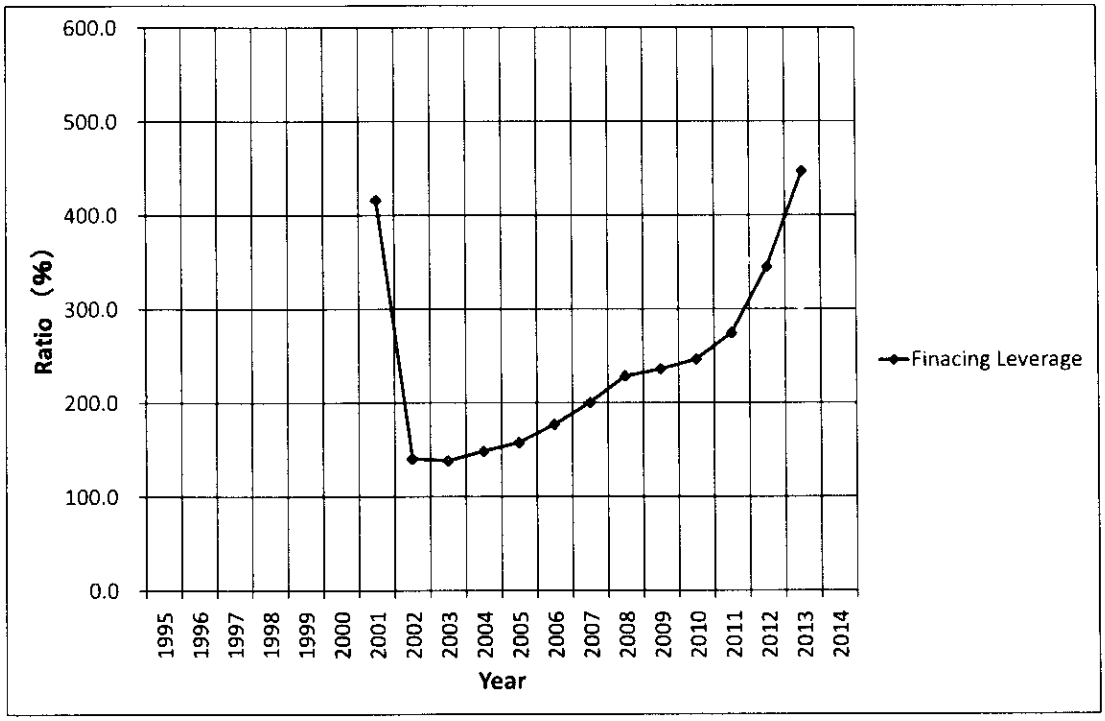


Figure 4.2.24 Change of Financing Leverage in Indonesia

Table 4.2.19 Current Ratio, Capital Adequacy Ratio and Fixed Assets Ratio in Infdonesia

Year	Current Ratio % *1	Capital Adequacy Ratio % *1	Fixed Assets Ratio % *1	Remarks
1995				
1996				
1997				
1998				
1999				
2000				
2001	40.92	24.03	357.03	
2002	68.42	71.10	132.16	
2003	59.46	72.12	130.44	
2004	73.75	67.21	139.88	
2005	68.06	63.28	145.38	
2006	104.05	56.40	156.68	
2007	107.29	49.88	168.80	
2008	76.44	43.68	204.47	
2009	98.12	42.31	210.14	
2010	81.48	40.54	216.74	
2011	92.58	36.42	237.06	
2012	103.63	28.99	296.39	
2013	96.06	22.36	383.57	
2014				

* Blank : N/A
*1 Source : Caluculating Value using Financial Data of PT PLN-HP(Financial Statements)

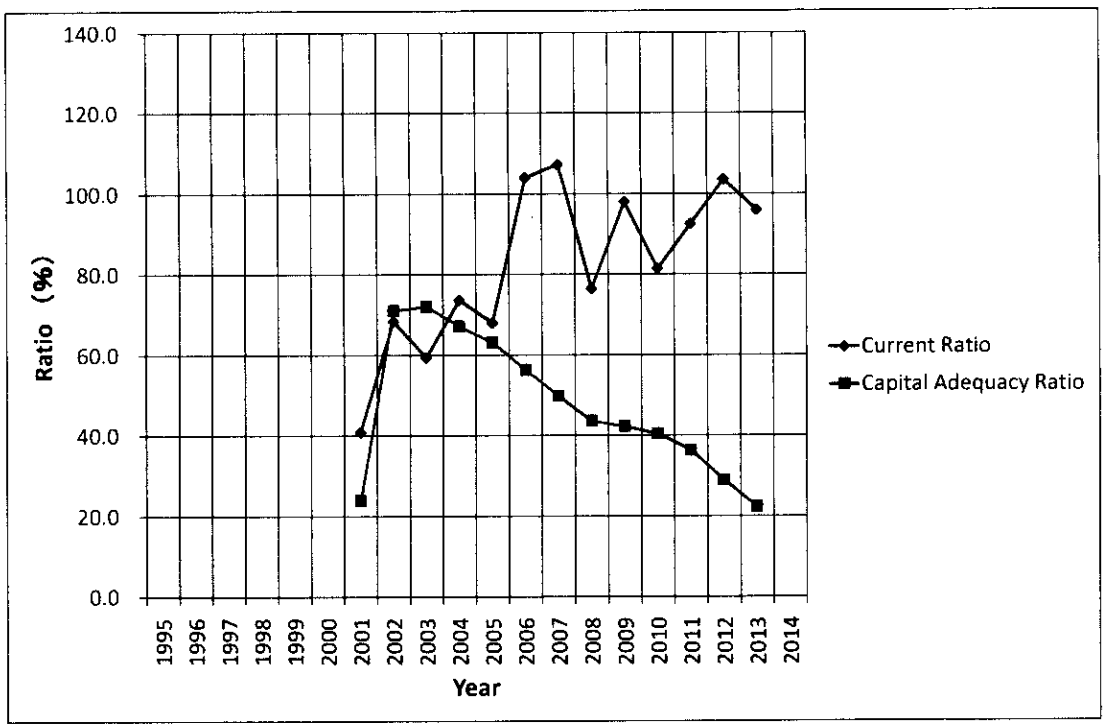


Figure 4.2.25 Change of Current Ratio and Capital Adequacy Ratio in Indonesia

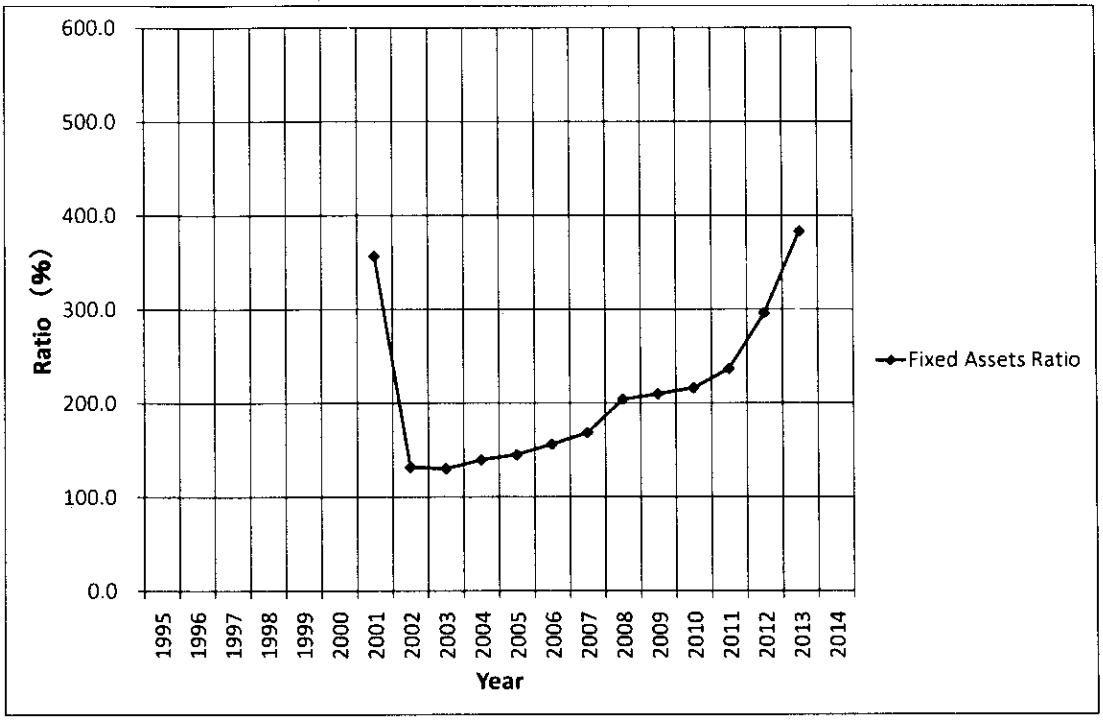


Figure 4.2.26 Change of Fixed Assets Ratio in Indonesia

Table 4.2.20 Burden Rate in Indonesia

Year	Government Tax Revenue	Electric Power Company Subsidy	Exchange Rate	Government Tax Revenue	Electric Power Company Subsidy	Burden Rate	Remarks
	million Local Currency	million Local Currency	Local Currency /USD	million USD	million USD	%	
	a	b	c	d	e		
				=a/c	=b/c	=a/d*100	
	*1	*2	*3				
1995	68,909,900		2,248.61	30,646			
1996	80,244,200		2,342.30	34,259			
1997	107,814,900		2,909.38	37,058			
1998	152,263,300		10,013.62	15,206			
1999	188,428,700		7,855.15	23,988			
2000	203,045,479		8,421.78	24,110			
2001	317,746,293	6,735,210	10,260.85	30,967	656	2.1	
2002	324,027,804	4,739,074	9,311.19	34,800	509	1.5	
2003	374,485,402	4,096,633	8,577.13	43,661	478	1.1	
2004	438,800,210	3,469,920	8,938.85	49,089	388	0.8	
2005	538,894,002	12,510,960	9,704.74	55,529	1,289	2.3	
2006	685,237,413	32,909,148	9,159.32	74,813	3,593	4.8	
2007	764,121,451	36,604,751	9,141.00	83,593	4,004	4.8	
2008	1,053,084,642	78,577,390	9,698.96	108,577	8,102	7.5	
2009	924,686,395	53,719,818	10,389.94	88,998	5,170	5.8	
2010	1,073,832,299	58,108,418	9,090.43	118,128	6,392	5.4	
2011	1,336,271,877	93,177,740	8,770.43	152,361	10,624	7.0	
2012	1,486,152,643	103,331,285	9,386.63	158,327	11,008	7.0	
2013	1,632,381,070	101,207,859	10,461.24	156,041	9,675	6.2	
2014			11,865.21				

* Blank : N/A
*1 Source : IMF-HP(World Economic Outlook Database)
*2 Source : PT PLN-HP(Financial Statements)
*3 Source : WB-HP(Data)

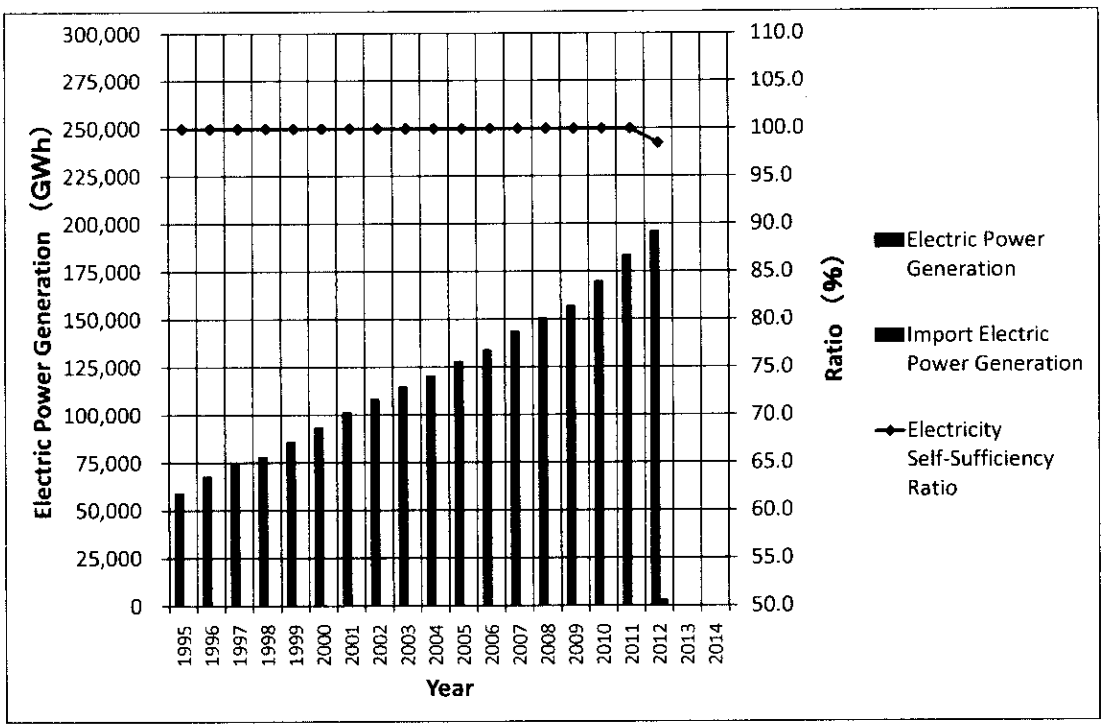


Figure 4.2.27 Change of Burden Rate in Indonesia

Table 4.2.21 Evaluation Point of Diagnostic Objects in Indonesia

Year	Energy Access	Low Cost	Low Carbon	Low Risk	Efficiency	Finacial Soundness	Total	Remarks
	a	b	c	d	e	f	=Ave(a~f)	
	*1	*1	*1	*1	*1	*1		
1995	7		35	33	22		24	
1996	7		30	33	23		23	
1997	8		19	33	25		21	
1998	8		31	33	23		24	
1999	8		25	33	33		25	
2000	9		29	33	33		26	
2001	9	56	27	33	32	8	28	
2002	9	36	29	41	26	18	27	
2003	9	33	20	46	22	20	25	
2004	9	50	18	47	28	17	28	
2005	10	50	18	35	32	19	27	
2006	6	53	15	65	28	18	31	
2007	6	60	18	64	30	17	33	
2008	31	60	17	83	33	16	40	
2009	32	66	18	88	35	22	44	
2010	23	63	22	93	34	23	43	
2011	30	70	14	92	35	18	43	
2012	37	61	12	81	31	15	40	
2013	25			32		10	22	
2014								

