

**Asia Clean Energy Forum  
Policy and Finance Solutions for Energy Security & Climate Change  
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## **Promoting Cleaner Coal**

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Deputy Governor – Fuel  
Electricity Generating Authority of Thailand**



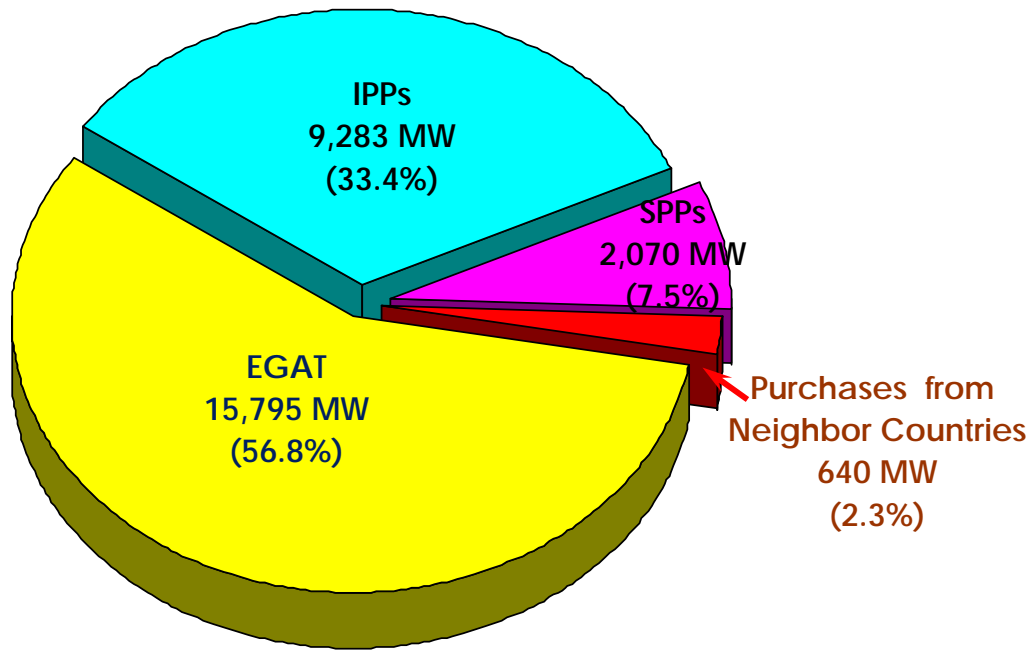
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2. Existing coal-fired power plant in Thailand
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4. Constraints on coal utilizing as fuel for electricity generating in Thailand
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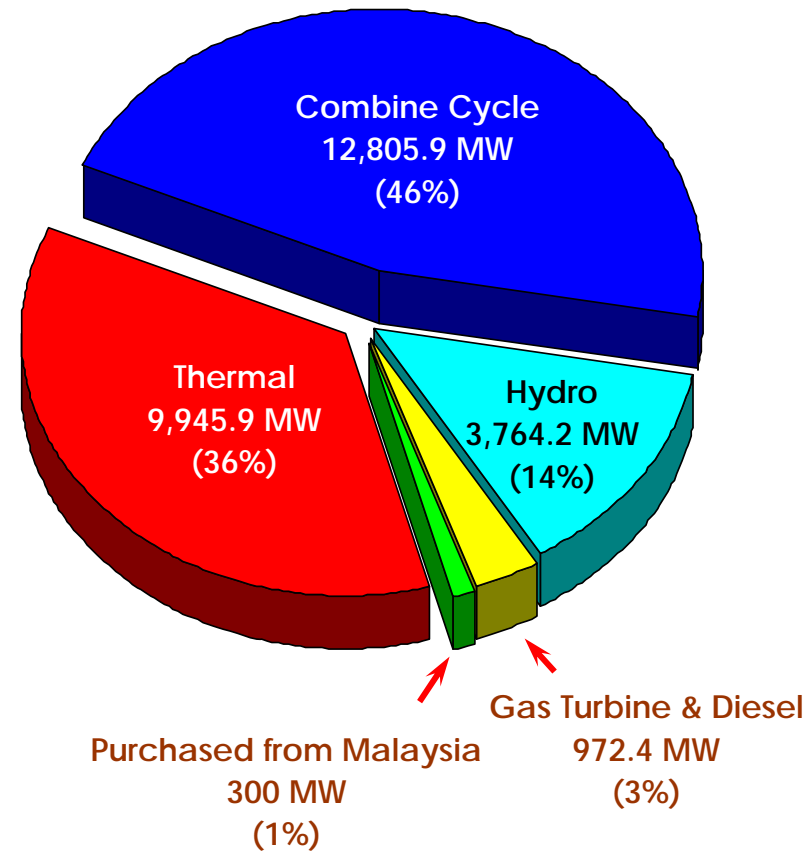


