Workshop of Trans-boundary Air Pollution in North East Asia

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NATIONAL PROCESS TO ESTABLISH NEW SO2 EMISSION STANDARDS IN MONGOLIA

PROF.ADIYASUREN Ts, "ECO ASIA" UNIVERSITY

PROF. TSEYEN-OIDOV J, UNIVERSITY OF SCIENCE AND TECHNOLOGY

C O N T E N T S

INTRODUCTION

We propose this draft emission standards for coal fired power plants to the Ministry of Nature, Environment and Tourism (MNET) and Mongolian Agency For Standardization and Metrology consideration.

- based on the experience and lessons learned from others;
- considering the current status of Mongolia regarding availability of coal, financial, environmental, and technology resources;
- people's understanding and acceptability;
- through careful comparison and analysis.

MONGOLIA-briefly

- ❖Territory :1.565.000 sq.km
- ❖Population: 2.8 million
- ❖GDP Growth: 7.5%
- ❖GDP per capita: 2050USD
- ❖Unemployment rate: 3.2%
- ❖Birth rate 2.3%

Power Plants in Mongolia

- In Mongolia, over 98% of electricity is generated by coal-fired power plants.
- Total available power capacity in Mongolia is 615 MW.
- In 2010, total power generation reached 4.3 billion kWh with 98.7% from coal-fired power plants.
- 7 main coal-fired power plants with capacity of 836.3 MW.

Power Plants in Mongolia

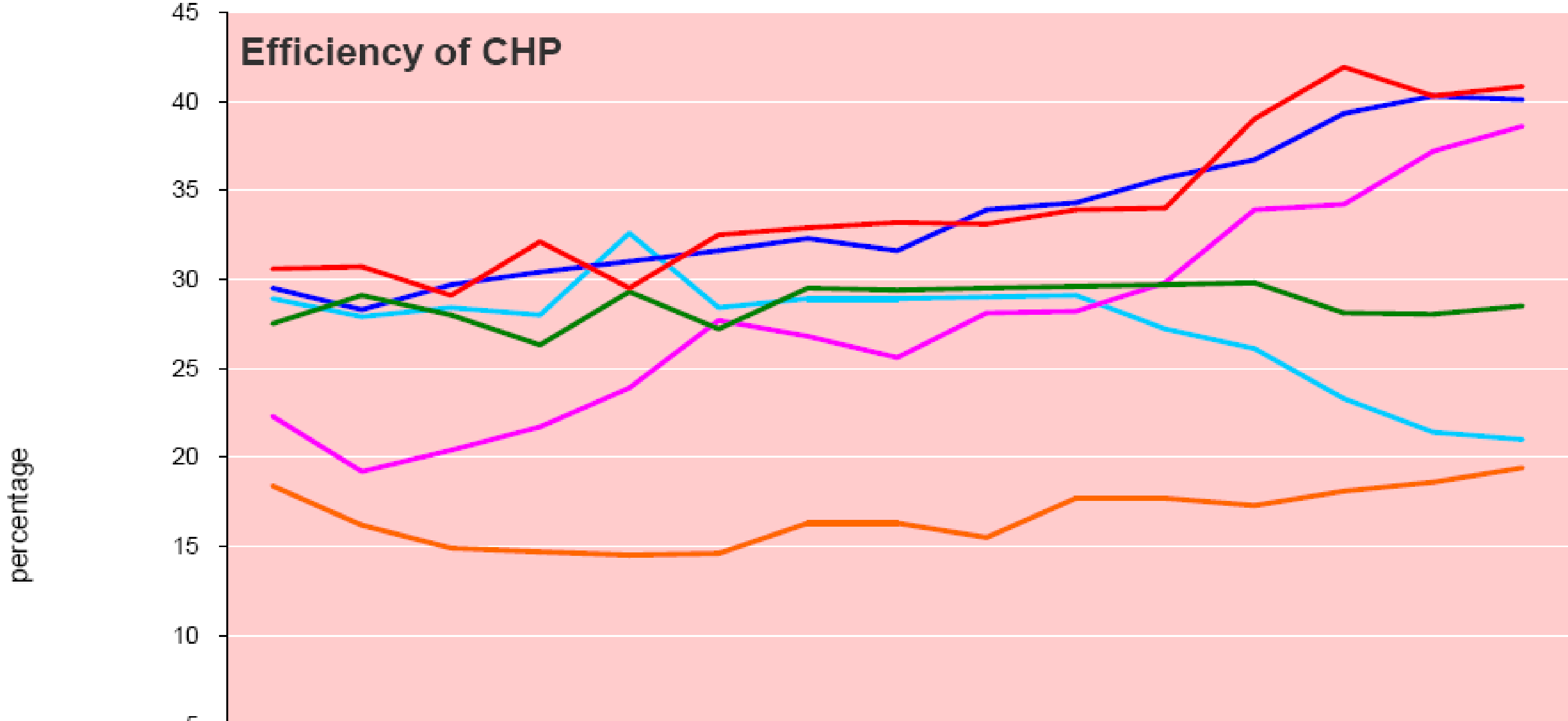
No	Power Plants	Capacity (MW)	Available capacity (MW)	Installation year	Efficiency (in 2009)
1	TPP #2	21.5	18	1961	21.0
2	TPP #3	136	105	1968	38.6
3	TPP #4	560	452	1983	40.1
4	Erdenet Plant	28.8	39	1987	40.8
5	Darkhan Plant	48	21	1965	28.5
	CES Subtotal	**794.3**	**615**	--	
6	Dornod Plant	36	--	1969	19.4
7	Umnugobi Plant	6	--	2001	--
	Total	**836.3**			