* Blank:N/A
*1 Source:Calculating Value by the Power Sector Diagnostic Assistance Tool

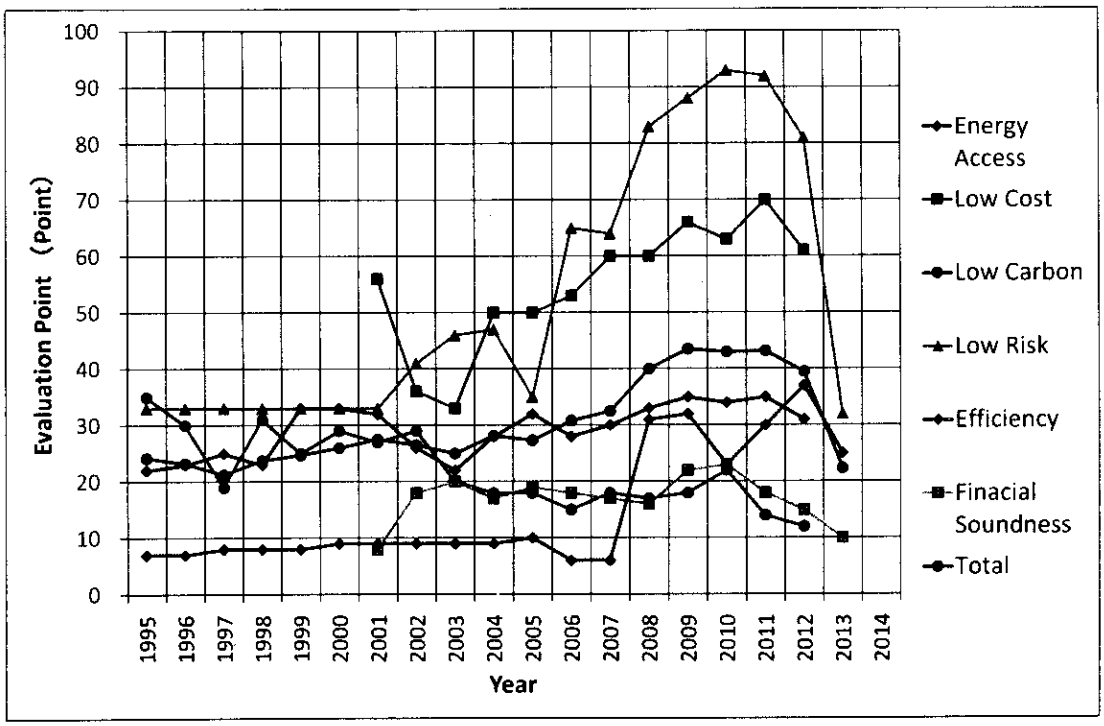


Figure 4.2.28 Change of Evaluation Point of Diagnostic Objects in Indonesia

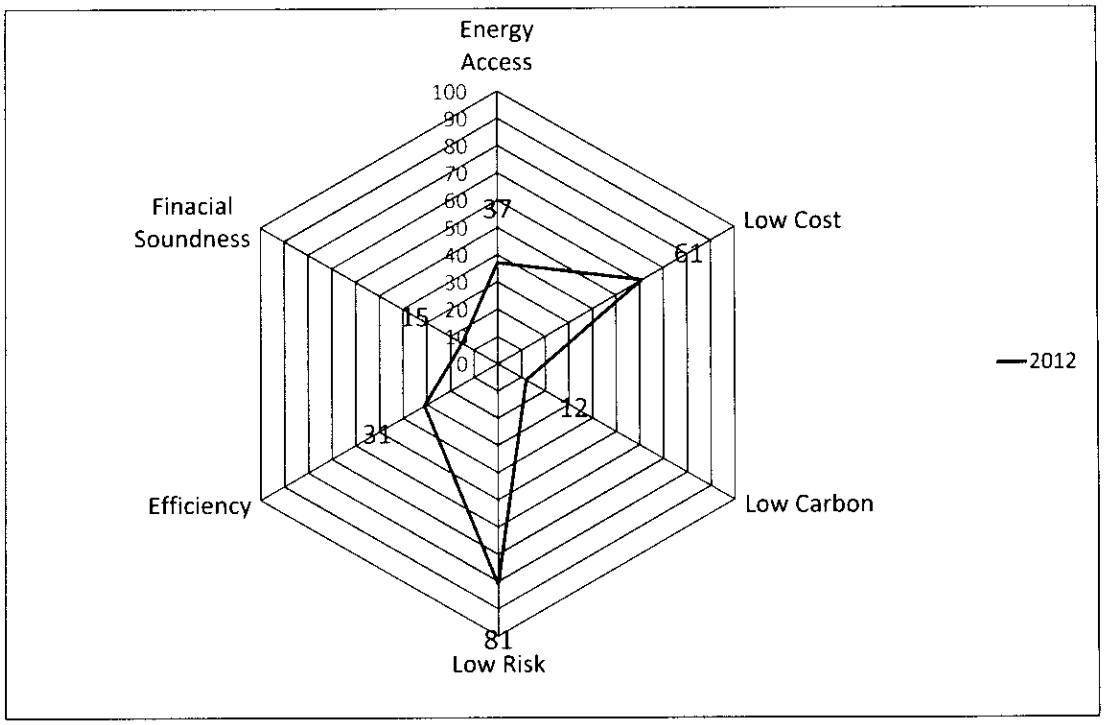


Figure 4.2.29 Diagram in Indonesia

5. Cross Country Analysis

5.1 Analysis Method

In Cross Country Analysis, the database of 50 countries, such as 24 countries of JICA Prioritized Countries in Power Sector and 26 countries of Reference Countries, as shown in Table 5.1.1 enable to make some correlation analysis with Macro Data (referring to *1) and Electric Power Index (referring to *2).

*1 Macro Index : GDP/capita, Population, Population Density and Country Areas
*2 Electric Power Index : Electrification Ratio, Electric Power Consumption/capita, Electric Power System Scale (Gross Installed Generation Capacity), Carbon Dioxide Emission Unit (per All Electric Power Generation) , Carbon Dioxide Emission Unit (per Thermal Electric Power Generation), Electric Power Loss Ratio, SAIDI/year and SAIFI/year

Table 5.1.1 JICA's Power Sector prioritiaed Countries and Reference Countries

Item			Asian Area		African Area		Other's Area		Developed Countries		Subtotal
			Country Name	Number	Country Name	Number	Country Name	Number	Country Name	Number	
GDP /Capita	More Than 20,000	JICA'S Power Sector Important Countries	—	0	—	0	—	0	—	0	0
		JICA'S Reference Countries	Korea	1	UAE Oman	2	—	0	[illegible]	7	10
		Subtotal		1		2		0		7	10
	Less Than 20,000 More Than 2,000	JICA'S Power Sector Important Countries	Indonesia Sri Lanka Mongolia	3	Nigeria	1	Fiji Marshall islands Micronesia Jordan Peru Bolivia	6	—	0	10
		JICA'S Reference Countries	China Iran Turkey Thailand Malaysia Brazil	6	South Africa Egypt	2	Brazil Russia	2	—	0	10
		Subtotal	—	9	—	3	—	8	—	0	20
	Less Than 2,000	JICA'S Power Sector Important Countries	Viet Nam LOA PDR Cambodia Myanma India Pakistan Bangladesh Uzbekistan	8	Etiopia Kenya Tanzania Uganda Malawi	5	Solomon Islands	1	—	0	14
		JICA'S Reference Countries	Nepal	1	Ghana Sierra Leone Rwanda Zambia Mozambique	5	—	0	—	0	6
		Subtotal	—	9	—	10	—	1	—	0	20
Total			—	19	—	15	—	9	—	7	50

5.2 Analysis Results

The analysis procedure is as follows:

① Time-Series Analyses (Macro Indices, Electric Power Indices)
For the purpose of checking the collected data, the analyses are implemented.

② Correlation Analyses (Macro Indices, Electric Power Indices)
The correlation between eight Macro Indices and four Electric Power Indices was analyzed as follows;

＜Electric Power Indexices＞
Category "Energy Access"
- Electrification Ratio
- Electric Power Consumption/cap
- Electric Power System Scale (Gross Installed Generation Capacity)

Category "Low Carbon"
- Carbon Dioxide Emission Unit (per All Electric Power Generation)
- Carbon Dioxide Emission Unit (per Thermal Electric Power Generation)
- Electric Power Loss Ratio

Category "Low Risk"
- System Average Interruption Duration Index (SAIDI)
- System Average Interruption Frequency Index (SAIFI)

＜Macro Indexies＞
- GDP/capita
- Population
- Population Density
- Country Area

The diagrams for the purpose of analyzing the correlations are shown in the attached documents of this chapter, Time-Series Analysis and Correlation Analysis. The results are as follows;

(1) Case Analysis of "Energy Access"

(1)-1 Electrification Ratio

The correlation diagram between GDP/capita and the electrification ratio, either 2010 or the latest year before 2010, are shown in Figure 5.2.1.1 and Figure 5.2.1.1-1. The JICA team understands GDP/capita to express the growing phases of countries and electrification ratio to express "Access to electric services". These figures implicate as follows;

- These figures reveal the positive correlation between the population electrification and GDP/capita, i.e. the electrification ratio ascends rapidly, and then gradually closes to 100% over 80 to 90 %.
- As an example, the time-series data of Indonesian electrification ration is shown in Figure 5.2.1.1-1. No country has the electrification ratio that declines with GDP/capita.
- The above-mentioned points implicate that areas, which can be easily done, are preceded by a rising electrification ratio are preceded by a rising electrification ratio. On the other hand, area with difficulty follows, and then it takes long time to reach 100 %.

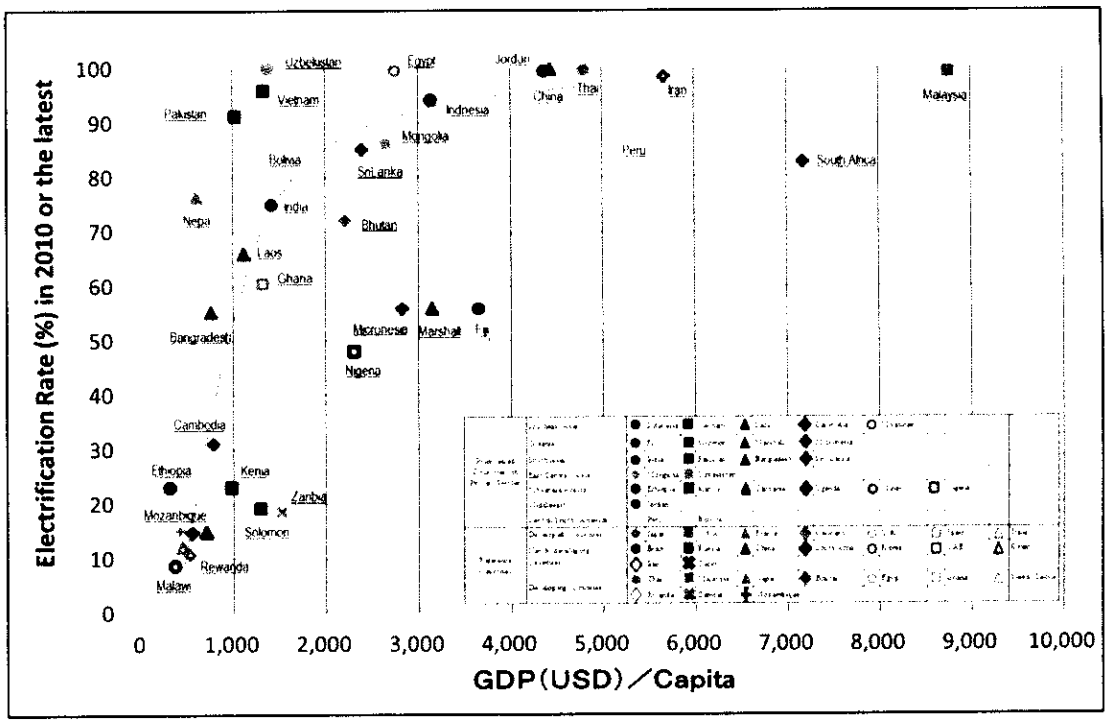


Figure 5.2.1.1 Correlation Diagram between GDP/capita and Electrification Ratio (2012 or the Latest Year Before 2012)