# Thailand's Installed Capacity (April 2007 = 27,788.5 MW)

## Classified by Producer

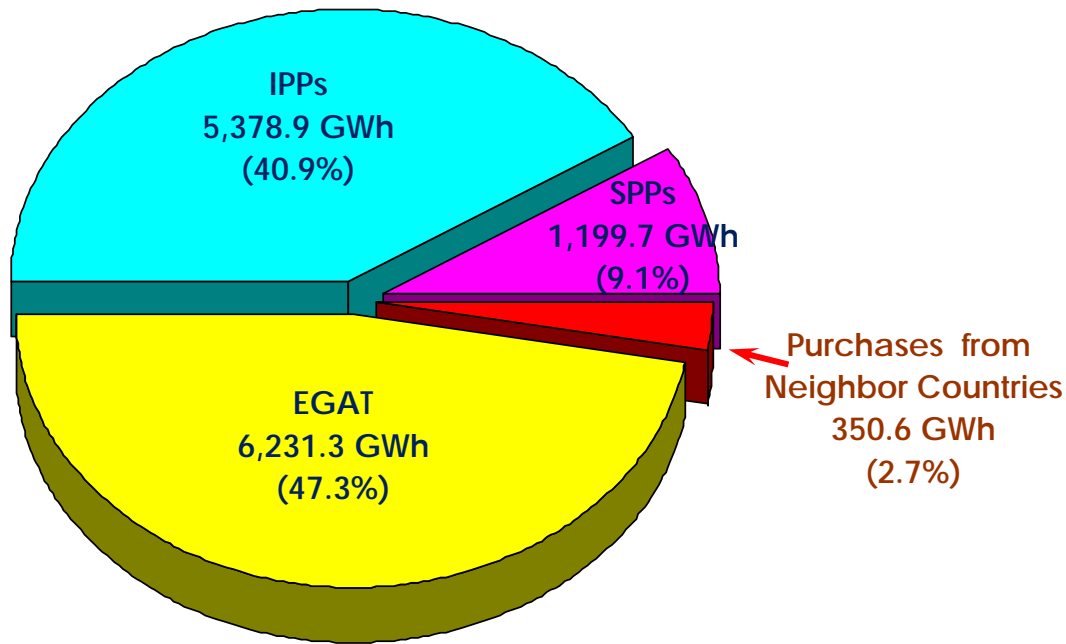


## Classified by Type of Power Plant

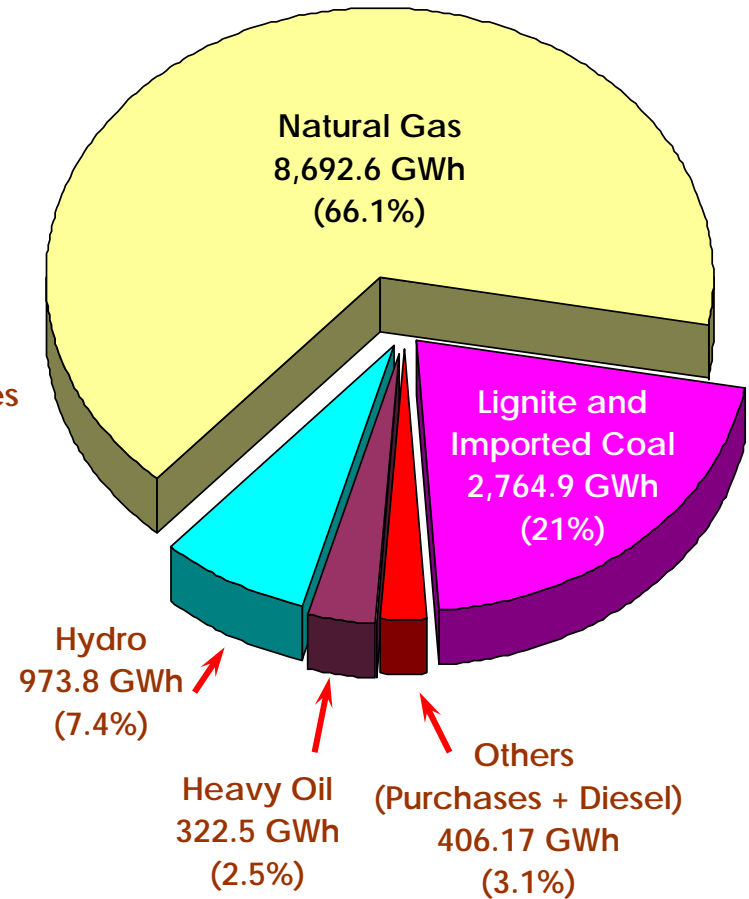


# Thailand's Generation Mix (March 2007 = 13,160.5 GWh)

## Classified by Producer



## Classified by Fuel Type



# Existing Coal-fired Power Plant in Thailand

Coal-Fired Power Plant	Install Capacity (MW)	Percentage (%)
<b>EGAT's Power Plant</b>		
- Mae Moh Unit 4	150.00	4.00
- Mae Moh Unit 5	150.00	4.00
- Mae Moh Unit 6	150.00	4.00
- Mae Moh Unit 7	150.00	4.00
- Mae Moh Unit 8	300.00	8.01
- Mae Moh Unit 9	300.00	8.01
- Mae Moh Unit 10	300.00	8.01
- Mae Moh Unit 11	300.00	8.01
- Mae Moh Unit 12	300.00	8.01
- Mae Moh Unit 13	300.00	8.01
<b>Sub-Total</b>	<b>2,400.00</b>	<b>64.06</b>
<b>IPP</b>		
- BLCP Unit 1	673.25	17.97
- BLCP Unit 2	673.25	17.97
<b>Sub-Total</b>	<b>1,346.50</b>	<b>35.94</b>
<b>Total</b>	<b>3,746.50</b>	<b>100.00</b>