ENERGY EFFICIENCY IN MONGOLIA

- THE FUEL UTILIZATION EFFICIENCY AT CHPS: 20-40%

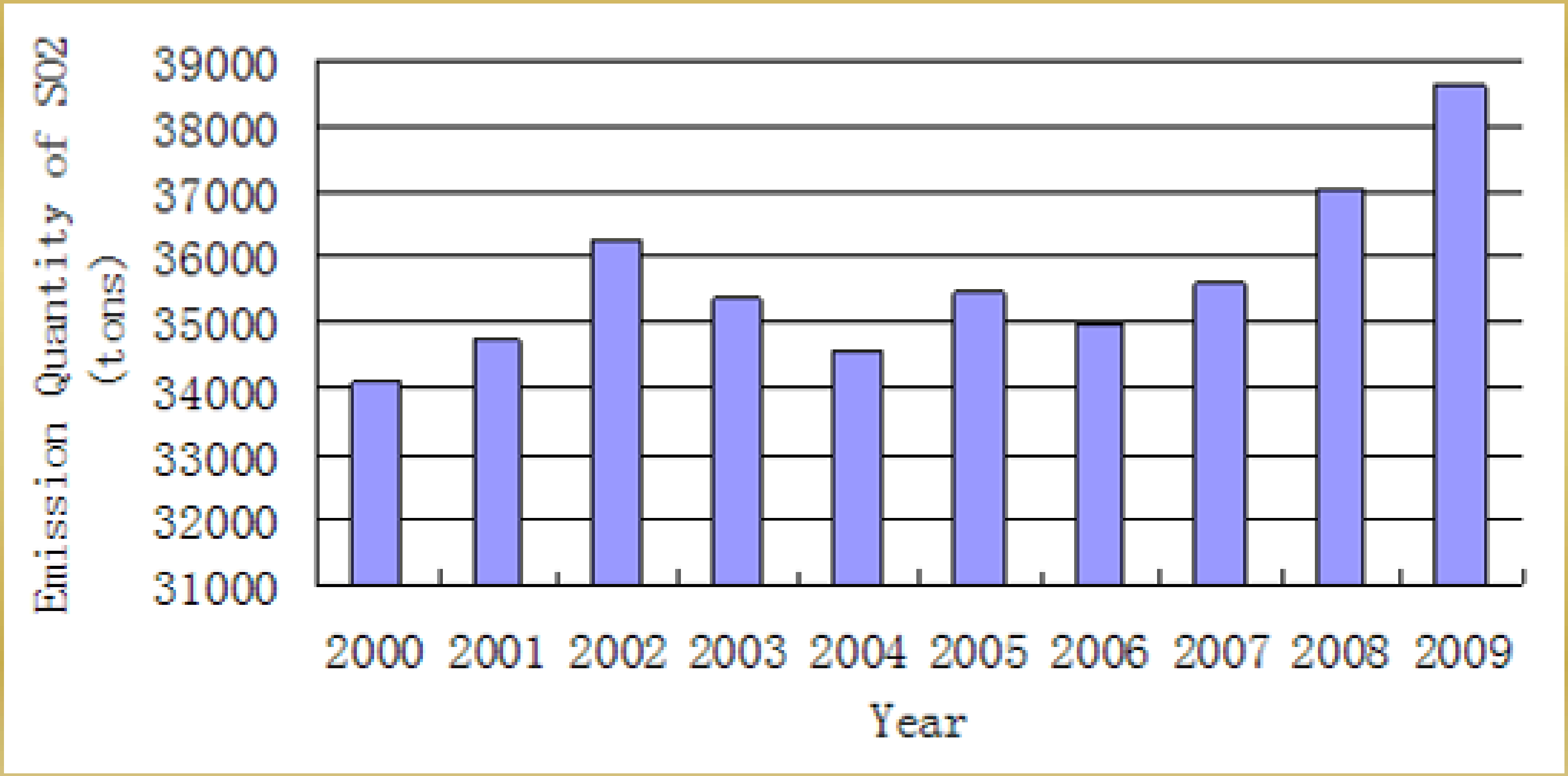
- MODERN CHP PLANT EFFICIENCY: 50-80%.

Statics-2009.pdf - Adobe Acrobat Professional



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009 year
CHP No.2	28,9	27,9	28,4	28,0	32,6	28,4	28,9	28,9	29,0	29,1	27,2	26,1	23,3	21,4	21,0
CHP No.3	22,3	19,2	20,4	21,7	23,9	27,7	26,8	25,6	28,1	28,2	29,8	33,9	34,2	37,2	38,6
CHP No.4	29,5	28,3	29,7	30,4	31,0	31,6	32,3	31,6	33,9	34,3	35,7	36,7	39,3	40,3	40,1
Darkhan CHP	27,5	29,1	28,0	26,3	29,3	27,2	29,5	29,4	29,5	29,6	29,7	29,8	28,1	28,0	28,5
Erdenet CHP	30,6	30,7	29,1	32,1	29,5	32,5	32,9	33,2	33,1	33,9	34,0	39,0	41,9	40,3	40,8
Dornod CHP	18,4	16,2	14,9	14,7	14,5	14,6	16,3	16,3	15,5	17,7	17,7	17,3	18,1	18,6	19,4