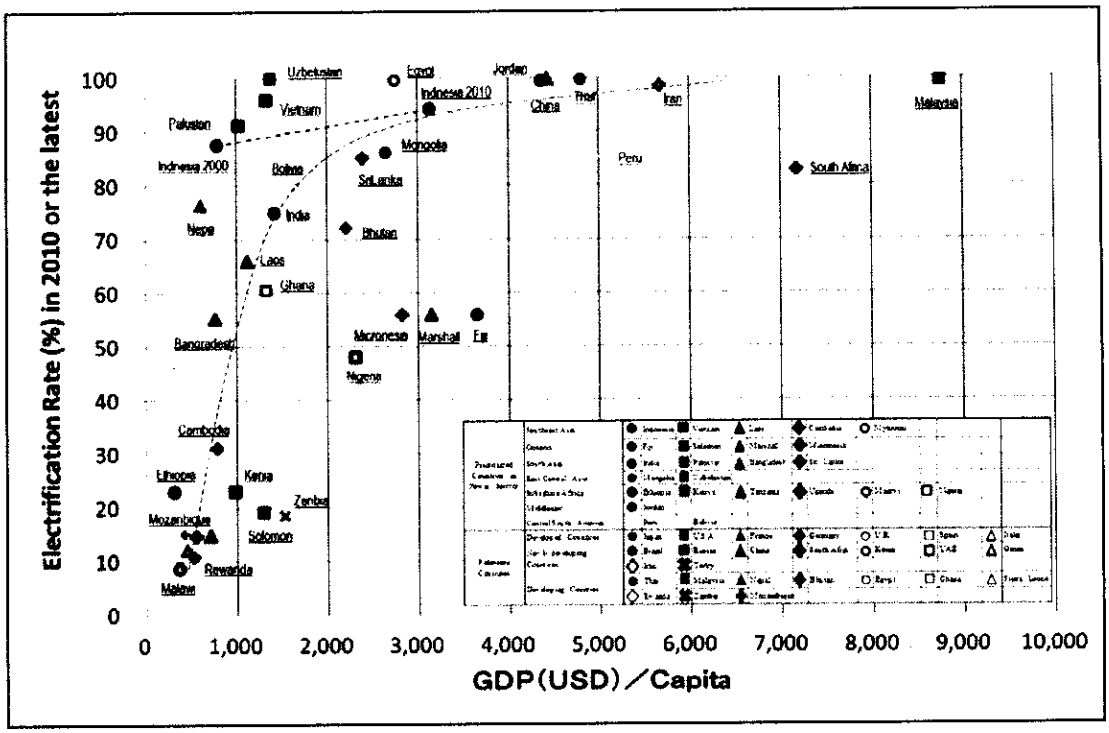


Figure 5.2.1.1-1 Correlation Diagram between GDP/capita and Electrification Ratio (With Time-Series of Indonesia)

(1)-2 Electric Power Consumption /capita

(Cross Country Analysis of GDP/capita)

The correlation diagram between GDP/capita and the electric power consumption/capita, either 2010 or the latest year before 2010, are shown in Figure 5.2.1.2 and Figure 5.2.1.2-1. The JICA team understands GDP/capita in order to express the growing phases of countries. These figures implicate as follows;

- These figures reveal the positive correlation between the population electrification and GDP/capita, i.e. the electric power consumption/capita increases as GDP/capita increases.
- The degrees of increase of the countries' electric power consumption/capita, the gradients of the lines, are not same, and then with regard to 50 analyzed countries, the degrees of increase are identified as 2 groups, such as "Large Increase Group"and "Small Increase Group".

  (Large Increase Group)

  U.S.A., U.A.E., Oman, Russia, Malaysia, South Africa, China, Iran, Jordan, Egypt, Uzbekistan and Vietnam, etc.

  (Small Increase Group)

  Japan, Germany, France, U.K., Italia, Spain, Brazil, Turkey, Peru, Mongolia, Fiji, Indonesia and Sri Lanka, etc.
- Vietnam, Laos and Marshall of "JICA Prioritized Countries in Electric Power Sector" belong to "Large Increase Group". These countries need more electric power, comparing with "Small Increase Group". It is considered it means that the low effectiveness of electric power energy.

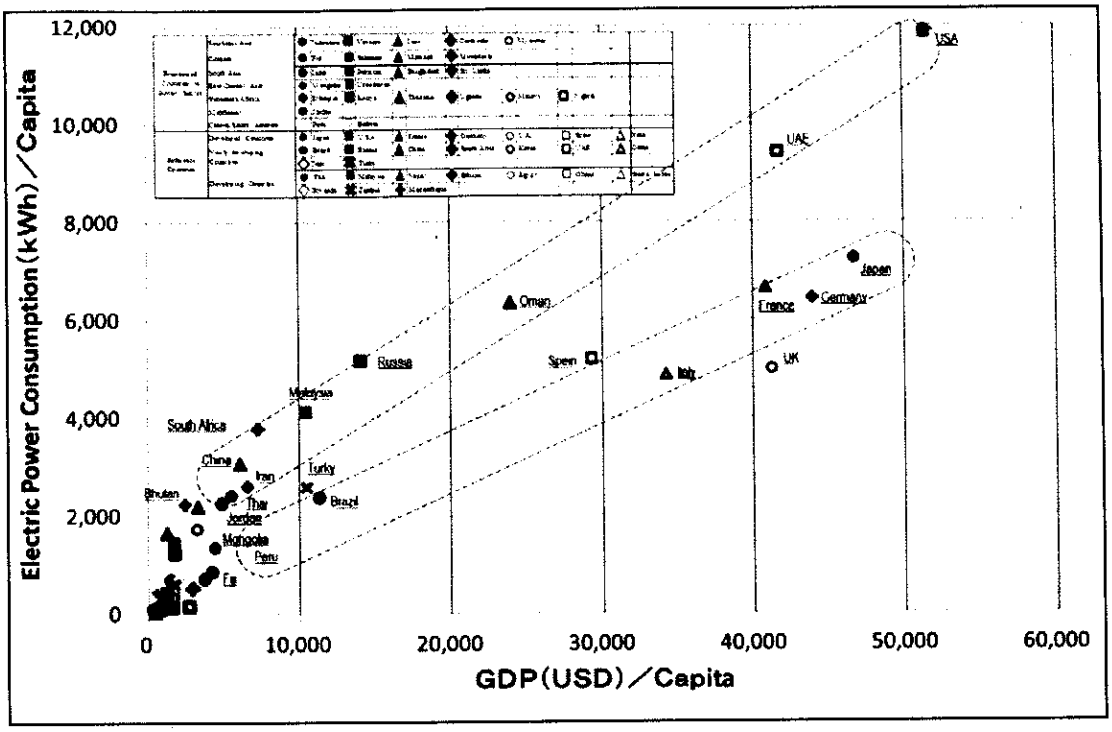


Figure 5.2.1.2 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (2012 or the Latest Year Before 2012)

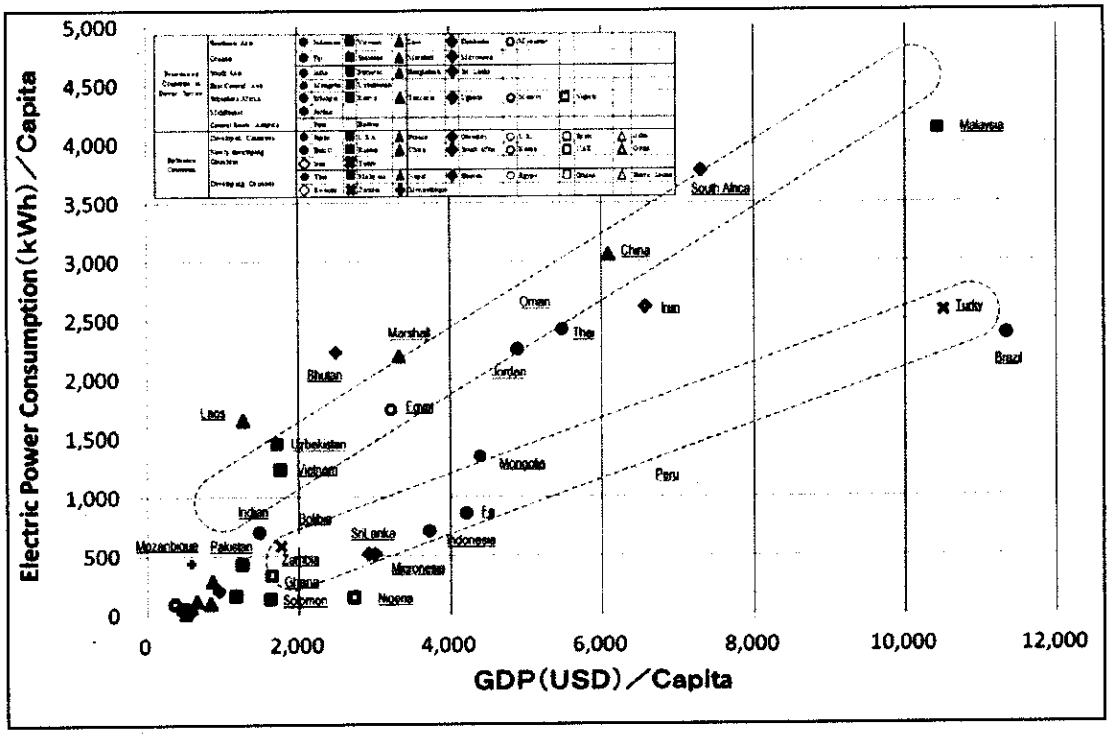


Figure 5.2.1.2-1 Correlation Diagram between GDP/capita and Electric Power Consumption/cap (Enlarged Figure of Figure 5.2.1.2)

(Time-Series Analysis of Electric Power Consumption/capita 1)

The time-series of the correlation diagram between GDP/capita and electric power consumption/capita are shown in Figure 5.2.1.3 and Figure 5.2.1.3-1 - Figure 5.2.1.3-4. Figure 5.2.1.3-1 – Figure 5.2.1.3-3 are enlarged figures of Figure 5.2.1.3. These figures implicate as follows;

- The electric power consumption/capita increases as GDP/capita increases. Approximately, the countries over GDP/capita of around 20,000 USD/capita trend not growth (do not grow) . It is thought that the full spread of personal electronics has no room to make the electric power consumption/capita increase, under the growth of GDP/capita.
- The sub-Saharan countries such as Ethiopia, Kenya and Tanzania, etc. implicate no increase of the electric power consumption/capita. It is thought that the countries in the early phase of development, either that the growth of GDP/capita makes consumers' income does not make consumer's income go up, or that few spread of personal electronics keeps the growth of GDP/capita from increasing.

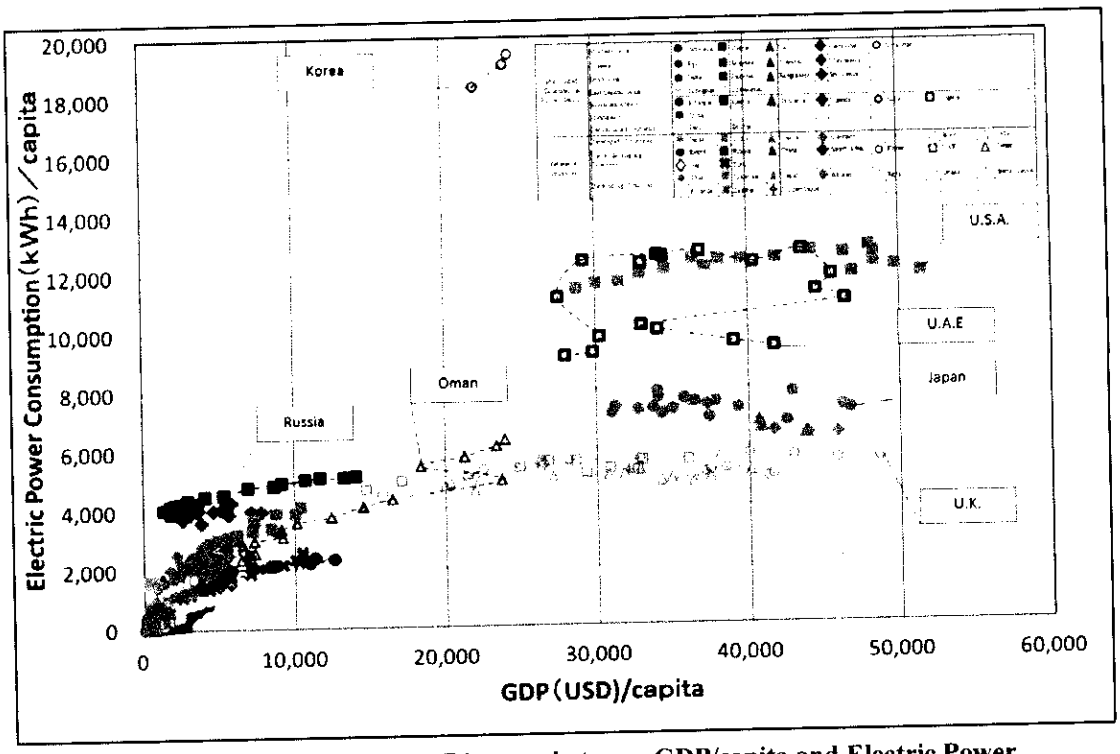


Figure 5.2.1.3 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (With Time-Series)