# Mae Moh Coal-fired Power Plant

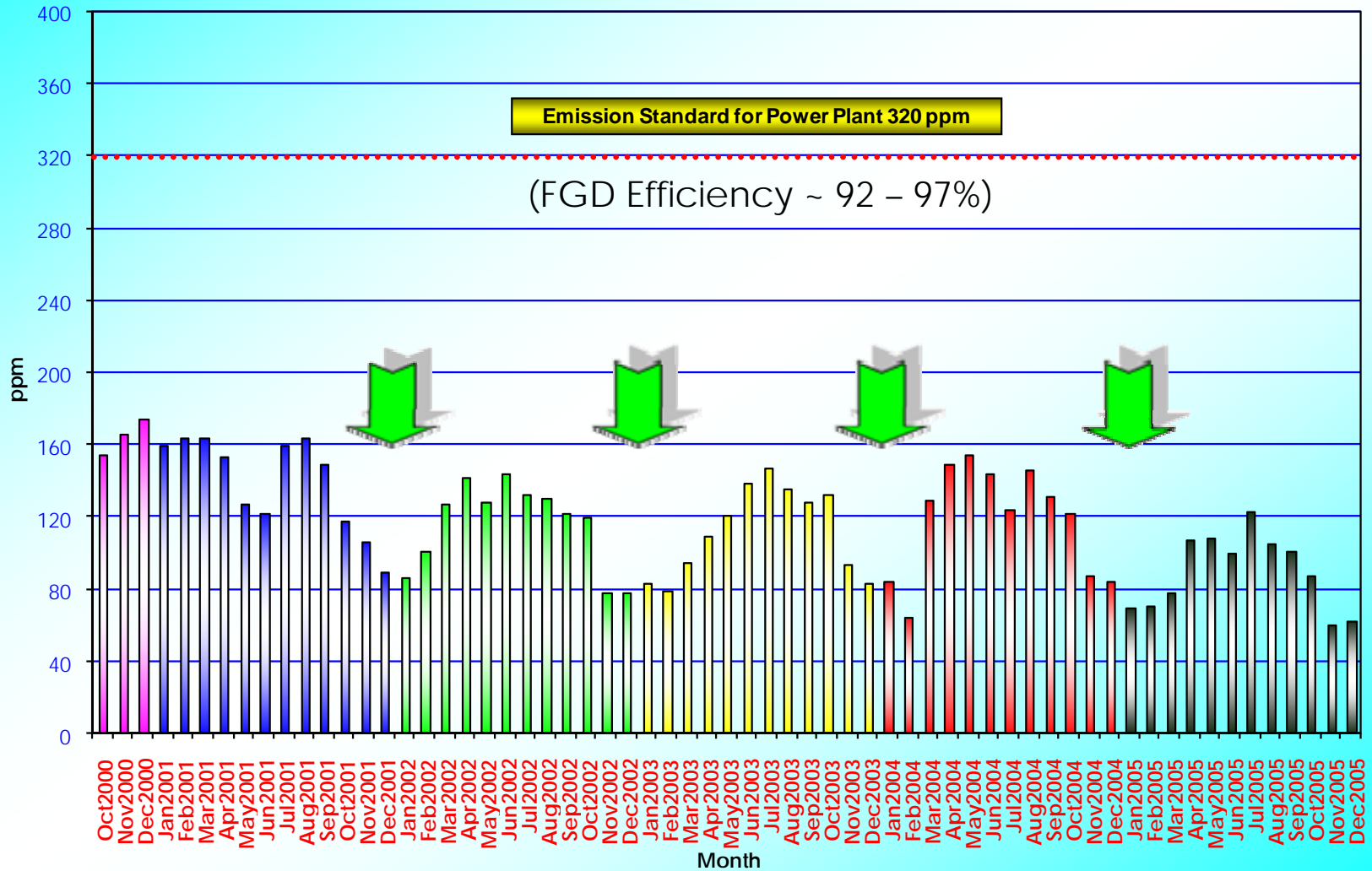
- **Technology** : Conventional pulverized coal fired, steam-electric generation with nominal output of 4 x 150 MW and 6 x 300 MW, Single reheat cycle, Main steam conditions 140 Bar (a), 530 °C and 161 Bar (a), 538 °C
- **Boiler** : Subcritical pressure, single reheat, single drum, single furnace, balanced draft, forced circulation type
- **Steam Turbine** : Triple pressure, single reheat, condensing, tandem compound type
- **Environmental Control Equipment** :
  - *NO<sub>x</sub>* ; Low NO<sub>x</sub> burner
  - *SO<sub>x</sub>* ; Wet Limestone Flue Gas Desulphurisation Plant
  - *Particulate* ; Electrostatic Precipitator
- **Fuel** :
  - *Main* ; Lignite Coal
  - *Startup* ; Light Diesel



# Mae Moh Coal-fired Power Plant

SO<sub>2</sub> Emission controlled by Lime stone- wet scrubber

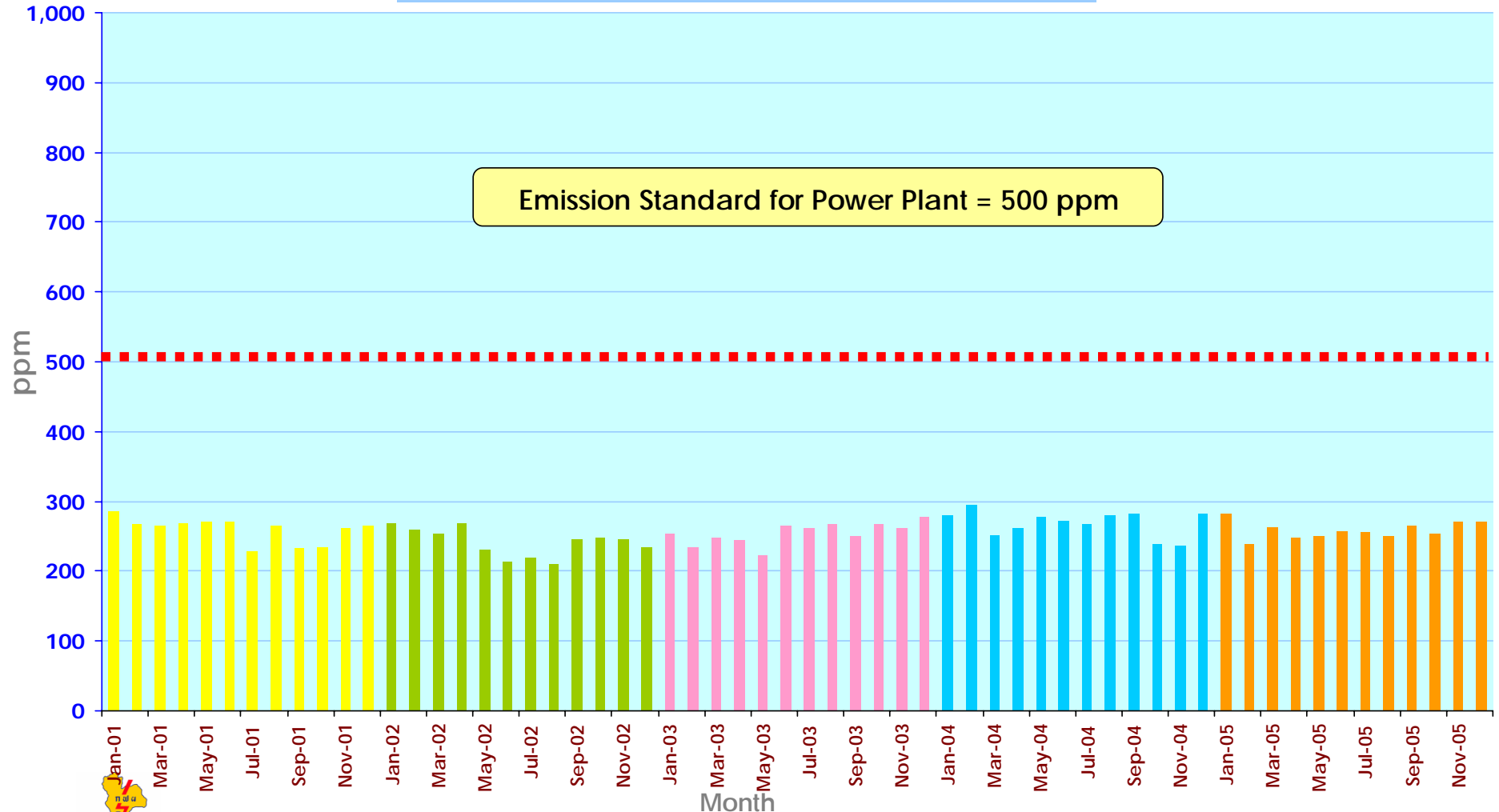
## Average SO<sub>2</sub> Emission Concentration