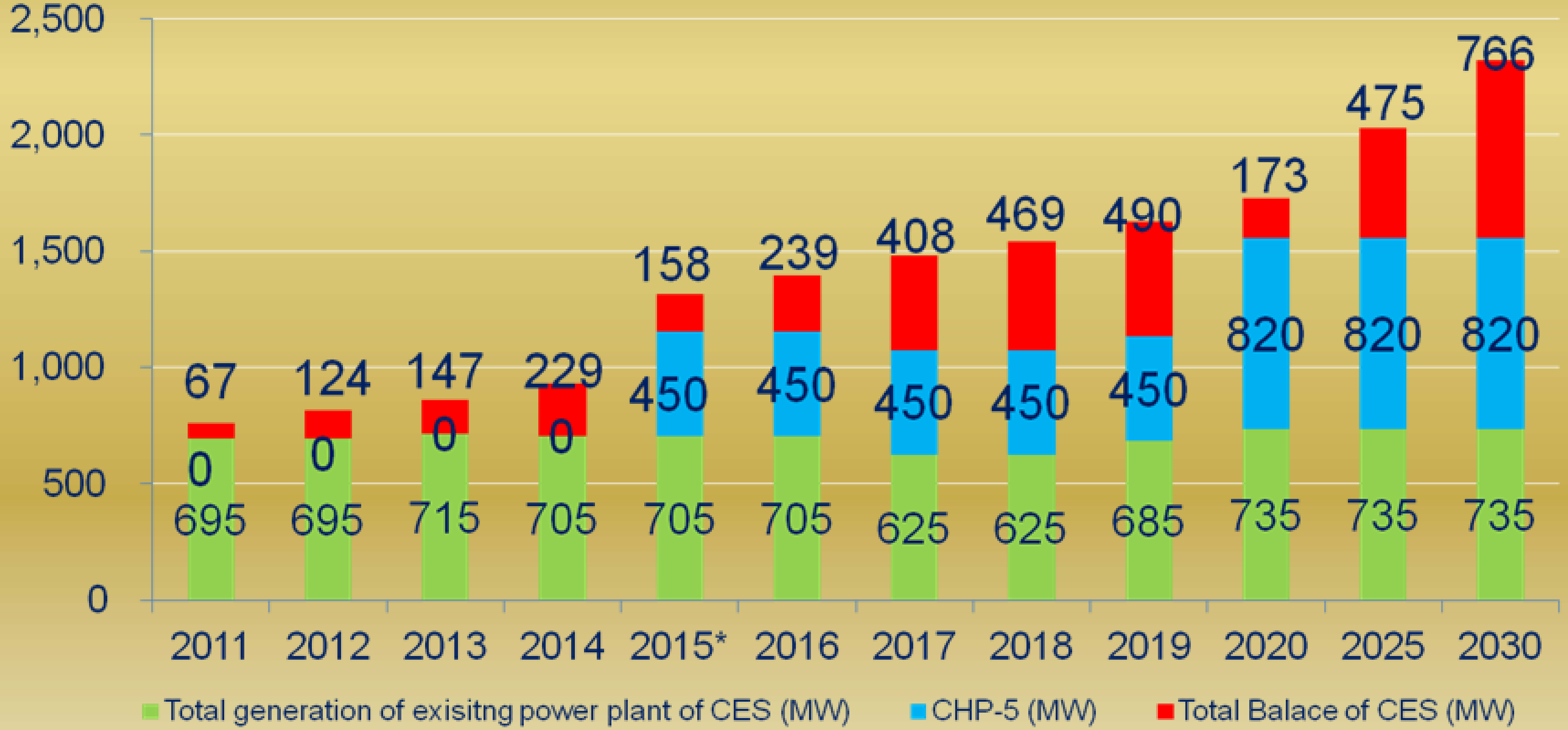
SO_2 Emission from Power Plants



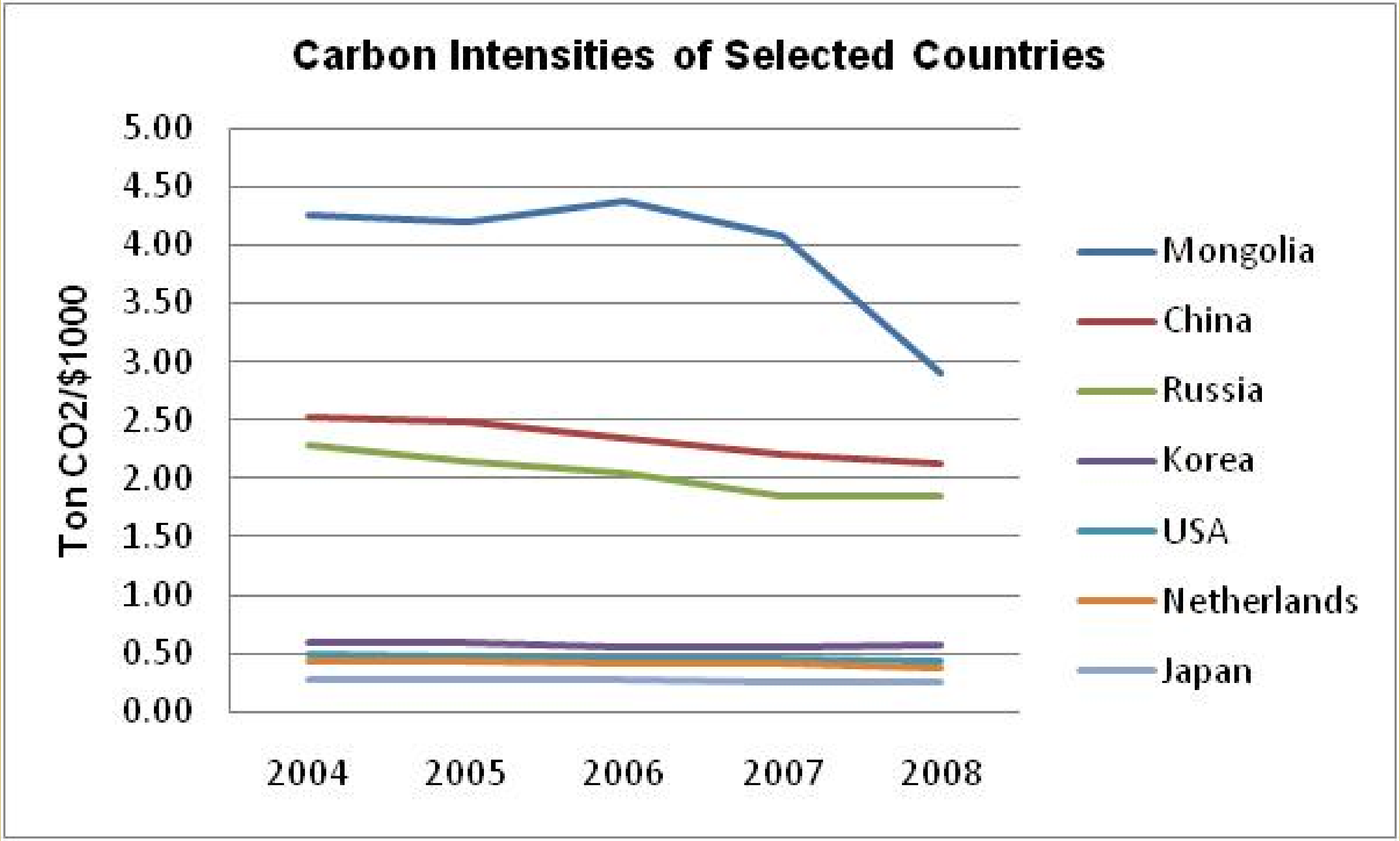
Power Supply and Demand Assessment

Additional power demand forecast:

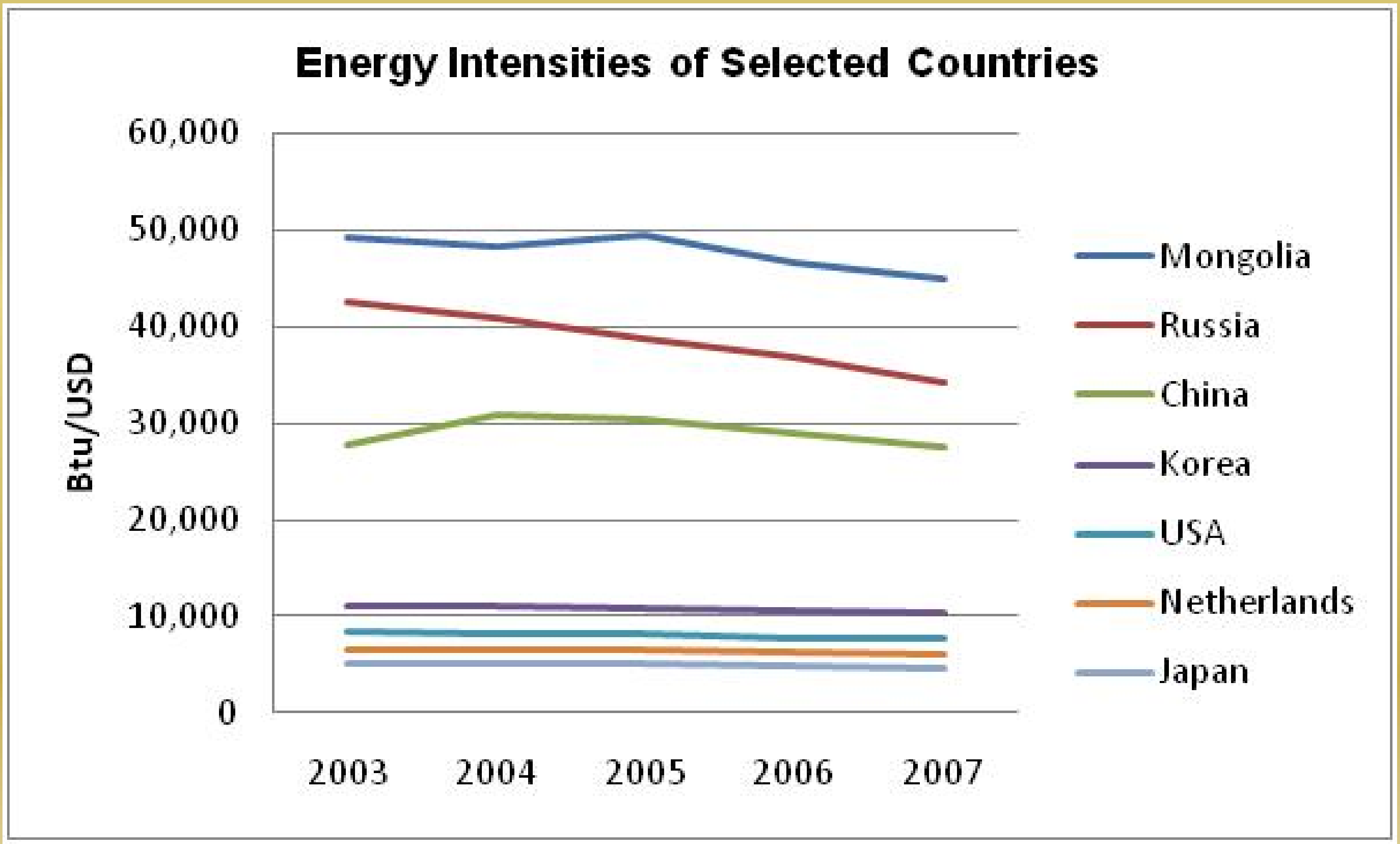
- 608 MW, by 2015
- 993 MW, by 2020
- 1568 MW, by 2030



Carbon Intensity Comparison



Energy Intensity Comparison



1 Btu = 252 cal or 1056 J

Scope of New Mongolia Emission Standard -1

- In term of the air pollution, UB is among the most polluted cities in the world, especially during winter time.

- Pollutants such as PM and SO_2 are much higher than international standards. Annual average concentrations of PM_{10} are higher than Mongolian and International Air Quality Standards (AQS).

- The measured PM_{10} levels by AMHIB in UB are 2-5 times higher than Mongolia's AQS of 50 $\mu g/m^3$, 5-10 times higher than the World Health Organization (WHO) Guideline Value of 20 $\mu g/m^3$, and 3-7 times higher than the European limit value of 40 $\mu g/m^3$.

Scope of New Mongolia Emission Standard -1

- It is well-documented that particles (primary PM_{10}, $PM_{2.5}$, and secondary PM due to SO_2 and NOx emissions) cause negative health effects, causing people. Inhaling PM can severely affect the lungs and the heart.

- Statistics show that over 50,000 people suffer from respiratory diseases.

- In 2007, it is estimated that the maximum health costs associated with the air pollution in UB correspond to the equivalent of U.S. $147 million, representing 8.0% of UB's GDP and 3.8% of national GDP.

Scope of New Mongolia Emission Standard -1

- More than 6.4 billion MNT has already been spent in the last few years to in combat smoke and air pollution.
- In 2009, smoke and air pollution in UB increased 28% compared to the previous year due to the increase in settlement in Ger areas of UB.
- In UB, the main sources of ground level PM concentrations are primary carbonaceous particles from coal combustion for heating and cooking (Ger households) and industrial activities (HOBs and power plants).
- Emissions from coal-fired power plants are the main contributors of the bad air quality in UB.
- SO_2 and NOx are also major source of acid rain and cause trans-boundary air pollution in other countries.

Scope of New Mongolia Emission Standard -1

- In 2009, coal consumption from the three main power plants in UB was 3.79 million tons.