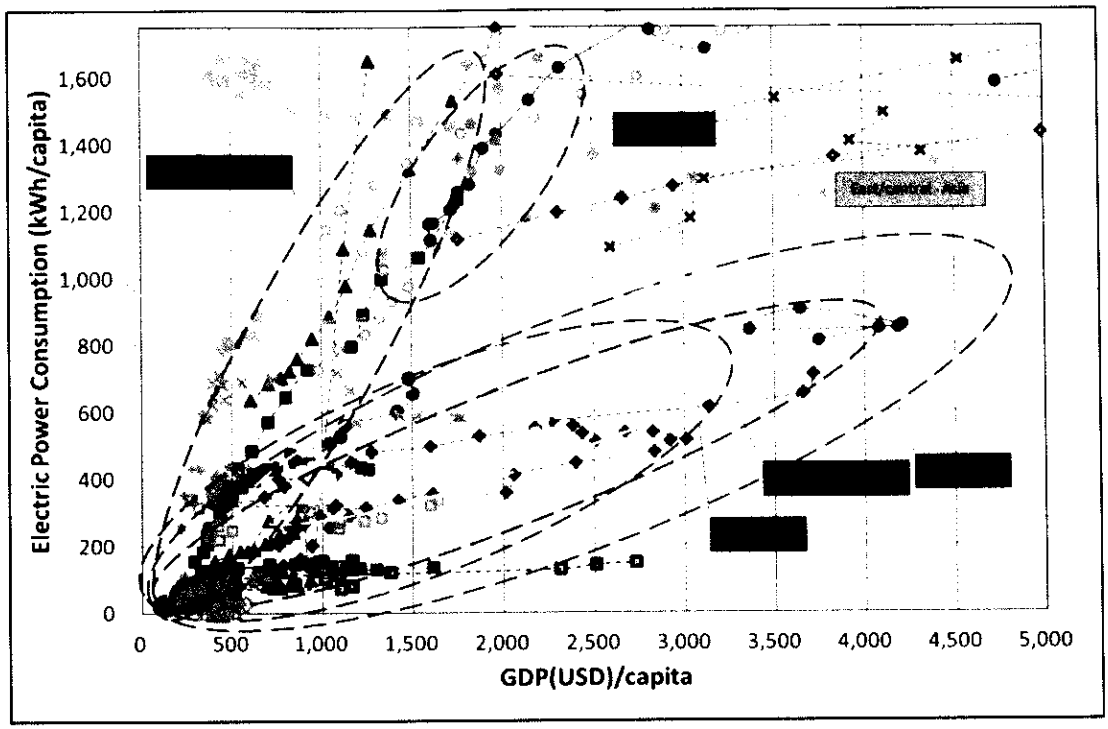


Figure 5.2.1.3-1 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (Enlarged Figure of Figure 5.2.1.3)

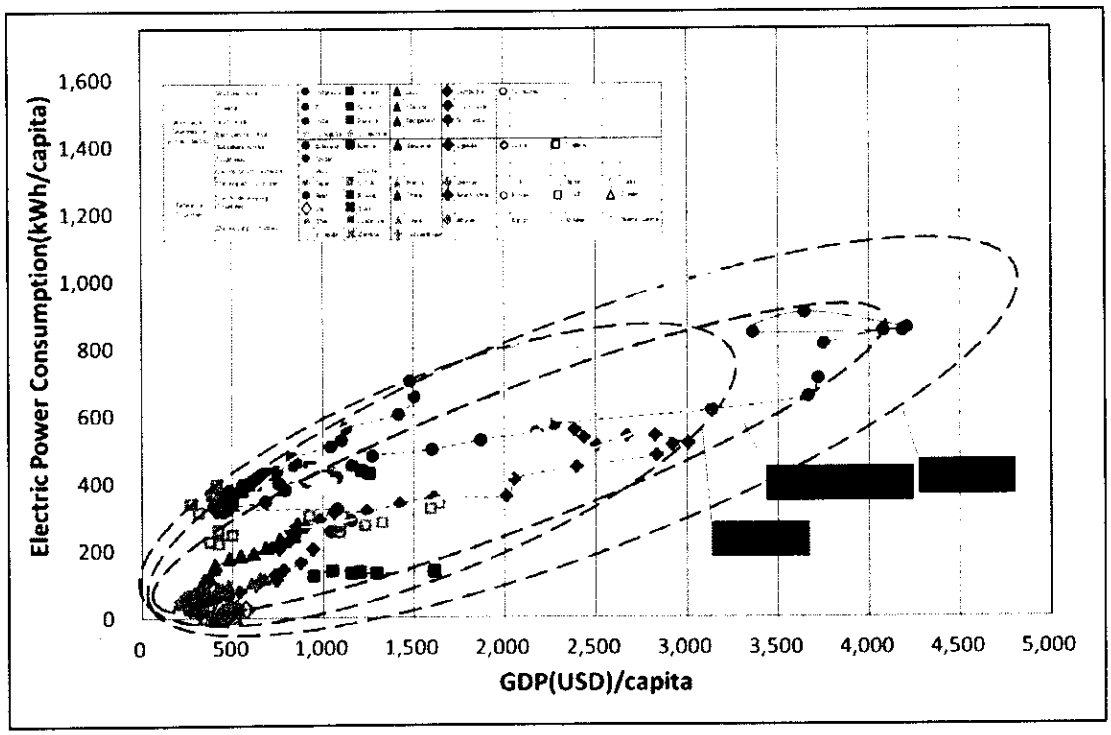


Figure 5.2.1.3-2 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (Little Growth of Electric Power Consumption/capita)

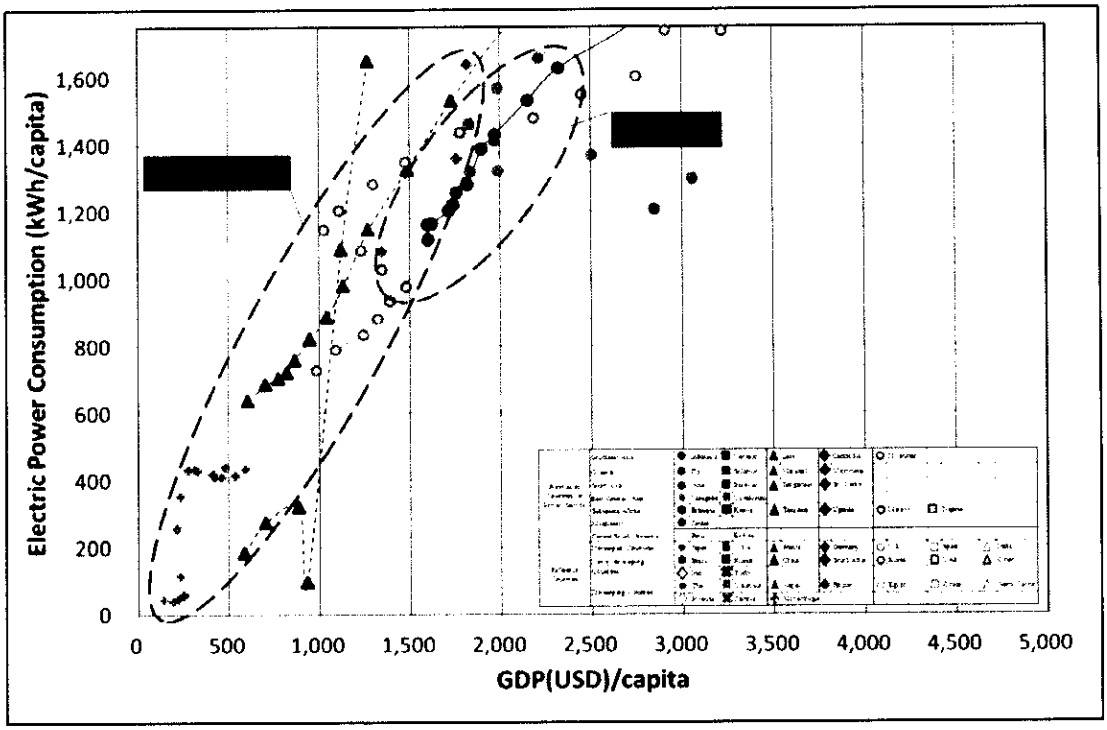


Figure 5.2.1.3-3 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (Large Growth of Electric Power Consumption/capita)

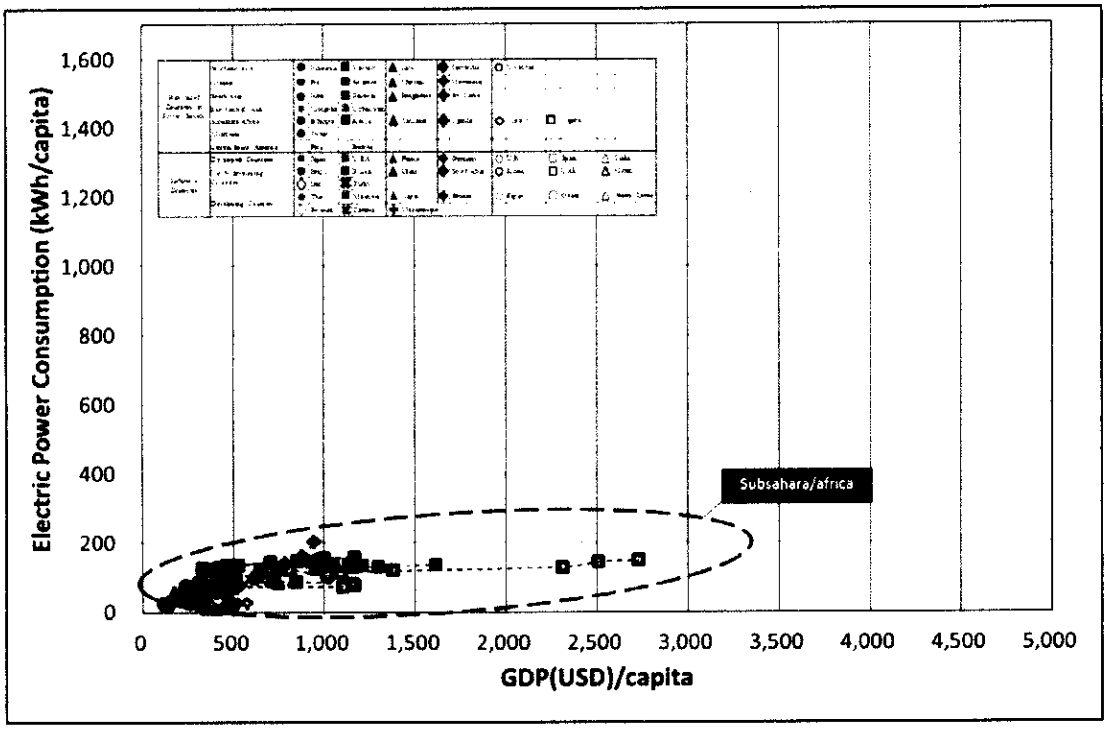


Figure 5.2.1.3-4 Correlation Diagram between GPD/capita and Electric Power Consumption/capita (Less Growth of Electric Power Consumption/capita)

(Time-Series Analysis of Electric Power Consumption/capita 2)

The correlation diagram between GDP/capita and electric power consumption/capita with transverse logarithmic axis is shown in Figure 5.2.1.4, and that with transverse and longitudinal axis is shown in Figure 5.2.1.5. These diagrams implicate as follows;

- Figure 5.2.1.4 has the regression line of each country. The gradients of the lines implicates that GDP/capita might be grouped as three with rough boundaries of 2,000USD/capita and 20,000USD/capita.
- Figure 5.2.1.5 implicates that the electric power consumption/capita might increase as GDP/capita increases; however, the electric power consumption/capita might represent an asymptotic upper line in relation to the power consumption of around 12,000kWh/capita.
- The above-mentioned is interpreted as follows. Also Table 5.2.1.1 summarizes the result below.
  -As the countries have some rapid spread of household appliances in development phase, the gradients of the electric power consumption/capita might increase.
  -As the countries have some saturated condition of household appliances in stable phase, the electric power consumption/capita might have asymptotic upper.

Table 5.2.1.1 Electric Power Consumption/capita in Several Phases of Countries

Item		Initial Stage	Growth Stage	Stability Stage
GDP (USD／Capita)		2,000	20,000	
Electric Power Cunsumption /cap.	Growth Rate	Low Level - MiddleLevel	MiddleLevel - Higth Level	Low Level - MiddleLevel
	Value (kWh／Capita)	—	—	Upper Limit 12,000

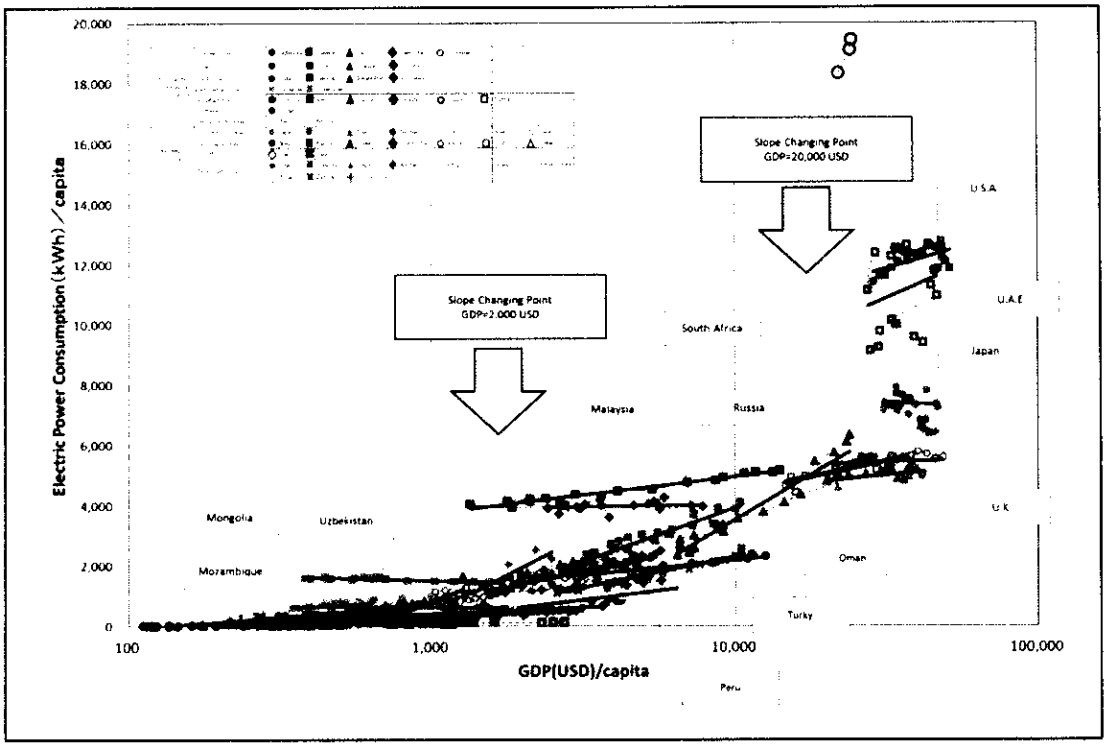


Figure 5.2.1.4 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (Logarithmic Transverse Axis)