# Mae Moh Coal-fired Power Plant

## NO<sub>x</sub> Emission controlled by Low – NO<sub>x</sub> Burner

### Average NO<sub>x</sub> Emission Concentration

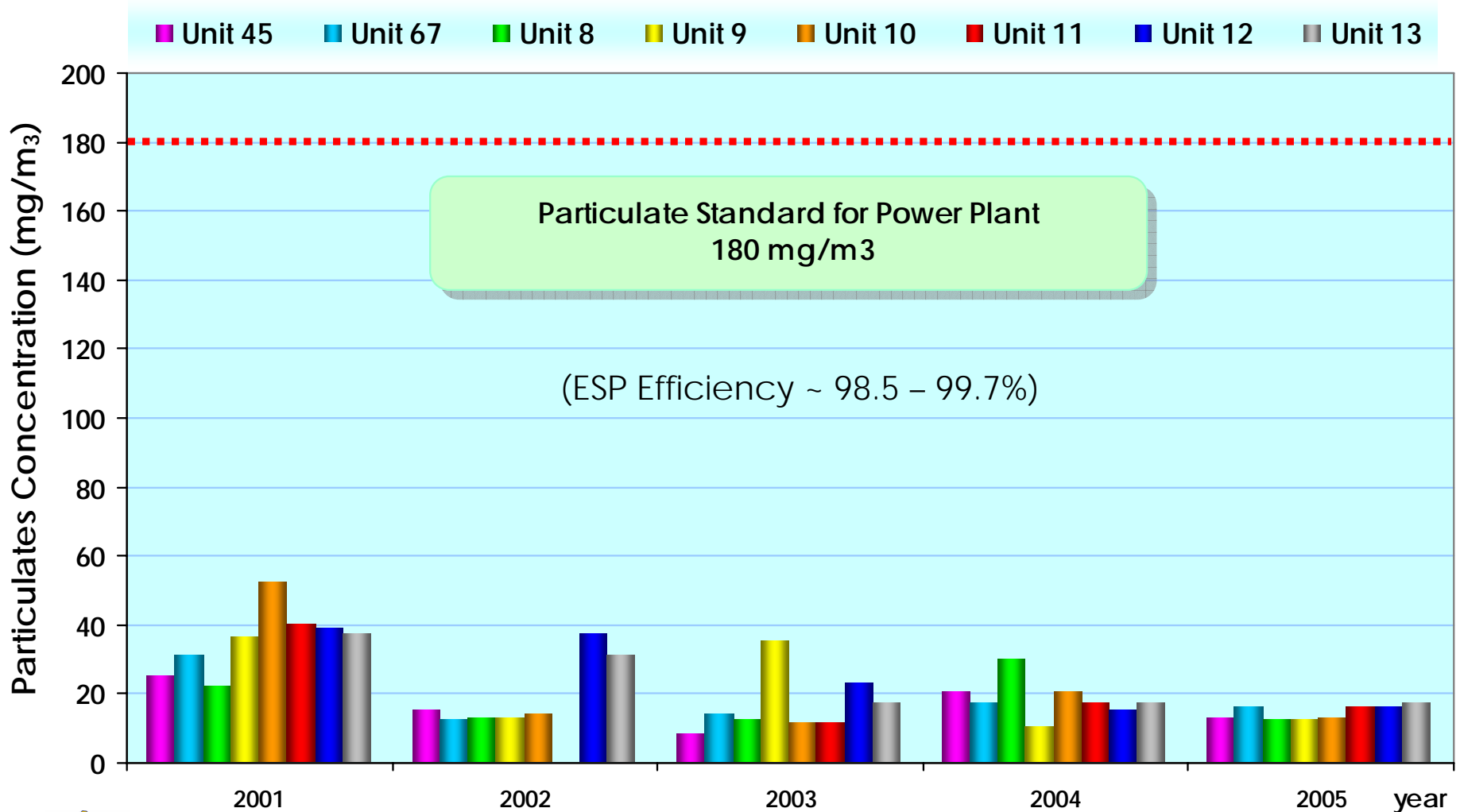


Electricity Generating Authority of Thailand

# Mae Moh Coal-fired Power Plant

## Particulates Emission controlled by Electro-static Precipitator

### Particulates at Stack Emission



# Electricity Generation Mix by Countries in 2004

Unit : %

	Poland	South Africa	Australia	China	India	USA	Germany	Malaysia	Thailand
<b>Coal</b>	93.08	92.31	79.19	77.89	69.05	50.08	49.96	27.90	15.91
<b>Fuel Oil</b>	1.63	0.00	0.72	3.26	5.39	3.33	1.64	3.31	6.16
<b>Natural Gas</b>	2.04	0.00	12.28	0.36	9.48	17.52	9.97	61.76	70.95
<b>Nuclear</b>	0.00	5.46	0.00	2.29	2.55	19.48	27.09	0.00	0.00
<b>Hydro</b>	2.39	1.89	6.88	16.07	12.69	7.14	4.52	7.03	4.80
<b>Renewable</b>	0.86	0.34	0.92	0.11	0.85	2.45	6.83	0.00	2.17