- The PM, SO_2, NOx emissions from these power plants in UB are 14,381, 30,330, and 9,171 tons, respectively.

- Therefore, more stringent emission standards on PM, SO_2, and NOx are urgently needed to reduce current emissions to acceptable levels.

- The new emission standards would cover PM, SO_2, NO_X emissions as controlled pollutants for existing and new power plants.

Emission Standards for Power Plants in Mongolia

- The current emission standards for coal-fired boilers were established in 2008 (MNS5915:2008).
- Mongolia’s current emission standards are based on emission measurements from existing boilers so they are complex and without strong rationale to justify these standards.
- This draft standard is first for power plant boilers and HOBs in Mongolia . The standards regulated SO_2, NOx, CO, and PM emission from coal-fired boilers for power plants and HOBs.
- There are 15 different emission limitation levels on each pollutant for different type of boilers and capacities, including steam boiler and hot water boilers.

Emission Control Equipment

- CHP #4 which is equipped with ESP for PM control.
- Other the coal-fired steam boilers for power plants is equipped with wet scrubbers.
- The Boilers for thermal stations equipped with cyclones.
- No emission control equipment is used at heat only boilers
- Uncontrolled pollutants emit from these boilers and power plants pollute the air in surrounding areas.

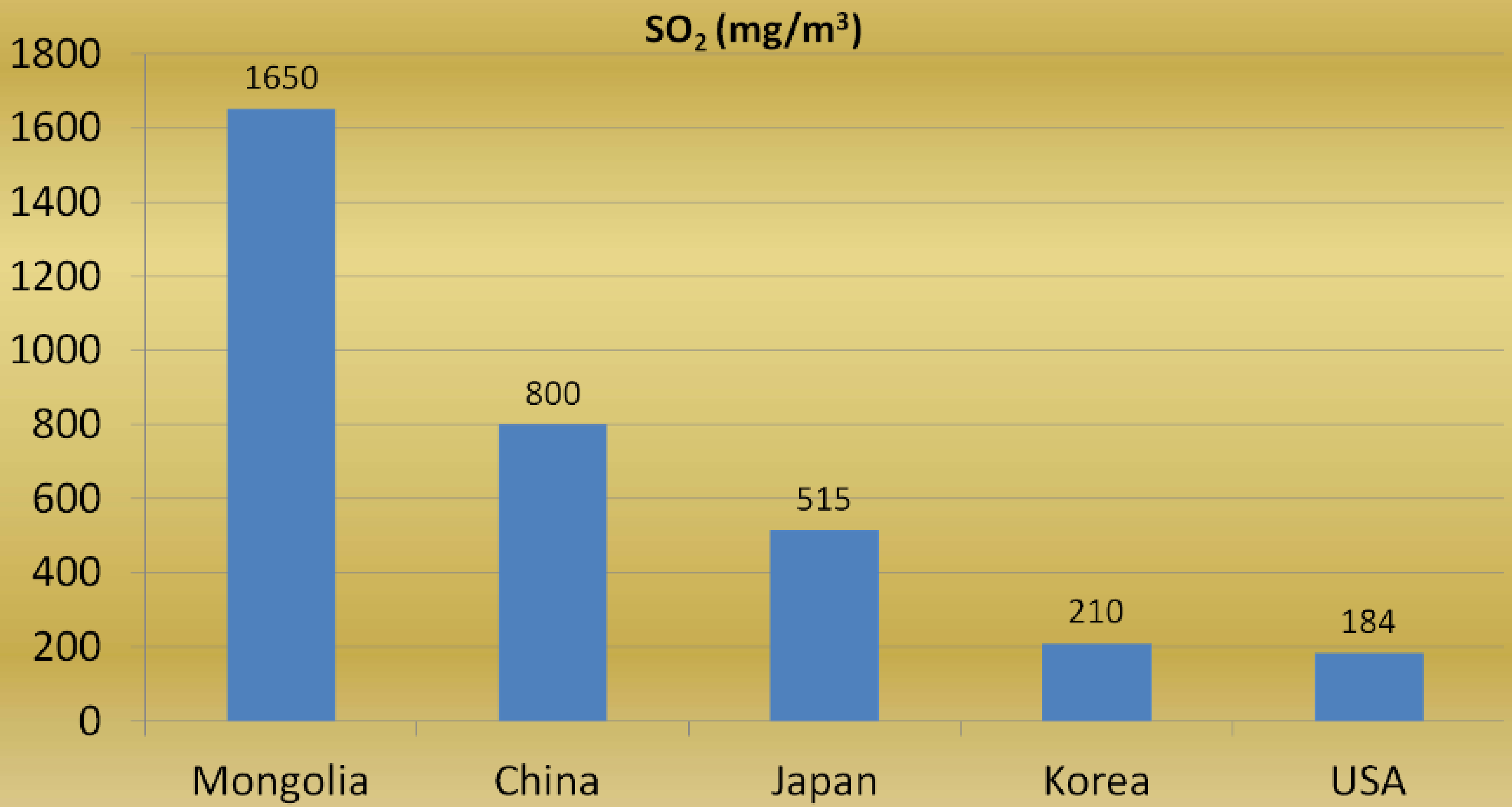
Comparisons of Emission Standards

Pollutant	Unit	Mongolia	China	Japan	ROK	U.S.	EU
SO2	mg/nm3	615-193,1	400-1200	170-860	210	184	400-2000
PM	mg/nm3	200-21,000	50-200	50-100	20	20-40	30-100
NOX	mg/nm3	320-1,270	450-1100	200	160	135-370	200-600