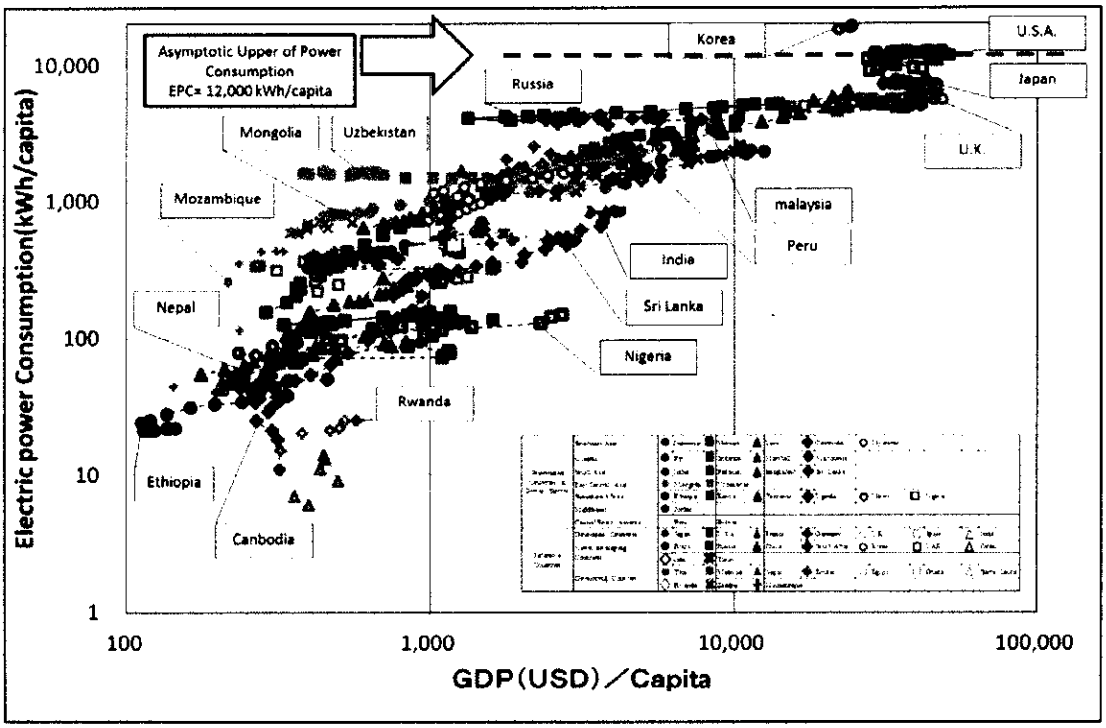


Figure 5.2.1.5 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (Logarithmic Transverse and Longitudinal Axis)

(2) Analytical Example of "Low Carbon"

(2)-1 Carbon Dioxide Emission Unit per All Power Generation

The correlation diagram between GDP/capita and carbon dioxide emission unit per all power generation, either 2010 or the latest year before 2010, are shown in Figure 5.2.2.1 and Figure 5.2.2.1-1. These figures implicate as follows.

- Figure 5.2.2.1 shows that the carbon dioxide emission unit per all electric power generation indicates no correlation with GDP/capita. Figure 5.2.2.1-1 shows that the unit has no time-series changing.
- The above-mentioned is interpreted as follows, under that the carbon dioxide emission unit per all electric power generation is strongly affected by the composition of electrical source.
  - For example, countries, which are mainly supplied by coal-fired plants, have more carbon dioxide emission unit per all electric power generation than countries mainly supplied by gas-fired plants or hydropower plants.
  - No time-series of the unit changes for the data collection period this time, 20 years, because the composition of electrical sources does not change for short period such as 10 to 20 years.

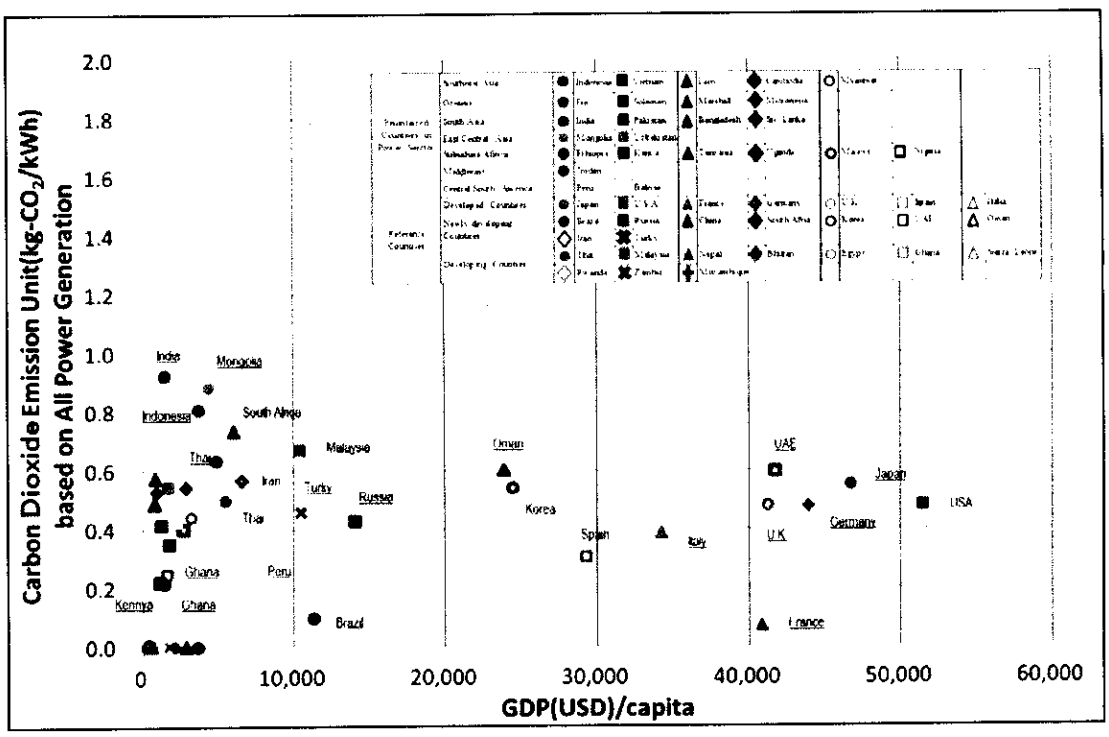


Figure 5.2.2.1 Correlation Diagram between GDP/capita and Carbon Dioxide Emission Unit per All Electric Power Generation

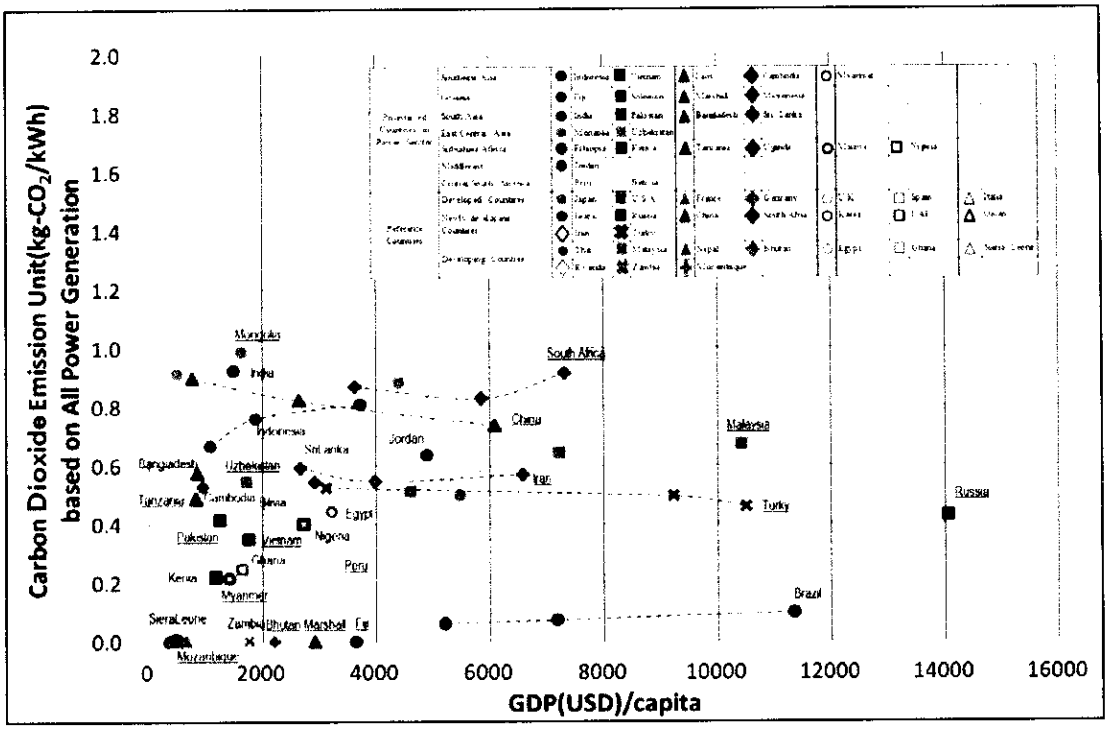
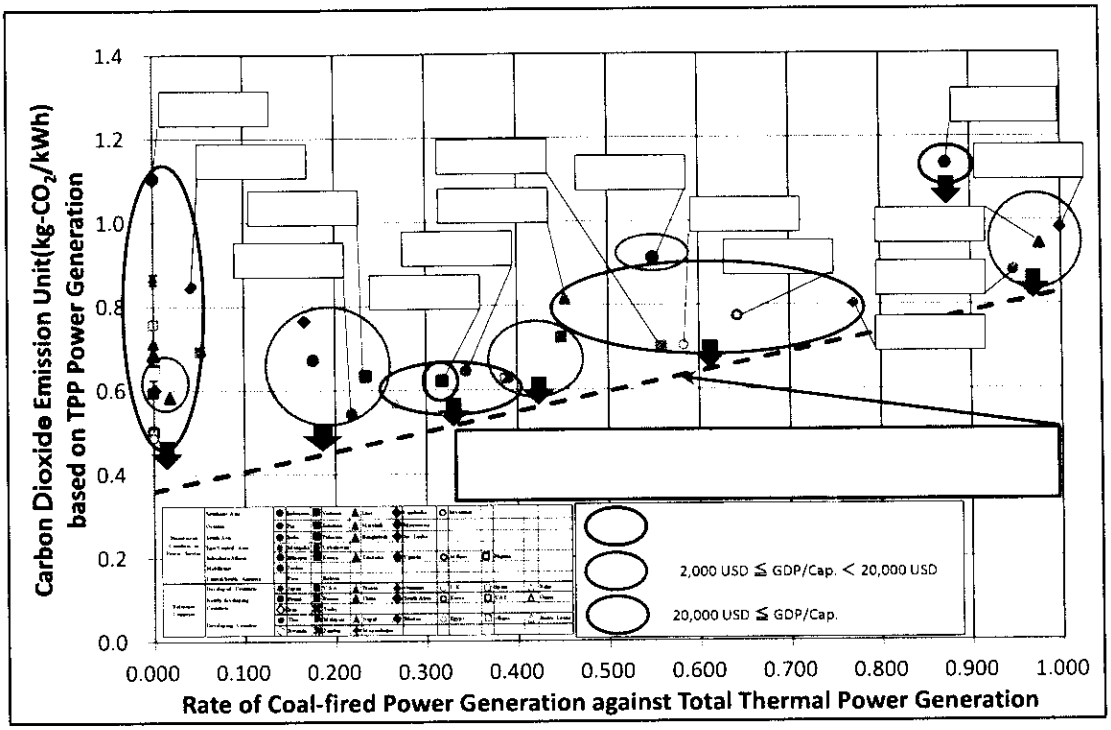


Figure 5.2.2.1-1 Correlation Diagram between GDP/capita and Carbon Dioxide Emission Unit per All Electric Power Generation (With Time-Series)

(2)-2 Analysis of Reducing Carbon Dioxide Emission Unit

The correlation diagram between rate of coal-fired power generation agaist total thermal power generation and carbon dioxide emission unit based on TPP power generation is shown in Figure 5.2.2.2. The transverse axis shows the ratio of coal-fired generation against coal-fired and gas-fired generation of the countries. In the figure, the red broken line shows the minimum carbon dioxide emission unit that the state-of-the -art technology has accomplished. These figures implicate as follows.

- Figure 5.2.2.2 shows that the higher the ratio of the coal-fired is, the more the unit is. Generally, the further development phase of the countries is, the less the unit is. The unit of all the countries is more than the minimum carbon dioxide emission unit that the state-of-the -art technology has accomplished.
- The above-mentioned is interpreted as follows;
  - Comparing with the state-of- the-art technology, all the countries have some rooms to reduce carbon dioxide emission unit.
  - As a best practice country for the JICA prioritized countries in Power Sector, a country with near the coal-fired ratio and further development country is possible to be chosen.



(Source) "Outline of Demand and Supply for Electricity", Resources and Energy Agency
"Technology Strategy Map 2009", NEDO
"Draft Report of Cost Verification Committee", Cost Verification Committee, National Strategy Council

Figure 5.2.2.2 Correlation Diagram between rate of Coal-Fired Power Generation agaist Total Thermal Power Genaration and Carbon Dioxide Emission Unit based on TPP Power Generatio

(2)-3 Analysis of Installation Timing of High Efficiency Thermal Power Generation Unit, Considering Peak Demand of Power System

It is recognized that any installed capacity of electric power generation should be lower than one tenth of the peak demand of the system, in order to avoid any harmful influence for the system, any sudden outage of units. Therefore, the peak demand of any system should be more than 6,000MW, which is ten times of the minimum installed capacity of a single ultra supercritical coal-fired unit, 600MW. This condition is one of the conditions for installation of the coal-fired. The timing that each country meets this condition is calculated as below.