Source : IEA Energy Statistic 2005



# World Coal Consumption

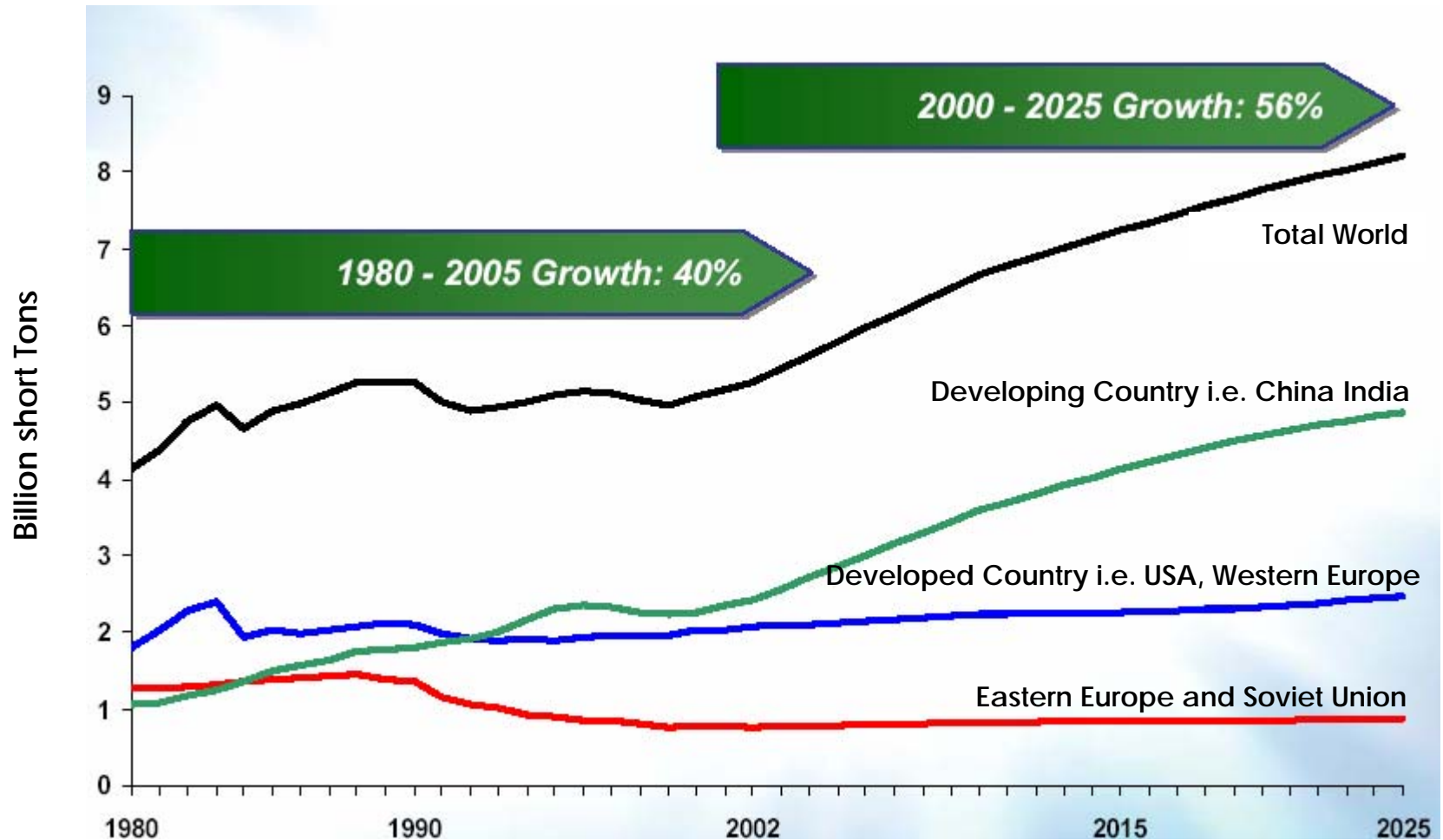
Unit : Million tonnes of oil equivalent

	2000	2001	2002	2003	2004	2005
China	667.4	681.3	713.8	853.1	978.2	1,081.9
USA	569.1	552.3	552.0	562.5	566.2	575.4
India	169.1	172.1	181.7	188.4	203.7	212.9
Japan	98.9	103.0	106.6	112.2	120.8	121.3
Russia Federation	106.0	109.0	103.9	109.4	106.8	111.6
South Africa	81.9	80.6	83.5	89.3	94.5	91.9
Germany	84.9	85.0	84.6	87.2	85.4	82.1
Poland	57.6	58.0	56.7	57.7	57.3	56.7
Australia	48.3	49.6	52.3	50.9	52.4	52.2
Ukraine	38.8	39.4	38.3	39.0	38.1	37.4
United Kingdom	36.7	40.0	36.6	38.8	38.1	39.1
Taiwan	28.9	30.8	32.9	35.3	36.8	38.2
Total World	2,360.9	2,381.3	2,433.5	2,629.2	2,798.9	2,929.8