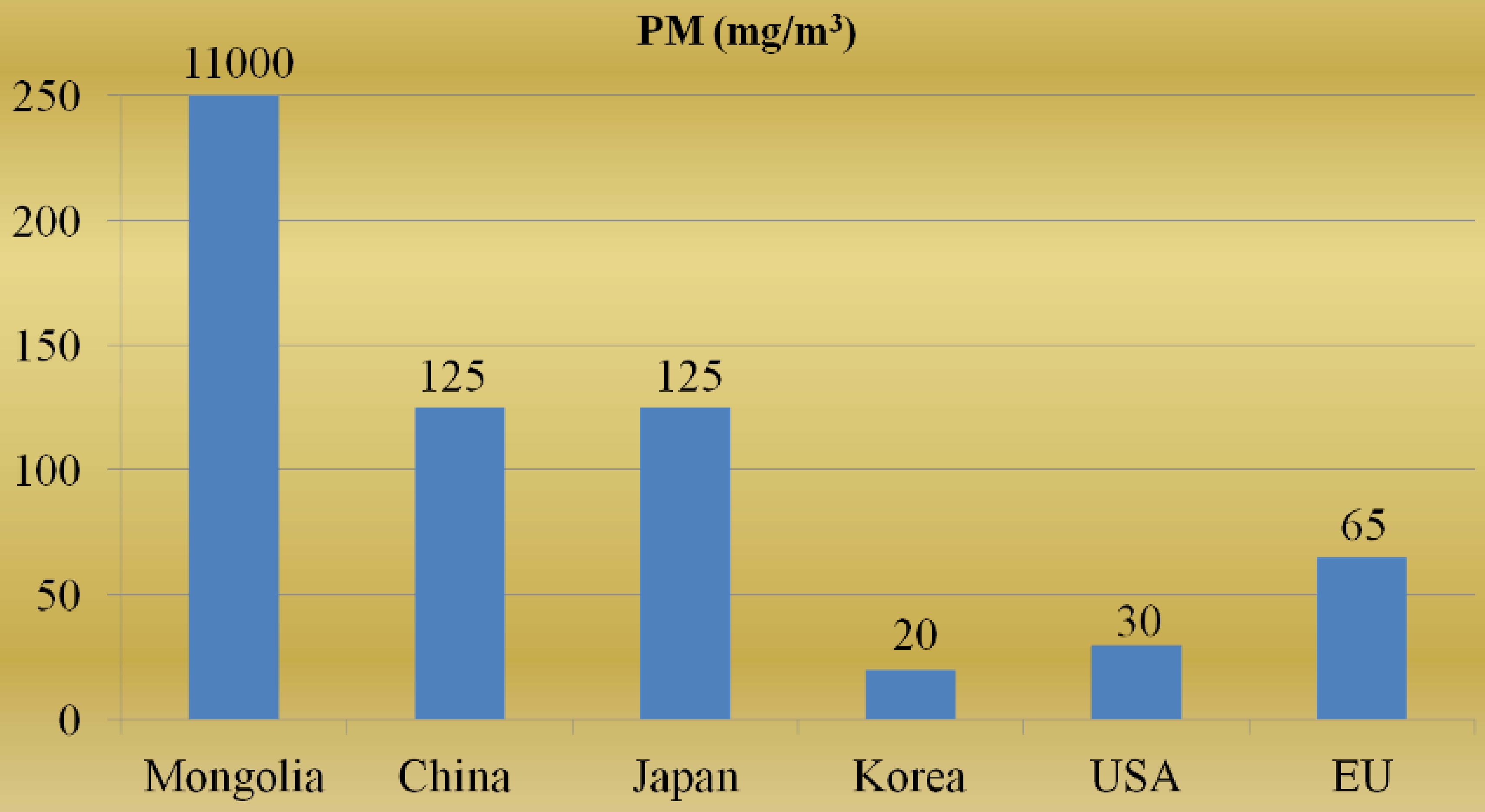
For PM emission standards, Mongolia has the highest emission standards for PM. The ROK has the lowest emission standards for PM among the five countries. The U.S. also has very stringent PM standards.

For NOx emission standards, again ROK has the lowest standards at 160 mg/m^3 while Mongolia has the highest at 715-1,100 mg/m^3 for relative large boilers (>76 ton/hr). It has been reported that the actual NOx emission limits both Japan and U.S. are much lower than the standards.

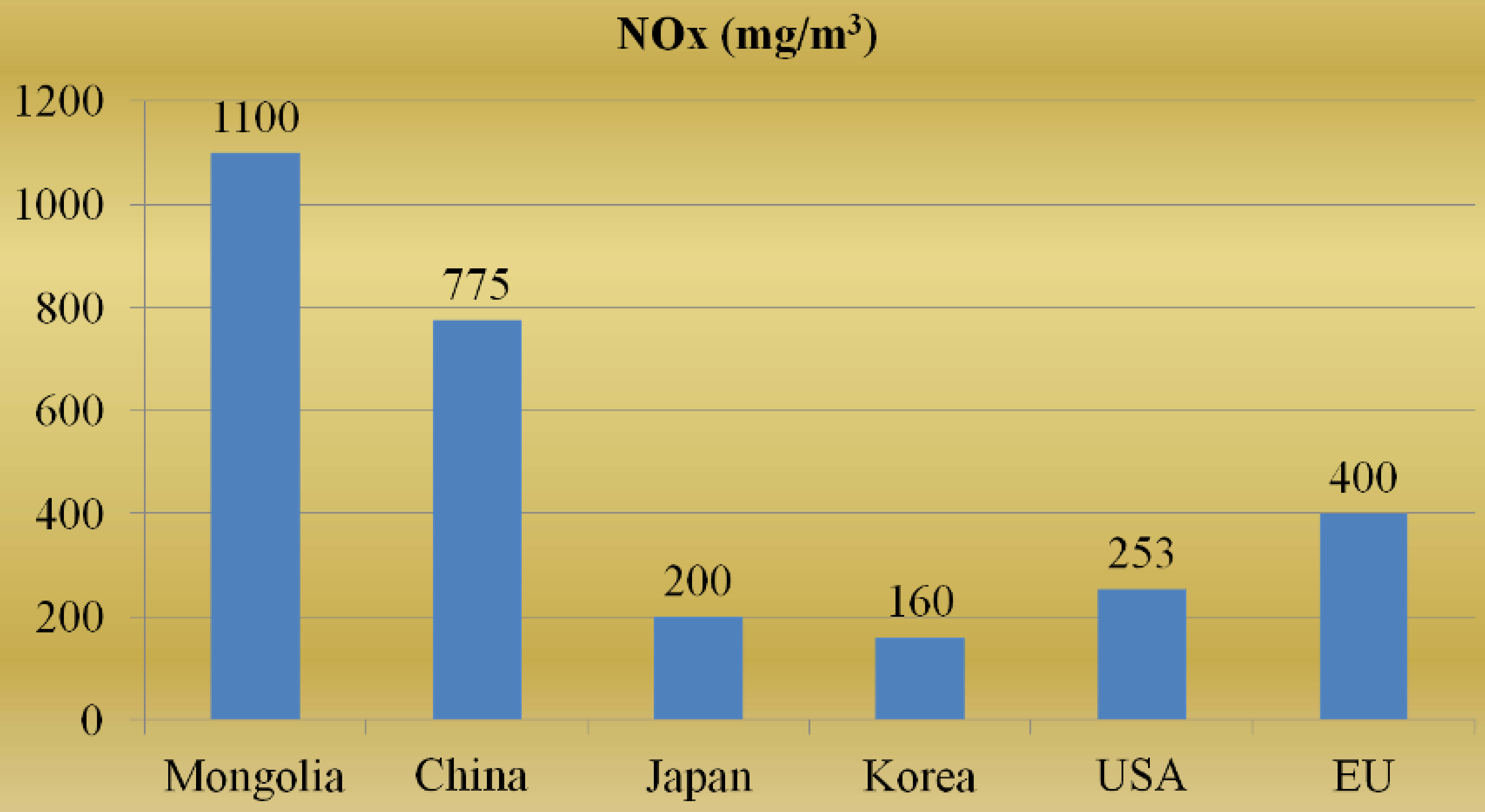
Comparison of Average SO_2 Emission Standards