- Based on the annual electric power demand, the annual peak demand was assumed, with system reserve ratio of 10 % and annual load factor of 70%. Then the peak demand at the latest year of this survey, 2012, was extrapolated to the following years, with the averaged growth rate over the calculated peak demand from 2007 to 2012, the latest five years. For reference, one more extrapolation was added with assumptive rate of 8 %. Complying with the above-mentioned calculation, the calculated peak demands until 2040 are shown in Table 5.2.2.1.

- Figure 5.2.2.3 - Figure 5.2.2.7 show the peak demands of Mongolia, Ethiopia, Ghana, Jordan and Nigeria among JICA prioritized countries in Power Sector, which has not reached 6,000MW of peak demand.

The additional condition to the above-mentioned, that the country is operating a coal-fired generation, was taken into account to predict the timing of the installation of an ultra supercritical coal-fired generating unit, shown in Table 5.2.2.1. The additional condition is to clarify the following conditions.

- Cheap coal supply
- Engineers to operate a coal-fired power plant

Table 5.2.2.2 shows the timing of the installation of Ultra Supercritical Coal-fired Unit for the countries among JICA prioritized countries in Electric Power Sector as follows.

- Present, 2015
  Indonesia, Vietnam, Uzbekistan, India, Pakistan and Bangladesh
- Until 2025
  Myanmar

Table 5.2.2.1 Calculated Peak Demand

Minimum capacity of Ultra Supercritical Coal-Fired Power to be installed 600MW
Minimum System Capacity 600MW

: Installed Capacity Larger than 6,000MW
: Ultra Supercritical Coal-Fired Power feasible to install

Country Category	Country	GDP Capita 2012(USD)	Electric Power Generation(GWh)							Annual Peak of Electric Power (Annual Load Factor 70%)							Annual Peak of Electric Power (Increase rate over last 5 years)						Annual Peak of Electric Power (For reference: Increase rate=8%)					
			2006	2007	2008	2009	2010	2011	2012	2006	2007	2008	2009	2010	2011	2012	2015	2020	2025	2030	2035	2040	2015	2020	2025	2030	2035	2040
Reference Country	U.S.A.	51,429	4,300,831	4,349,840	4,368,260	4,188,214	4,378,422	4,349,571	4,290,547	701,375	709,367	712,371	683,009	714,028	709,323	699,698	695,960	684,500	675,170	665,966	656,889	647,934	881,418	1,295,092	1,902,915	2,796,606	4,108,250	6,036,367
Reference Country	Japan	46,684	1,104,589	1,135,718	1,082,549	1,050,326	1,117,123	1,051,261	1,034,305	180,135	185,212	176,541	171,286	182,179	171,439	168,673	159,468	145,228	132,260	120,450	109,695	99,900	212,480	312,205	458,728	674,022	990,359	1,455,162
Reference Country	Germany	43,932	639,492	640,578	640,406	595,617	632,983	613,068	629,812	104,288	104,465	104,437	97,133	103,226	99,978	102,709	101,670	99,961	98,281	96,629	95,005	93,409	129,384	190,107	279,330	410,427	603,053	886,082
Reference Country	U.A.E	41,700	66,768	76,106	86,260	90,573	97,728	99,137	100,927	10,888	12,411	14,067	14,771	15,937	16,167	16,459	19,497	25,855	34,287	45,470	60,299	79,965	20,734	30,365	44,462	65,771	96,339	141,090
Reference Country	U.K.	41,243	397,282	396,830	388,874	376,755	381,760	367,455	363,837	64,788	64,715	63,417	61,441	62,257	59,924	59,334	56,223	51,640	47,347	43,410	39,801	36,492	74,744	109,823	161,367	237,100	348,378	511,882
Reference Country	France	40,853	574,581	568,784	573,908	535,472	569,166	560,343	564,275	93,702	92,757	93,592	87,324	92,819	91,380	92,021	91,583	90,857	90,337	89,822	88,713	88,010	115,920	170,325	250,263	367,719	540,300	793,878
Reference Country	Italia	34,267	314,121	313,888	319,130	292,641	302,064	302,584	299,277	51,227	51,189	52,043	47,724	49,260	49,345	48,806	47,867	46,633	45,487	44,370	43,280	42,217	61,128	89,818	131,971	193,909	284,916	418,636
Reference Country	Spain	29,306	299,454	305,052	313,758	294,620	301,527	293,848	297,559	48,835	49,748	51,167	48,046	49,173	47,920	48,526	99,728	124,771	156,101	195,300	244,341	305,696	109,828	161,373	237,110	348,393	511,903	752,154
Reference Country	Korea	24,454	404,021	427,316	446,428	454,504	499,508	523,286	534,618	65,887	69,686	72,803	74,120	81,459	85,337	87,185	5,636	9,659	16,553	28,368	48,614	83,312	5,139	7,551	11,095	16,303	23,954	35,196
Reference Country	Oman	23,932	19,664	14,598	16,049	18,445	19,819	21,874	25,017	2,228	2,381	2,617	3,008	3,232	3,567	4,080	180,270	198,106	200,479	211,418	222,954	235,120	219,964	323,199	474,885	697,762	1,025,241	1,506,315
Reference Country	Russia	14,056	995,794	1,015,333	1,040,379	991,980	1,038,030	1,054,765	1,070,734	162,393	165,579	169,664	161,771	169,281	172,010	174,614	102,562	127,250	157,978	196,066	243,336	302,003	111,495	166,762	245,027	360,026	528,996	777,264
Reference Country	Brazil	11,338	419,337	445,147	463,067	466,121	515,745	531,757	552,469	68,385	72,594	75,516	76,015	84,107	86,718	90,096	44,658	55,833	69,806	87,275	109,116	136,422	49,200	72,291	106,220	156,072	229,320	336,947
Reference Country	Turky	10,509	176,299	191,558	198,418	194,812	211,208	229,395	239,496	28,751	31,239	32,358	31,770	34,444	37,409	39,057	26,564	36,606	50,445	69,515	95,795	132,009	27,606	40,563	59,600	87,572	128,671	189,061
Reference Country	Malaysia	10,425	89,830	97,516	97,801	116,003	124,786	129,274	134,381	14,649	15,903	15,949	18,918	20,350	21,082	21,915	41,526	40,650	39,792	38,953	38,131	37,326	52,085	77,852	114,391	168,077	246,961	362,866
Reference Country	South Africa	7,313	251,798	263,479	258,291	249,557	259,601	262,538	257,919	41,389	42,968	42,122	40,697	42,335	42,814	42,061	47,329	58,997	73,542	91,673	114,274	142,449	52,237	76,753	112,775	165,703	243,472	357,741
Reference Country	Iran	6,579	192,682	203,986	214,530	221,370	232,959	240,052	254,276	31,422	33,266	34,985	36,101	37,991	39,147	41,467	7,735	10,313	13,751	18,335	24,448	32,598	8,199	12,046	17,700	26,007	38,213	56,148
Frontrunner Country	Peru	6,419	27,358	29,931	32,430	32,929	35,890	39,223	39,909	4,462	4,881	5,289	5,370	5,853	6,396	6,508	1,046,690	1,509,990	2,415,365	3,669,199	5,573,908	8,467,365	1,025,945	1,507,449	2,214,957	3,254,470	4,781,884	7,026,156
Reference Country	China	6,095	2,869,825	3,287,504	3,481,989	3,741,993	4,208,023	4,715,788	4,994,072	468,008	536,123	567,839	610,240	686,240	769,046	814,428	29,736	34,556	40,158	46,668	54,233	63,025	34,229	50,294	73,899	108,581	159,542	234,412
Reference Country	Thai	5,480	138,742	143,378	147,426	148,389	159,518	155,986	166,621	22,626	23,382	24,042	24,199	26,014	25,438	27,172	3,133	4,000	5,106	6,518	8,320	10,621	3,409	5,005	7,361	10,815	15,891	23,349
Frontrunner Country	Jordan	4,895	11,120	13,001	13,838	14,272	14,777	14,647	16,596	1,813	2,120	2,257	2,327	2,410	2,389	2,706	141	148	156	164	173	182	172	252	371	545	800	1,176
Frontrunner Country	Fiji	4,401	756	794	805	810	869	836	836	123	129	131	132	142	136	136	921	1,197	1,558	2,027	2,637	3,432	989	1,454	2,136	3,138	4,611	6,776
Frontrunner Country	Mongolia	4,396	3,544	3,701	4,001	4,039	4,313	4,536	4,816	578	604	652	659	703	740	785	38,510	52,500	71,590	98,019	133,631	182,228	40,243	59,130	86,882	127,658	187,572	275,605
Frontrunner Country	Indonesia	3,718	133,840	143,475	150,423	156,797	169,786	183,416	195,895	21,826	23,398	24,531	25,570	27,689	29,911	31,946	21	24	27	31	35	40	25	37	55	80	118	173
Frontrunner Country	Marshal	3,472	100	106	109	111	114	114	N/A	16	17	18	18	19	19	N/A	31,570	41,469	54,472	71,552	93,967	123,457	33,766	49,613	72,868	107,111	157,381	231,248
Reference Country	Egypt	3,221	115,807	125,129	131,040	139,000	146,796	157,406	164,364	18,820	20,406	21,370	22,668	23,939	25,670	26,804	10	9	9	8	8	7	15	22	32	46	68	100
Frontrunner Country	Micronesia	3,165	71	70	66	70	70	66	N/A	12	11	11	11	11	11	N/A	2,167	2,605	3,131	3,764	4,524	5,438	2,445	3,592	5,278	7,755	11,395	16,744
Frontrunner Country	Sri Lanka	2,921	9,500	9,901	10,005	9,986	10,801	11,658	11,901	1,549	1,615	1,632	1,629	1,761	1,901	1,941	5,350	6,684	8,350	10,432	13,032	16,281	5,897	8,665	12,731	18,707	27,486	40,386
Frontrunner Country	Nigeria	2,730	23,110	22,978	21,110	19,777	26,121	27,034	28,706	3,769	3,747	3,443	3,225	4,260	4,409	4,681	1,125	1,169	1,214	1,260	1,309	1,359	1,386	2,036	2,992	4,396	6,459	9,491
Reference Country	Bhutan	2,458	4,475	6,496	6,892	6,929	7,256	6,976	6,746	730	1,059	1,124	1,130	1,183	1,138	1,100	1,487	1,986	2,654	3,545	4,737	6,329	1,574	2,312	3,398	4,992	7,335	10,778
Frontrunner Country	Bolivia	2,047	5,300	5,734	5,817	6,121	6,947	7,219	7,661	864	935	949	998	1,133	1,177	1,249	14	15	16	17	18	19	17	26	38	55	81	120
Frontrunner Country	Solomon	1,865	71	80	80	79	82	85	85	12	13	13	13	13	14	14	2,162	2,697	3,363	3,791	4,572	5,553	2,434	3,577	5,256	7,722	11,347	16,672
Reference Country	Zambia	1,770	9,890	9,827	9,696	10,499	11,302	11,476	11,850	1,613	1,603	1,581	1,697	1,843	1,871	1,932	24,820	32,835	96,862	177,577	325,550	996,826	25,236	37,080	54,483	80,054	117,626	172,831
Frontrunner Country	Vietnam	1,755	60,493	67,008	73,396	83,175	94,903	105,062	122,845	9,865	10,928	11,969	13,564	15,477	17,133	20,033	8,929	9,577	10,271	11,016	11,815	12,672	10,785	15,847	23,284	34,212	50,269	73,862
Frontrunner Country	Uzabekistan	1,718	50,920	48,950	49,400	49,950	51,300	52,400	52,500	8,304	7,983	8,056	8,146	8,431	8,545	8,562	2,718	4,683	8,070	13,906	23,961	41,280	2,470	3,629	5,331	7,836	11,513	16,917
Reference Country	Ghana	1,641	8,430	6,978	8,324	8,958	10,167	11,200	12,024	1,375	1,138	1,357	1,461	1,658	1,826	1,961	222,050	303,991	416,206	569,845	780,196	1,068,201	234,640	340,156	500,044	734,802	1,079,666	1,586,363
Frontrunner Country	India	1,481	773,784	823,563	848,355	917,302	979,416	1,074,540	1,127,574	126,188	134,306	138,349	149,593	159,722	175,235	183,884	2,387	4,063	6,914	11,769	18,884	31,671	2,205	3,239	4,760	6,994	10,276	15,099
Frontrunner Country	Myanmar	1,415	6,164	6,399	6,622	6,964	7,543	9,868	10,732	1,005	1,044	1,080	1,136	1,230	1,609	1,750	4,073	13,626	45,582	152,462	510,006	1,706,349	2,486	3,653	5,368	7,887	11,589	17,028
Frontrunner Country	Laos	1,408	3,553	3,618	3,971	3,727	8,149	12,242	12,103	579	590	648	608	1,329	1,996	1,974	15,722	15,718	15,874	15,951	16,029	16,107	19,747	29,015	42,633	62,641	92,041	135,238
Frontrunner Country	Pakistan	1,254	98,213	95,661	91,616	95,357	94,384	95,090	96,125	16,016	15,600	14,941	15,551	15,392	15,507	15,676	1,541	1,917	2,385	2,967	3,691	4,591	1,703	2,502	3,677	5,402	7,938	11,663
Frontrunner Country	Kenya	1,186	6,468	6,664	6,770	6,870	7,501	7,849	8,290	1,055	1,087	1,104	1,120	1,223	1,280	1,352	229	220	212	204	197	189	295	433	636	934	1,373	2,017
Frontrunner Country	Cambodia	945	1,176	1,489	1,479	1,256	994	1,053	1,434	192	243	241	205	162	172	234	10,528	16,647	26,327	41,632	65,835	104,108	10,074	14,802	21,748	31,957	46,955	68,993
Frontrunner Country	Bangladesh	862	29,536	31,011	34,319	37,225	41,813	44,163	49,039	4,817	5,057	5,597	6,071	6,819	7,202	7,997	1,145	1,503	2,189	3,027	4,105	5,786	1,188	1,745	2,564	3,768	5,538	8,135
Frontrunner Country	Tanzania	837	3,447	4,182	4,386	4,736	5,187	5,244	5,782	562	682	715	772	846	855	943	669	851	1,083	1,378	1,753	2,230	730	1,072	1,575	2,315	3,401	4,997
Reference Country	Nepal	653	2,748	2,792	2,812	3,115	3,208	3,492	3,552	448	455	459	508	523	569	579	642	864	1,069	2,313	3,546	5,437	636	919	1,350	1,984	2,916	4,284
Frontrunner Country	Uganda	653	1,594	1,986	2,267	2,189	2,406	2,493	3,045	260	324	370	357	392	407	497	41	105	268	682	1,734	4,411	30	44	64	94	139	204
Reference Country	Sierra Leone	634	39	57	135	129	166	145	145	6	9	22	21	27	24	24	26	147	292	572	1,123	2,202	64	94	137	202	297	436
Reference Country	Rwanda	630	160	158	183	238	270	300	310	26	26	30	39	44	49	51	3,052	3,486	3,981	4,546	5,192	5,929	3,734	5,487	8,061	11,845	17,404	25,572
Reference Country	Mozambique	593	14,737	16,076	15,127	16,963	16,666	16,830	15,166	2,403	2,622	2,467	2,766	2,718	2,745	2,473	1,589	2,980	5,621	10,572	19,884	37,395	1,378	2,014	2,959	4,347	6,388	9,385
Frontrunner Country	Ethiopa	468	7,269	7,547	7,777	8,992	8,980	9,307	9,671	533	578	616	651	812	1,029	1,088	430	592	814	1,120	1,540	2,119	448	658	967	1,421	2,087	3,067
Frontrunner Country	Malawi	267	1,553	1,585	1,763	1,728	1,987	2,074	2,180	253	258	288	282	324	338	356												