Source : BP Statistical Review of World Energy 2006



# World Coal Consumption Outlook

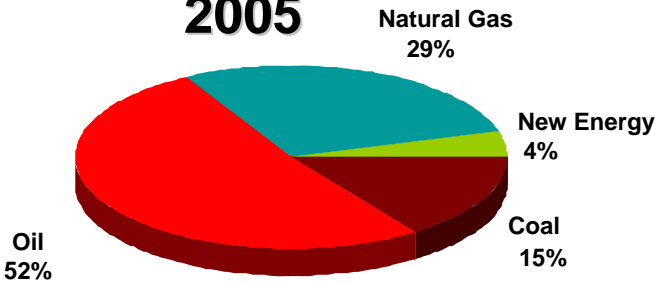


Source : EIA International Energy Outlook 2005

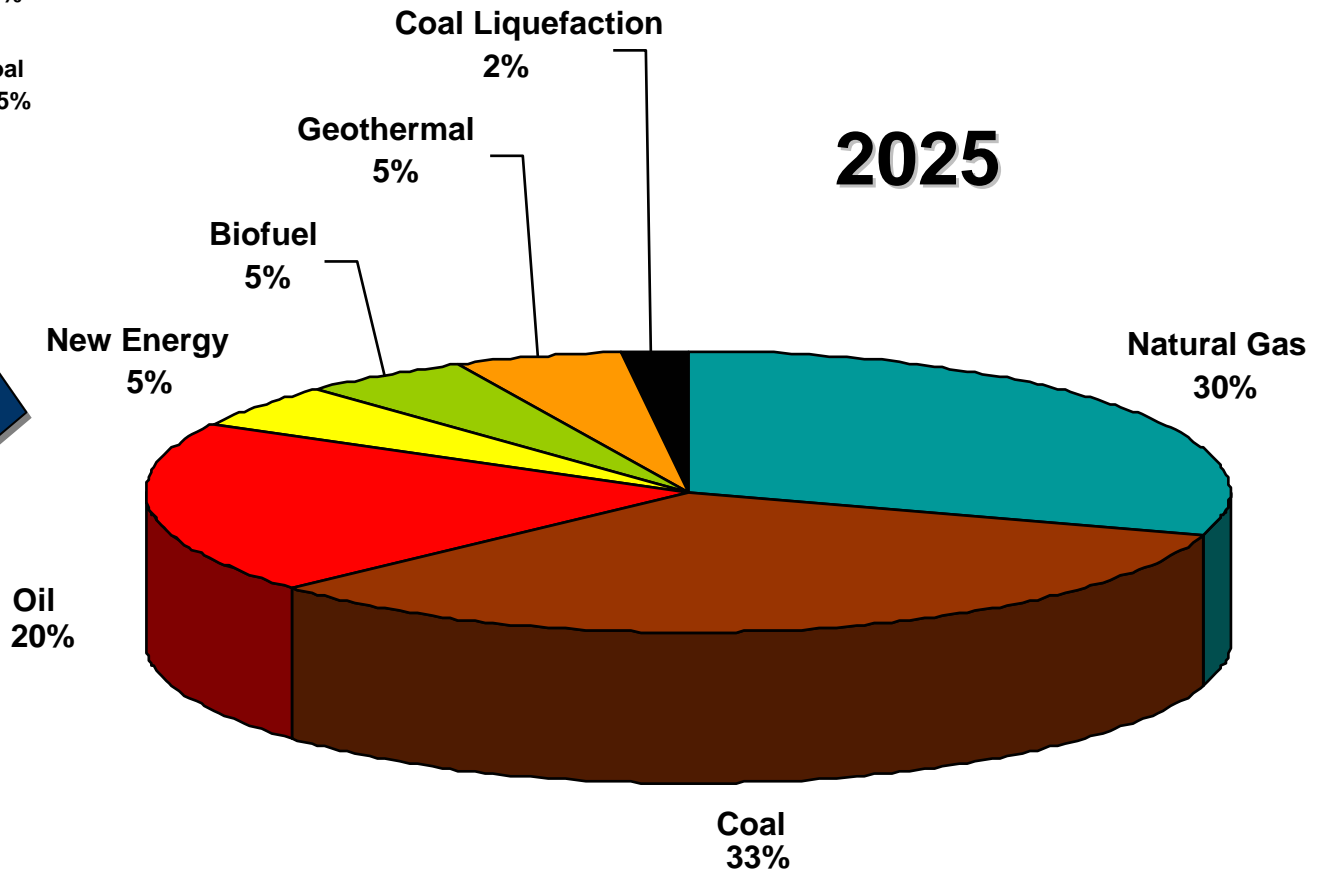


# Indonesia Toward Energy Mix 2025

**2005**

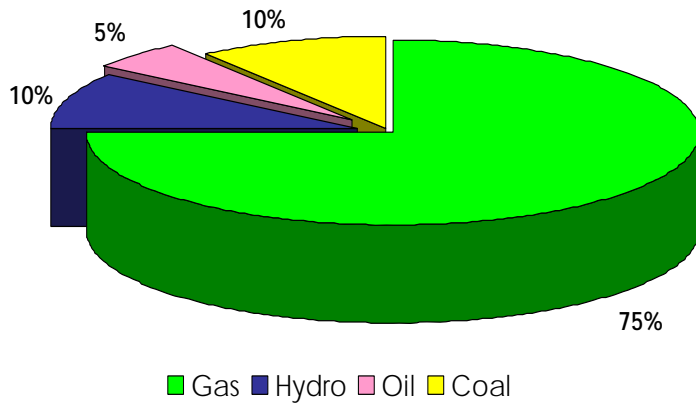


**2025**

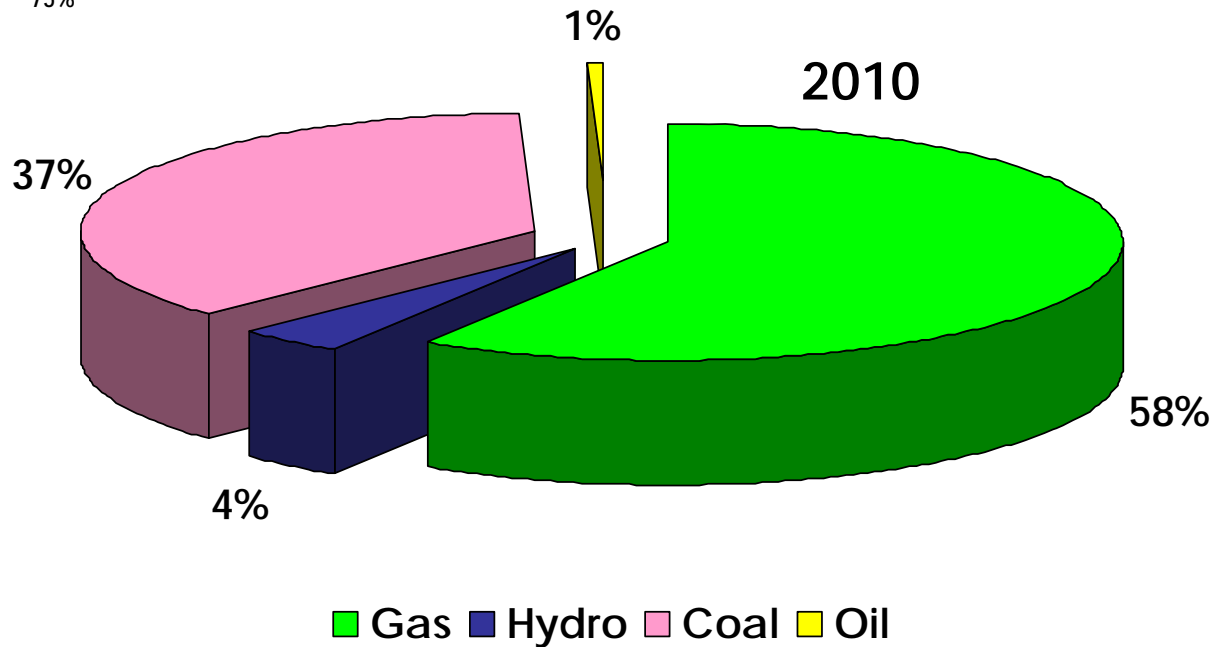


# Malaysia Toward Generation Mix 2010

1985-2000



2010



Source : TNB Fuel Services Sdn. Bhd., Malaysia Outlook of coal supply/demand and energy and coal policy in Malaysia.



- USA plans to construct 151 units of coal-fired power plants in the year 2020 with the total install capacity of 90 GW. It is expected that the gasification technology would be applied to 34 units of those power plants, Ultra-supercritical for 4 units, Supercritical for 16 units and CFB for 23 units of them. The rest of the units would be for Sub-critical Pulverized Coal boiler applied.