Comparison of PM Emission Standards



Comparison of NOx Emission Standards



PROPOSED NEW EMISSION STANDARDS FOR MONGOLIAN POWER PLANTS

- To provide power and heating supply, there are seven existing power plants and over 1500 of HOBs in Mongolia.
- These boilers are equipped with old technologies and no control of air emission in most cases.
- It is not suitable and not financially favorable to retrofit them with new control technologies.
- New standards will give existing facility some time to meet new standards, and otherwise they will be phased out.

PROPOSED NEW EMISSION STANDARDS FOR MONGOLIAN POWER PLANTS

- The following new Mongolian air emission standards are two-part, multi-pollutant control standards for new and existing power plants.

- The first part will apply to new coal-fired power plants and be in line with the current Chinese standards (Table1). The second part is for existing power plants and HOBs (Table 2). For existing power plants, it’s proposed that they comply with the new standards by 2020.

- This will allow them to rebuild or retrofit the plants with new pollution control equipment to meet new standards.

PROPOSED PM AND SO_2 EMISSION STANDARDS-2 FOR NEWLY-BUILT POWER PLANTS

Region	SO_2 (mg/m^3)	PM (mg/m^3)
Area I	400	50
Area II	600	200

Note: Area I is defined as the urban areas where population density equals to or greater than 10 persons per square kilometer or the population is 1,000 or greater.

Area II is defined as the remote areas that have a population density smaller than 10 persons per square kilometer or the population is less than 1,000.

PROPOSED NO_X EMISSION STANDARDS-2 FOR NEWLY-BUILT POWER PLANTS

Volatile Content in Coal	NOx (mg/m^3)
$V_{daf} < 10\%$	1,100
$10\% \leq V_{daf} \leq 20\%$	650
$V_{daf} > 20\%$	450

- Since most coal deposits in Mongolia are low sulphur coal. The emission standards for SO_2 can be tighter than for high sulphur coal without increasing control cost.

- So the emission limit for plant built in Area II is tighter than Chinese standards. From calculation shown later of this section, 600 mg/m^3 is achievable for most coal used in Mongolia when control equipment has 90% or more control efficiency. Thus, SO_2 emission limit for coal-fired power plants in Area II can be set at 600 mg/m^3 rather than 1,200 mg/m^3 in Chinese standards.

Proposed SO_2 and PM Emission Standards for Existing Power Plants

Phase	SO_2	PM
Before Dec. 31, 2014	50% reduction from the 2010 level or 1,200 mg/m^3	75% reduction from 2010 level or 2000 mg/m^3
Before Dec. 31, 2017	Another 50% reduction from the 2014 level (75% reduction from the 2010 level) or 600 mg/m^3	90% reduction from 2010 level or 200 mg/m^3
Before Dec. 31, 2020	In line with 2010 standards for new facilities	50 mg/m^3 In line with 2010 standards for new facilities

Comparison of New Mongolia Standards-2 with Other Countries' Standards

Pollutant	Mongolia	China	Japan	ROK	U.S.
SO_2 (mg/m^3)	400-600	400-1200	170-860	210	184
NO_X (mg/m^3)	450-1,100	450-1,100	200	160	135-370
PM (mg/m^3)	50-200	50-200	50-100	20	20-40

Rationale of the Proposed New Standards-2

- The Mongolia Government has identified environment protection and improvement as a national priority. In December 2009, the Government debriefed Resolution No. 46 of the Parliament on decreasing air pollution in UB City.

- The Government promised to decrease air pollution by 50% and will spend 180 billion MNT on combating air pollution problems. The proposed new emission standards are consistent with the Mongolian National Strategy.

SO_2 Control.

- As a countermeasure against air pollution and acid rain, establishment of an FGD is required for newly-established coal-fired power plants.

- Wet technology- limestone gypsum, sea-water washing, ammonia scrubbing, Wellman-Lord **(S^r $\leq$5%, 95…98%)**

- Half dry technology- circulating fluidized bed, spray dry, duct spray dry , **(S^r<2%, 95%)**

- Dry technology- furnace sorbent injection, sodium bicarbonate injection etc **(S^r<2%, 93%)**.

FGD Equipment for SO_2 Emission Reduction

FGD Type	Suitable Scale	Efficiency (%)	S % in Coal
Wet technology	100-1000 MW	95-98	Up to 5%
Dry technology	10-300 MW (1 Unit); Up to 500 MW (multiple units)	>93	Under 2%

- Some control equipment has the capability of simultaneously reducing emissions of multiple pollutants; this equipment may offer the potential to achieve emission control at lower cost and reduced environmental footprint when compared to conventional controls. All of these technologies and equipments are commercially available.