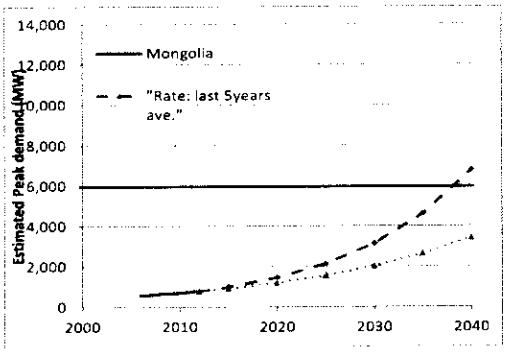


Figure 5.2.2.3 Peak Demand in Mongolia

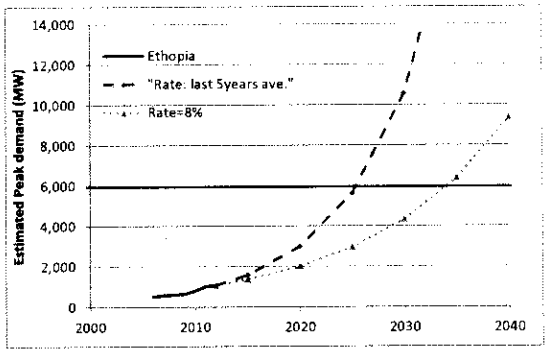


Figure 5.2.2.4 Peak Demand in Ethiopia

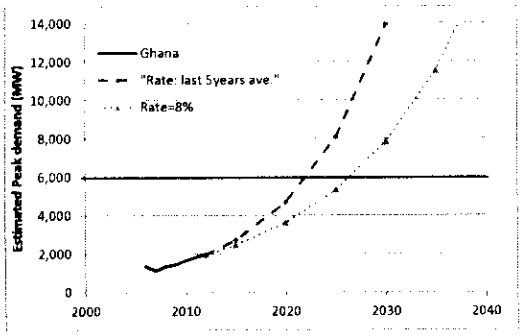


Figure 5.2.2.5 Peak Demand in Ghana

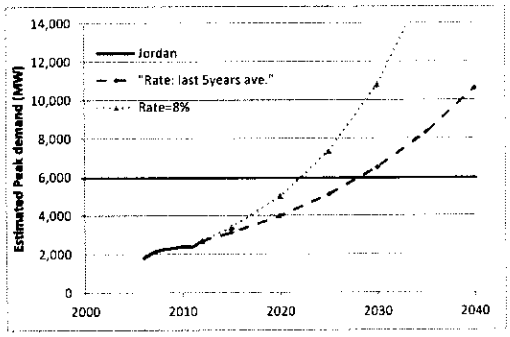


Figure 5.2.2.6 Peak Demand in Jordan

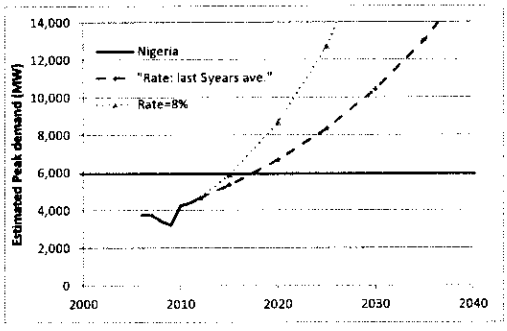


Figure 5.2.2.7 Peak Demand in Nigeria

Table 5.2.2.2 Timing of 6,000MW

Category of Countries	Current Situation of Coal-Fired Thermal Power Plants	Peak Deamnd of Power System to be over 6,000MW						
		2015	Before 2020	Before 2025	Before 2030	Before 2035	Before 2040	After 2040
JICA Prioritized Countries in Power Sector	Existing	Indonesia Veit Nam Uzbekistn India Pakistan Bangladesh	–	Myanmar	–	–	–	Sri LAnka Mongolia Cambodia
	None	–	Nigeria Lao PDR	–	Jordan Ethiopia	–	–	Kenya Tanzania Marshall Micronesia Bolivia Fiji Solomon Uganda Malawi
Reference Countries	Existing	USA Japan Germany UAE UK France Italy Spain Korea Russia Brazil Turkey Malaysia South Africa Iran Peru China Thailand	–	–	–	–	–	–
	None	Egypt	Oman	Ghana	–	–	–	Zambia Mozambique Nepal Sierra Leone Rwanda

(3) Analytical Example of "Financial Soundness"

The averaged income (the gross income/the gross electric power consumption) and the averaged cost (the gross cost/the gross electric power consumption) are shown in Figure 5.2.3.1 and Figure 5.2.3.2 respectively. Also, the averaged revenue (the averaged income – the averaged cost) is shown in Figure 5.2.3.3.

- The averaged cost has a positive correlation with GDP/capita. That is considered as below.
  - -In the beginning of development of countries, power plants can be installed near power demands.
  - -As the countries are developing further, the suitable sites near the demands for power generation are running out. Then the suitable sites are moving farther from the demands and need long transmission lines. Independent Power Producers, IPPs, makes the purchase cost expensive.
- The averaged income also has a positive correlation with GDP/capita. It is thought that electric tariffs are going to rise by the countries, following costs increase.
- The averaged revenue is largely negative, in some countries under 5,000USD/capita, as follows.
  - JICA Prioritized Countries in Power Sector: Jordan, Tanzania
  - Reference Countries: Ghana
- It is considered that these countries cannot raise the electric tariffs due to some reasons. The countries or some aid agencies would make up the deficit. It implicates that lowering electric power supply cost or raising electric power tariff is considered necessary.

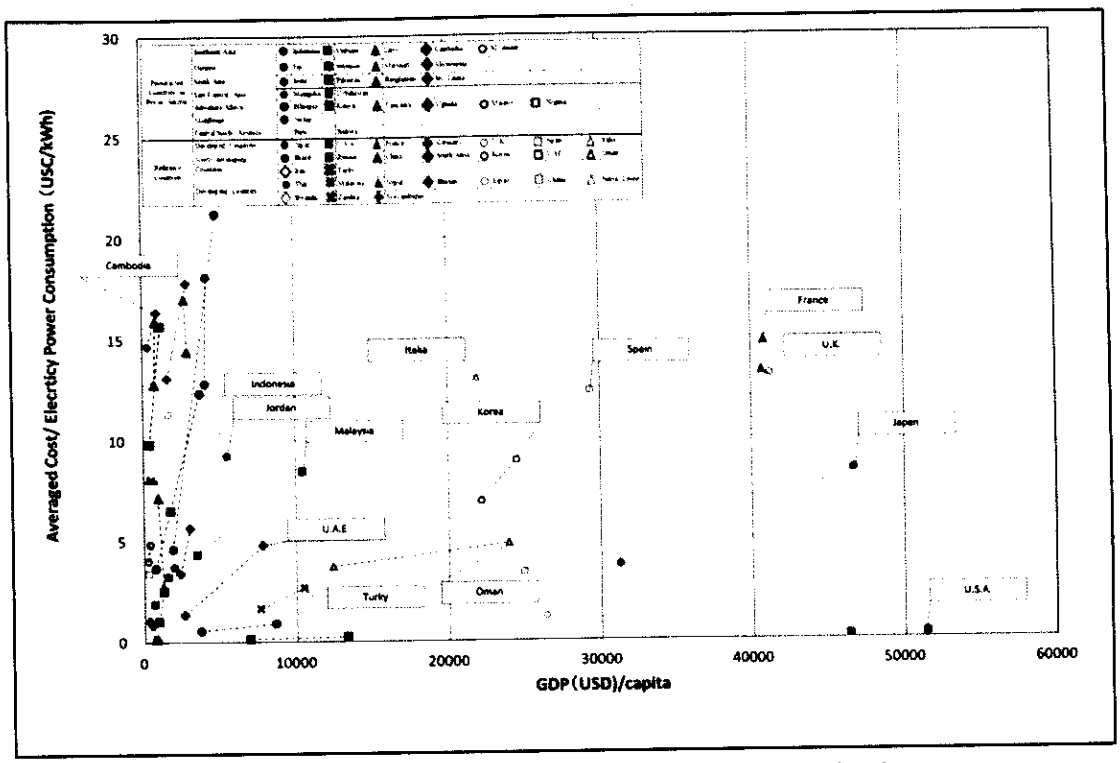


Figure 5.2.3.1 Correlation Diagram between GDP/capita and Averaged Cost per Gross Electric Power Consumption

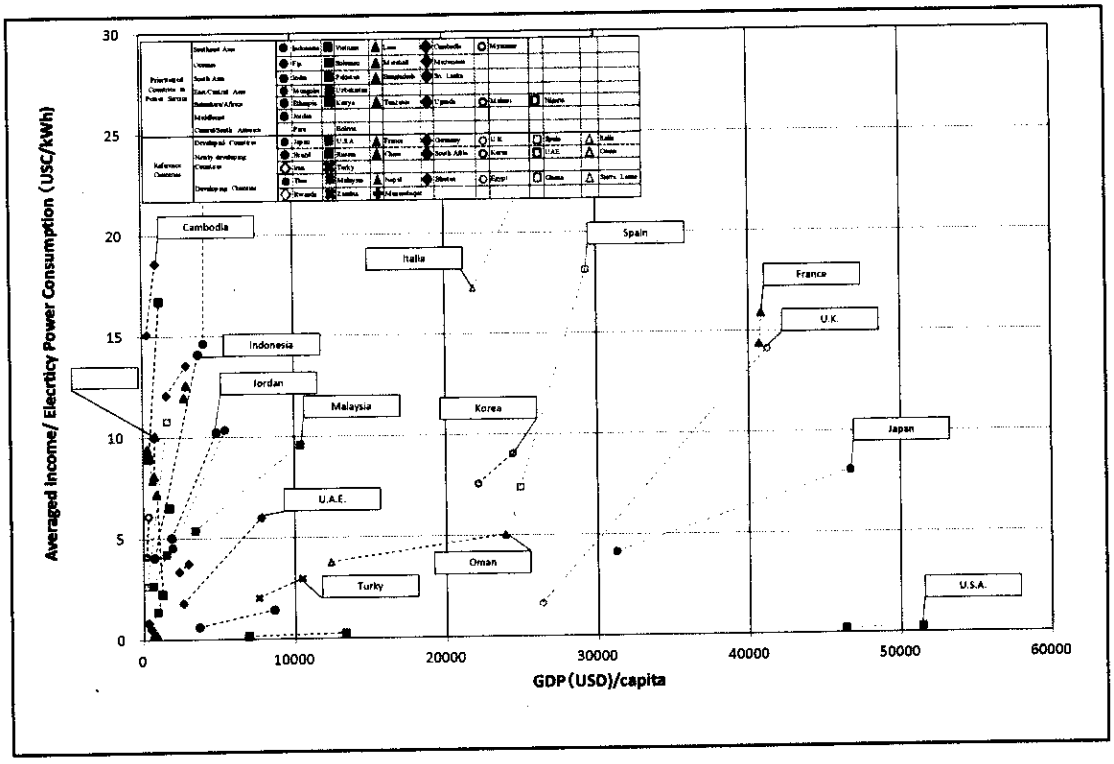


Figure 5.2.3.2 Correlation Diagram between GDP/capita and Averaged Income per Gross Electric Power Consumption