## Coal's Resurgence in Electric Power Generation

**151 Proposed & New (on-line) Plants**  
(Includes 9 Proposed Plants On-Hold & 10 Operating Plants)  
**90 GW Power**  
**\$ 145 Billion Investment**



**Equivalent Power**  
**for**  
**90 Million Homes**



OSAP 5/1/2007



- Oman has the total install capacity of power plants in the year 2006 at 2,956.6 MW with the natural gas for main fuel of 90%, while the diesel usage is at 10%.
- According to the growing of energy consumption at 9% per annum, the feasibility study on imported coal utilization for the power plants, to be constructed in the year 2012, with total install capacity of 1,000 MW has been carried out. It is expected that the location of the new power plants would be close to Sur or Duqm city.



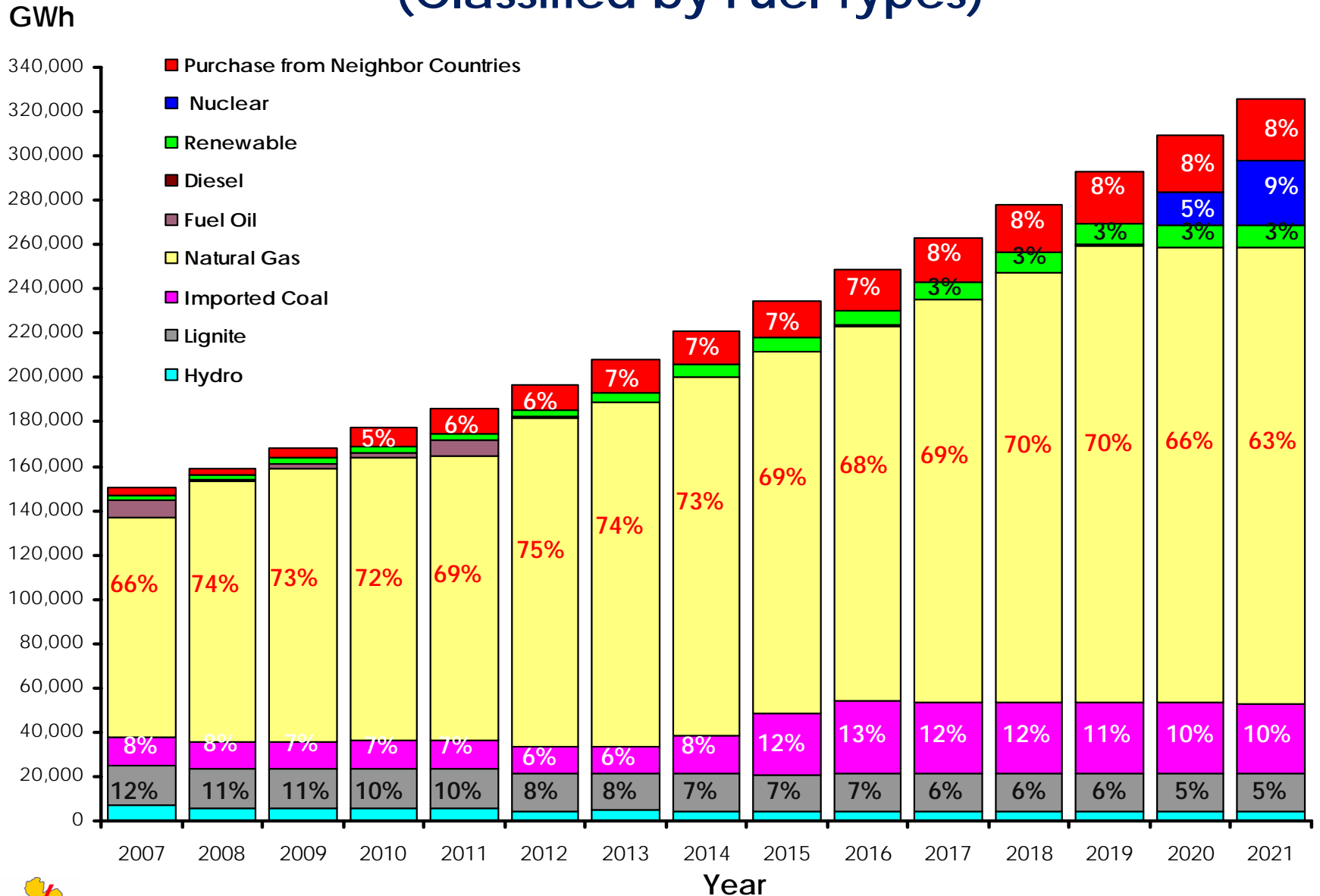
# Thailand Power Development Plan (PDP 2007)