- Mongolia can select the most suitable control technologies based on specific situation for individual power plant.

Projection of SO2 Emission after Control for Major Coal Deposits

Coal Deposit	Sulfur in Coal (%)	Heating Value (MJ/kg)	Mass Balance Calculation SO_2 Emission (ng/J)	S to SO_2 convert factor F	FGD with 90% Emission Reduction (ng/J)	FGD with 90% Emission Reduction (mg/m^3)	FGD with 95% Emission Reduction (mg/m^3)
Baganuur	0.36	14.4	500	0.9	45	128	64
Shivee-Ovoo	0.9	11.7	1,538	0.9	139	394	197
Shariin Gol	0.6	17.2	698	0.9	63	179	90
Aduunchuluun	1.4	12.3	2,276	0.9	205	584	292
Tavantolgo	0.69	21.3	648	0.9	59	166	83

**S to SO_2 convert factor: 0.9 for pulverized coal boiler and 0.8 for CFB.*

Dust Control.

- Common PM control technologies are ESP, fabric filter collectors (baghouse), wet scrubbers and cyclone mechanical collectors. Most advanced PM control equipments used to control PM emissions from power plants are ESP and baghouse filter.

- The overall (mass) collection efficiencies for ESP can exceed 99.9%, and efficiencies in excess of 99.5% are common.

- Baghouses often are capable of 99.9% removal efficiencies.

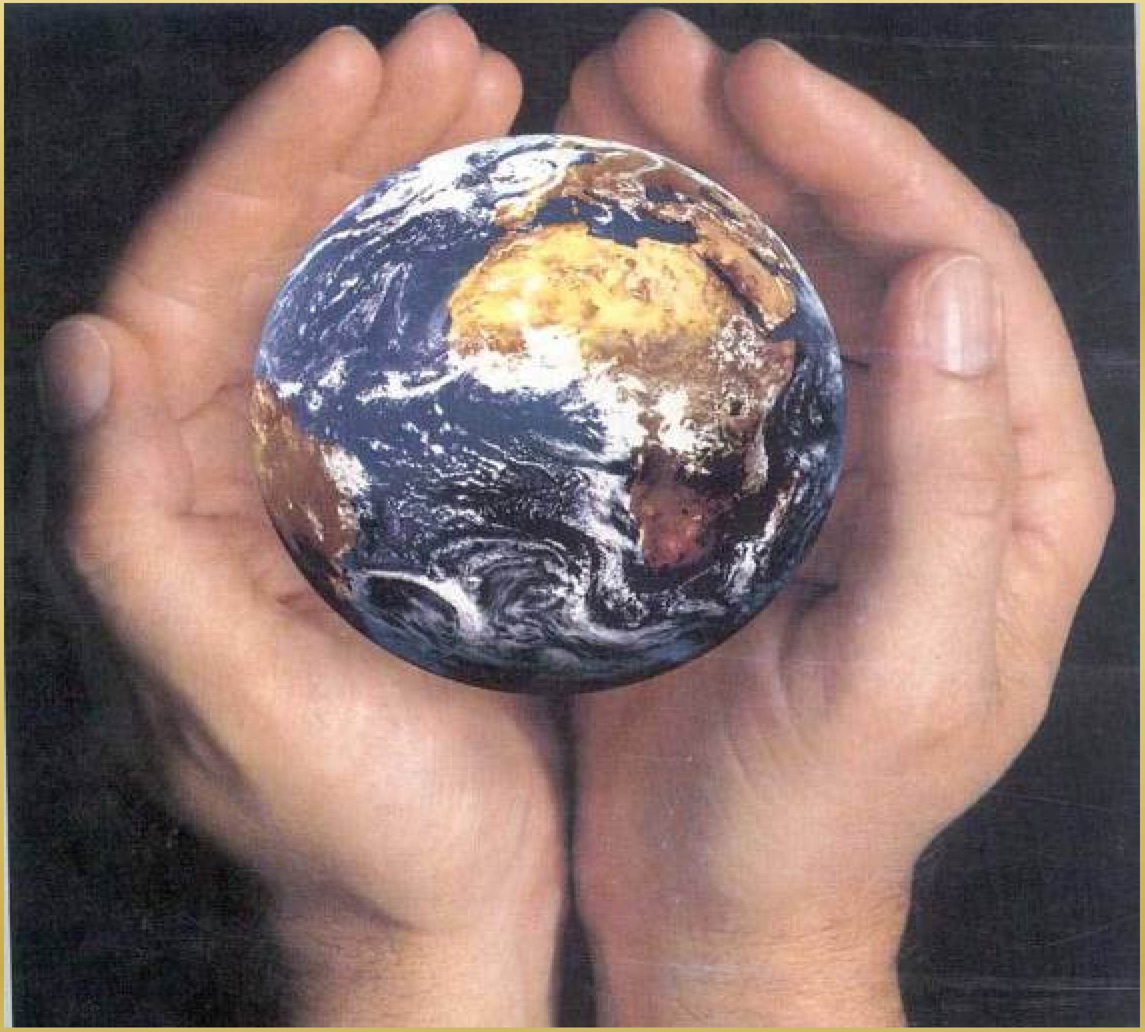
- Wet scrubbers designed for 85% SO_2 removal can provide control of PM emissions with a removal efficiency greater than 90% for particles with diameters above 10 microns.

- Multiple cyclones have overall mass removal efficiencies of 70-90%.

NOx Control.

- Low NOx generation system in boiler, selective non-catalytic reduction (SNCR) system are used for control of NOx. A reagent is injected into the flue gas in the furnace within an appropriate temperature window. The NOx and reagent react to form nitrogen and water. Emissions of NOx can be reduced by 30% to 50%.

- A typical SNCR system consists of reagent storage, multi-level reagent-injection equipment, and associated control instrumentation. The SNCR reagent storage and handling systems are similar to those for SCR systems. However, because of higher stoichiometric ratios, both the ammonia and urea SNCR processes require three or four times as much reagent as SCR systems to achieve similar NOx reductions.



THANK YOU FOR ATTENTION!