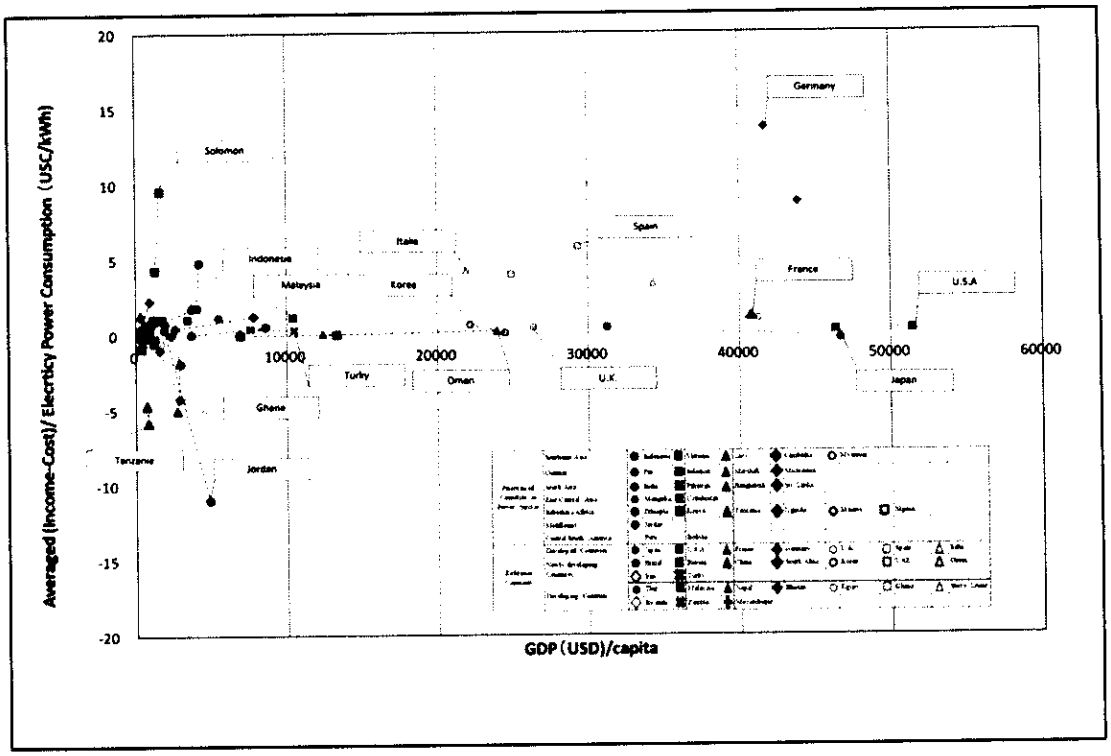


Figure 5.2.3.3 Correlation Diagram between GDP/capita and Averaged Revenue per Gross Electric Power Consumption

5.3 Attention Points of Multiple Classification Analysis

It is thought that the future electric power consumption/capita can be predicted by the multiple classification analysis, because the electric power consumption/capita has a positive correlation with GDP/capita. For the prediction, it is required that the below consideration should be given attention to.

- Figure 5.3.1 (the same figure of Figure 5.2.1.4) shows the time-series changing of the electric power consumption with GDP/capita. In the figure, each country has a positive correlation, but each value of the electric power consumption/capita is different from the others at the same GDP/capita. For example, U.S.A., Japan and U.K. are identified as the developed countries and the electric power consumption/capita of U.S.A. is twice as that of U.K., at the same GDP/capita. It means that some explanatory variables except the electric power consumption/capita should be taken into account.
- In order to examine the time series data of the electric power consumption/capita, the data after 1950 is shown in Figure 5.3.2. The data plotted in the figure is not the same as that of the Electric Power Information Database with regard to the data period or the coverage country, but the data were was used in this consideration for reference. Figure 5.3.2 shows that the curve profiles are similar but some points of the profile rising up are not the same. For example, China has increased the electric power consumption/capita in earlier GDP/capita, comparing with Japan. It implicates that the spread of cheap household appliances in earlier GDP/capita boosted up the electric power consumption/capita earlier, comparing with Japan.

In the analysis, it is thought that the principal component analysis should identify some explanatory variables in hiding except GDP/capita, the influence rate should be analyzed. The attention points are as follows;

- Because the whole curve profile of each country is necessary to be analyzed, the data is collected since 1950 at least.
- An index to show the spread of cheap household appliances should be identified as an explanatory variable, and then the index need to be added to the Electric Power Information Database.

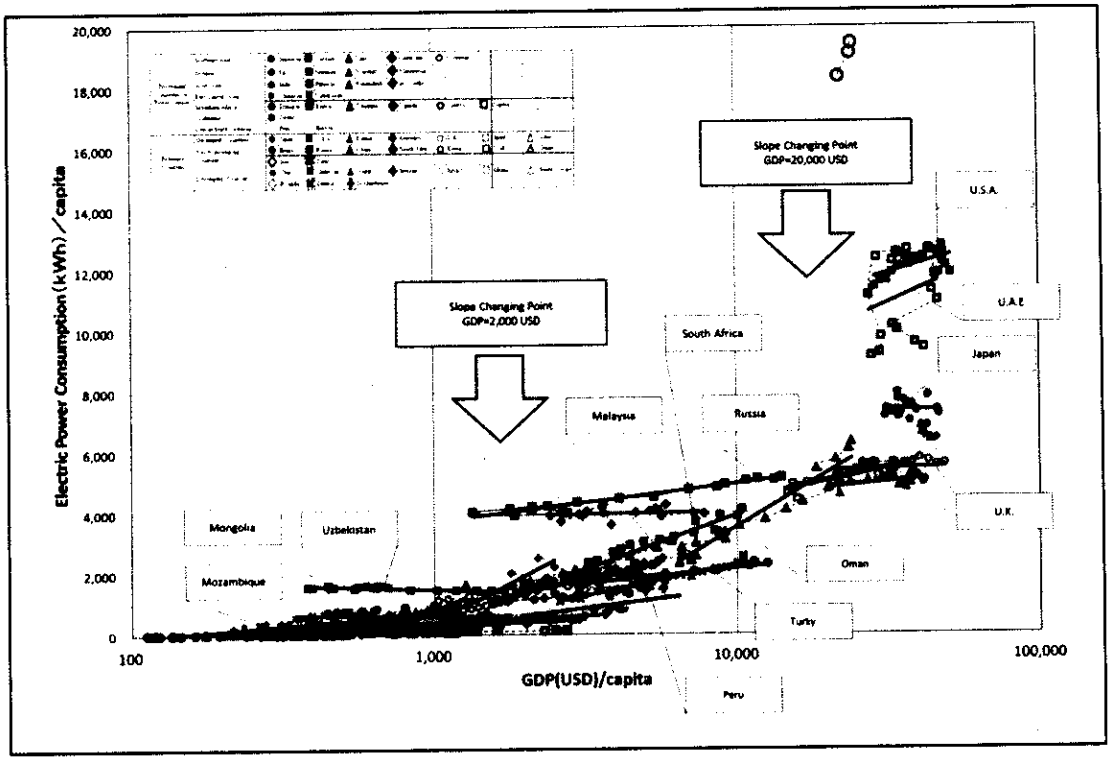


Figure 5.3.1 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (The Same Figure of Figure 5.2.1.4)

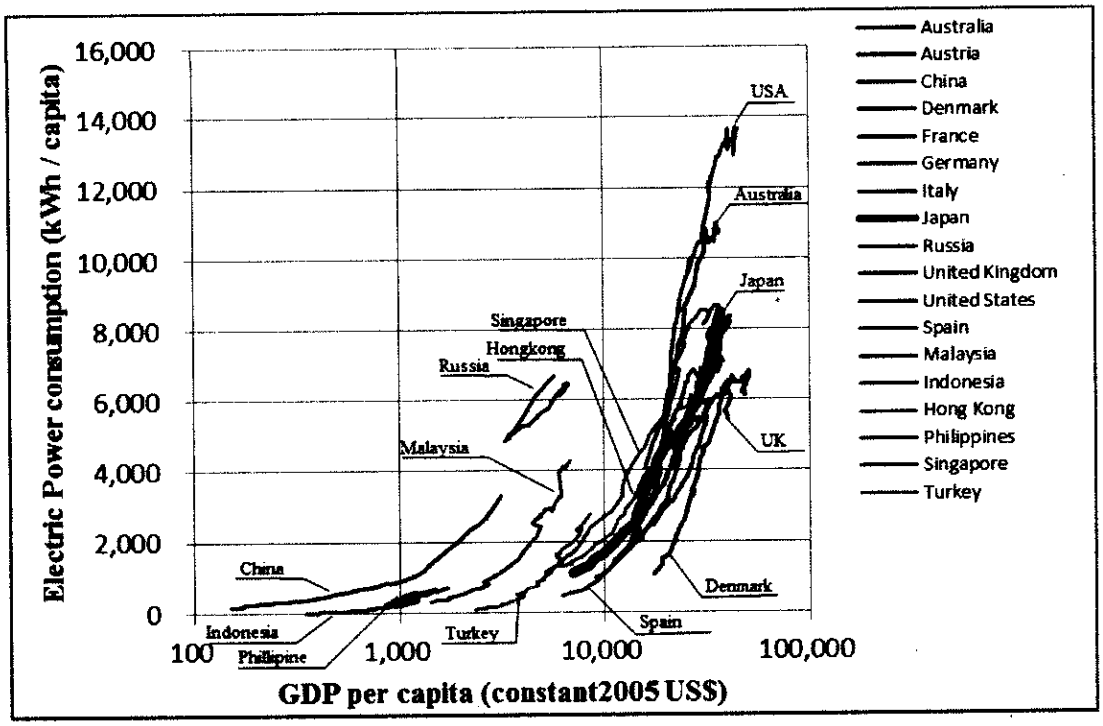


Figure 5.3.2 Correlation Diagram between GDP/capita and Electric Power Consumption/capita (Data Since 1960, Not Only Object Countries of This Invetigation)

6. Future Issues

In the Study of future issues, issue about investigating method of statistics data, addition of statistics data and investigating method of these statistics, intensification of investigating capacity of electric power statistics data by developing countries and addition of target countries of the Electric Power Information Database will be extracted.

6.1 Future Issue about Investigating Method of Statistics Data

In the investigating of statistics data, public HP data of International Organization, Target Country's Government and Target Country's Electric Power Company were investigated. As a result, all statistics data weren't able to investigate.

Therefore, it was found that investigation of statistics data is the important issue for performing appropriate study in developing countries by the Electric Power Sector Diagnostic Assistance Tool.

For a policy of this resolving issue, it thought about the investigation of statistics data that utilized JICA's Oversea Office.

6.2 Future Issue about Addition of Statistics Data and Investigating Method of Statistics Data

In the development of the Electric Power Information Database, statistics data to consider Evaluation Item (Evaluation Item for evaluating 6 Diagnostic Objects) were investigated. As a result, evaluation Item is representative item.

Therefore, it was found that subdivision of Evaluation Item is the important issue for performing appropriate study in developing countries by the Electric Power Sector Diagnostic Assistance Tool.

For a policy of this solving issue, it thought about the study of addition of statistics data and the investigation of statistics data that utilized JICA's Oversea Office.

Addition of statistics data thought about at present is as follows:

(1)Basic data
  (a)Electric Power Basic Data
    - Generation Facilities : Electric Power Capacity (MW) and Electric Power Generation (GWh) of Generation for Private use
  (b)Diagnostic Objects Data
    - Energy Access : Electric Power Consumption of Household (GWh)
    - Low Cost : Electric Power Charge of Household (Local Currency／kWh) , Feed-in Tariff Price (Local Currency)

6.3 Future Issue about Intensification of Investigating Capacity of Electric Power Statistics Data by Developing County's Government

In the investigating of electric power statistics data of JICA's Power Sector Prioritized Countries, HP data of International Organization, Target Country's Government and Target Country's Electric Power Company were investigated. As a result, all electric power statistics data weren't

able to investigatie.

Therefore, it was found that intensification of investgating capacity of electric power statistics data by developing country's government is the important issue for peroming approraiate study in developing countries by the Electric Power Sector Diagnostic Assistance Tool and corss country analysis.

For a policy of this resolving issue, it thought about the workshop agaist developing country's government organization in charge of electric power statistics data.

Intensification of investigating capacity of electric power statistics data thought about at present is as follows:

(1)Basic Data
(a)Electric Power Basic Data
- Transmission Facilities : Transmission Line Length (km)
- Substation Facilities : Substaion Capacity (MVA)
- Distribution Facilities : Distribution Line Length (km)

(2)Diagnostic Objects Data
(a)Energy Access
- Electrification Ratio (%)

(b)Low Cost
- Electric Power Supply Cost (Local Currency)
- Electric Power Sale Income (Local Currency)

(c)Low Carbon
- Carbon Dioxide Emission Unit (g-CO2/kWh)

(d)Low Risk
- SAIDI (Hour/Household)
- SAIFI (Time/Household)

(e)Financial Soundness
- Balance Sheet
- Profit Loss Statement
- Electric Power Company Subsidy (Local Currency)

6.4 Future Issue about Addition of target Countries of the Electric Power Information Database

In the investigating of statistics data, 50 countires (24 countires : JICA's Power Sector Prioritized Countires, 26 countires : Reference Countires) were investigated. As a result, the analysis precision of cross country analysis weren't enough.

Therefore, it was found that addition of target countires of the Electric Power Information Database is the important issue for peroming approraiate study in cross country analysis.

For a policy of this resolving issue, it thought about the study of Electric Power Information Database against all countries in UN (193 countires).

6.5 Attention Points of Multiple Classification Analysis

In the analysis, it is thought that the principal component analysis should identify some explanatory variables in hiding except GDP/capita, the influence rate should be analyzed. The attention points are as follows;

- Because the whole curve profile of each country is necessary to be analyzed, the data is collected since 1950 at least.
- An index to show the spread of cheap household appliances should be identified as an explanatory variable, and then the index need to be added to the Electric Power Information Database.