Unit : MW

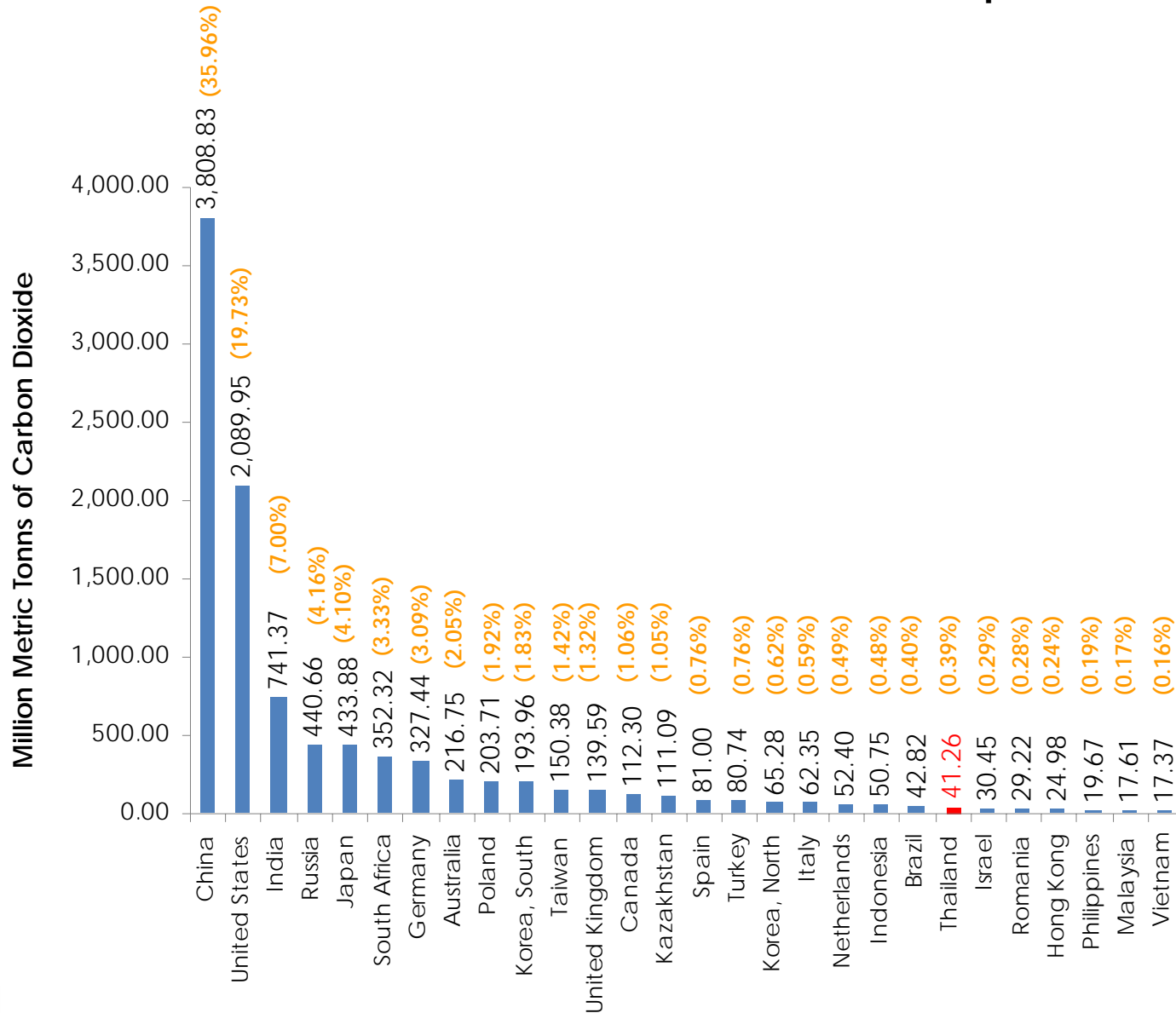
Year	New Power Plants				Purchase from Neighbour Countries	Added Capacity	Total Capacity	Power Demand	Reserve Margin (%)
	Gas	Coal	Nuclear	SPPs					
2007	-	-	-	-	597	597	34,037	27,996	18.0
2008	1,400	-	-	200	-	1,600	35,637	29,625	16.6
2009	1,400	-	-	200	963	2,563	37,580	31,384	15.8
2010	1,400	700	-	200	-	2,300	39,880	33,216	16.3
2011	1,400	1,400	-	200	380	3,380	42,085	35,251	15.6
<b>Total</b>	<b>5,600</b>	<b>2,100</b>	<b>-</b>	<b>800</b>	<b>1,940</b>	<b>10,440</b>			
2012	1,400	700	-	200	490	2,790	44,126	37,382	16.2
2013	2,800	-	-	200	500	3,500	47,118	39,560	15.4
2014	2,800	-	-	200	510	3,510	49,887	41,795	15.4
2015	3,500	-	-	200	530	4,230	52,828	44,082	16.3
2016	1,400	-	2,000	100	550	4,050	55,250	46,481	16.5
2017	700	-	2,000		570	3,270	58,320	48,958	15.3
<b>Total</b>	<b>12,600</b>	<b>700</b>	<b>4,000</b>	<b>900</b>	<b>3,150</b>	<b>21,350</b>			
<b>Grand Total</b>	<b>18,200</b>	<b>2,800</b>	<b>4,000</b>	<b>1,700</b>	<b>5,090</b>	<b>31,790</b>			



# Generation Mix for PDP 2007, Thailand (Classified by Fuel Types)



# World Carbon Dioxide Emissions from the Consumption of Coal, 2004



Source : EIA International Energy Annual 2004



# New EGAT Coal-fired Power Plant

- **Technology** : Super critical pulverized coal fired, steam-electric generation with gross output of 760 MW, Single reheat cycle, Main steam conditions 242 Bar (a), 538/566 °C
- **Boiler** : Super critical pressure, single reheat, single furnace, balanced draft, forced circulation type
- **Steam Turbine** : Triple pressure, single reheat, extracted-condensing, tandem compound type
- **Environmental Control Equipment** :
  - *NOx* ; Low NOx burner, S-OFA
  - *SOx* ; Seawater Flue Gas Desulphurisation Plant
  - *Particulate* ; Electrostatic Precipitator
- **Fuel** :
  - *Main* ; Bituminous Coal
  - *Startup* ; Light Diesel

S-OFA : Separated Over Fired Air



## - Comparison between coal-fired USC and SC's performance -

Boiler Type		Ultra supper critical (USC)	Super critical	Sub critical
Main/Reheat Steam Temp.	°C	600 / 610	538 / 566	538 / 566
Main Steam Press.	MPa	25.1	24.2	< 20
Plant Efficiency (HHV, Net/Gross)	%	41.4 / 43.6	39.9 / 42.1	37 / 39
Gross Output (Net/Gross)	MW	998.5 / 1,050	946 / 1,000	665 / 700
Fuel	-	Moura Coal (HHV 7,230 kcal/kg [a.d.])		
Fuel Consumption	t/h	303.6	299.1	226
CO <sub>2</sub> Discharge	kg/h	780x10 <sup>3</sup>	770x10 <sup>3</sup>	580x10 <sup>3</sup>
Unit CO <sub>2</sub> Discharge (Net/Gross)	kg-CO <sub>2</sub> /kWh	0.78 / 0.74	0.81 / 0.77	0.87 / 0.83

Source : Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI)

Introduction of the-state-of-the-Art technology of IHI for Ultra-Supercritical power plant (Japan)



# Constraints on coal utilizing as fuel for electricity generating in Thailand

1. Coal Utilization has not been totally, publicly accepted.
2. With limited natural resource, imported coal is required.
3. Power plants have to be located close to the limited seashore area.
4. The CO<sub>2</sub> mitigation cost with carbon credit trading is still higher than conventional pulverized coal power plant.



# Suggestions and Policy for supporting cleaner coal

1. There should be support in technologies development so as to mitigate CO<sub>2</sub> caused in electricity generation on commercial basis.
2. Carbon credit trading has to cover increased cost concerning CO<sub>2</sub> elimination.
3. There should be improving the efficiency of new coal-fired power plant for reduce CO<sub>2</sub> emission (i.e. Supercritical boiler).
4. There should be implementation on energy saving promoting.
5. Promoting power generation from renewable energy.





Thank you for your attention

