Workshop on Tranboundary Air Pollution in North-East Asia

Technical and Policy Issues for Addressing SO_2 Emission Regulations

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Outline

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Introduction

- Economic development in Northeast Asia countries has been growing;
- Demand and generation of electric power has also been increasing;
- Majority of increased power generation comes from coal-fired power plants;
- Coal is the primary fuel in PRC and Mongolia;
  - In Mongolia, over 98% of electricity is generated by coal-fired power plants
  - In China, the proportion of coal-fired power generation is around 68% of the total generation

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Introduction (cont)

- SO_2 emissions have been increasing and will continue the increasing trend in coming years;
- SO_2 emissions and acid rain have caused serious environmental damages.
- Trans-boundary air pollution in Northeast Asia has long been recognized as a serious issue.
- Action is urgently needed to deal with acid rain-related environmental impacts and the pollution that impacts other countries in the Northeast Asia sub-region under certain climate conditions.

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Project Summary

- Project Title: “Mitigation of Trans-boundary Air Pollution from Coal Fired Power Plants in Northeast Asia” (ADB TA 6371-REG)
- Executing Agencies:
  - China Electricity Council, PRC
  - Ministry of Nature, Environment and Tourism, Mongolia
- HJI Group (USA) was selected as the consulting firm through international bidding process
- Project was kicked off in March 2011, 4 workshops were held (2 in Mongolia and 2 in PRC)
- 2 international experts, 2 experts from Mongolia, 4 experts from PRC

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Objectives of TA

- Reduce trans-boundary air pollution
- Enhance environmental cooperation among countries
- Improve technical capacity and knowledge transfer
- Promote capacity for management of coal-fired power plant emissions

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Tasks under the Project

- Assess SO_2 and CO_2 emissions from power plants in Mongolia
- Review emission standards from other countries
- Propose emission standards for power plants in Mongolian
- Co-benefit approach strategy and mitigation plan for SO_2 and CO_2 emissions
- Workshops for knowledge transfer and information dissemination

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Technical Issues on SO_2 Emissions

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FGD Technologies

- SO_2 emissions from power plants can be controlled using flue gas desulphurization (FGD) technologies
- Many FGD technologies available commercially for SO_2 emission control: wet, semi-dry, and dry FGD processes.
- Wet Processes: Limestone gypsum; sea-water washing; ammonia scrubbing; Wellman-Lord process.
- Dry Processes: - Circulating fluidized-bed (CFB); spray dry; duct spray dry; furnace sorbent injection; sodium bicarbonate injection.

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FGD Technology Comparison

Wet Process and Dry Process Comparison

FGD Type	Suitable Scale	Efficiency (%)	S in Coal (%)
Wet technology	100-1,000 MW	90-98	Up to 5%
Dry technology	10-300 MW (1 Unit); Up to 500 MW (multiple units)	>93	Under 2%

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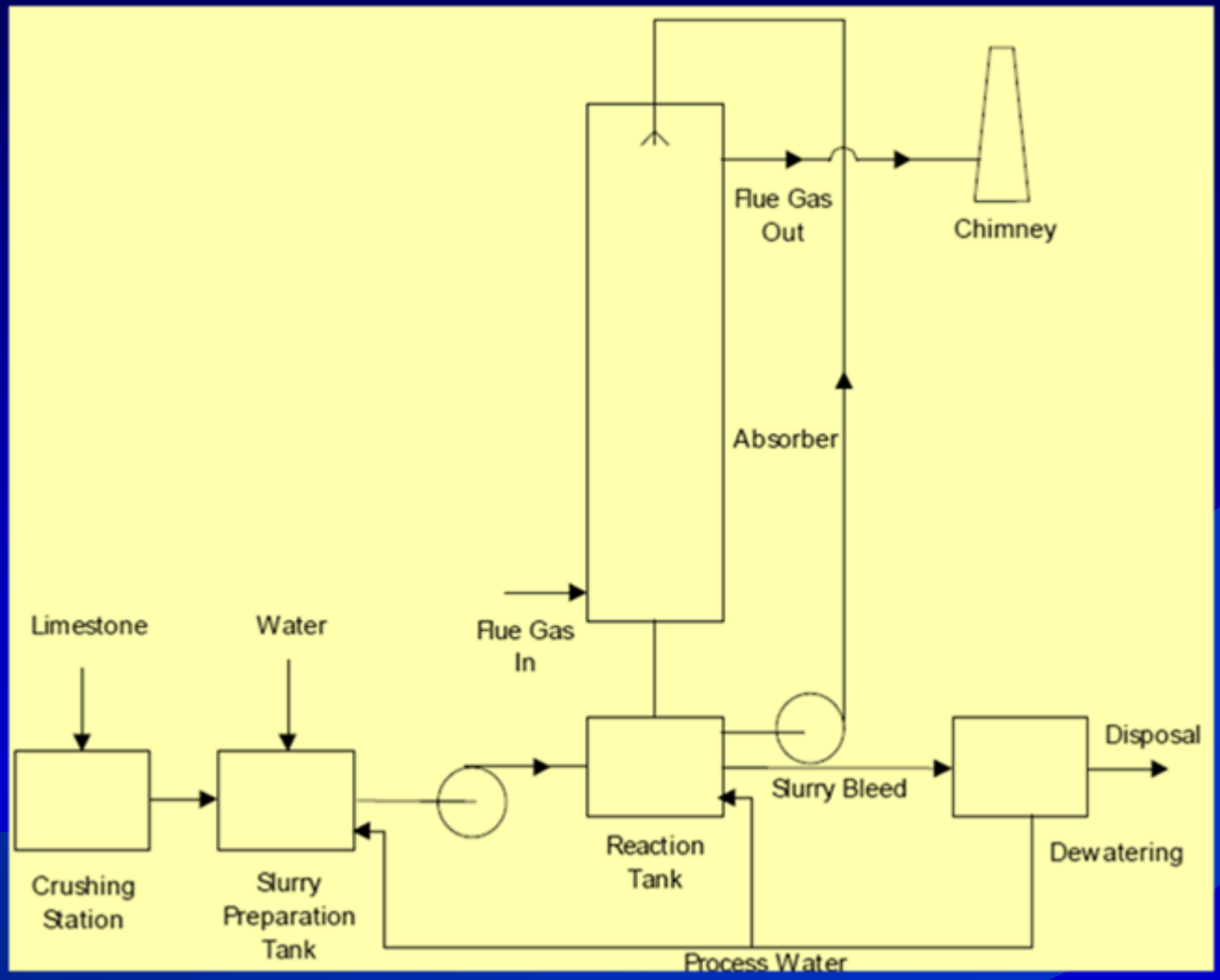
Wet FGD Process: Limestone Gypsum



Wet FGD Process: Limestone Gypsum

- Flue gas is treated with limestone slurry in order to remove the SO_2 and neutralize it
- Final product is gypsum
- Technology has evolved & improved over 30 years
- SO2 removal efficiency can be high to 95%
- The most common FGD process worldwide and has 85% share in Chinese FGD market
- Capital cost is high, but lower through-life cost for large inland plant with high sulphur fuel

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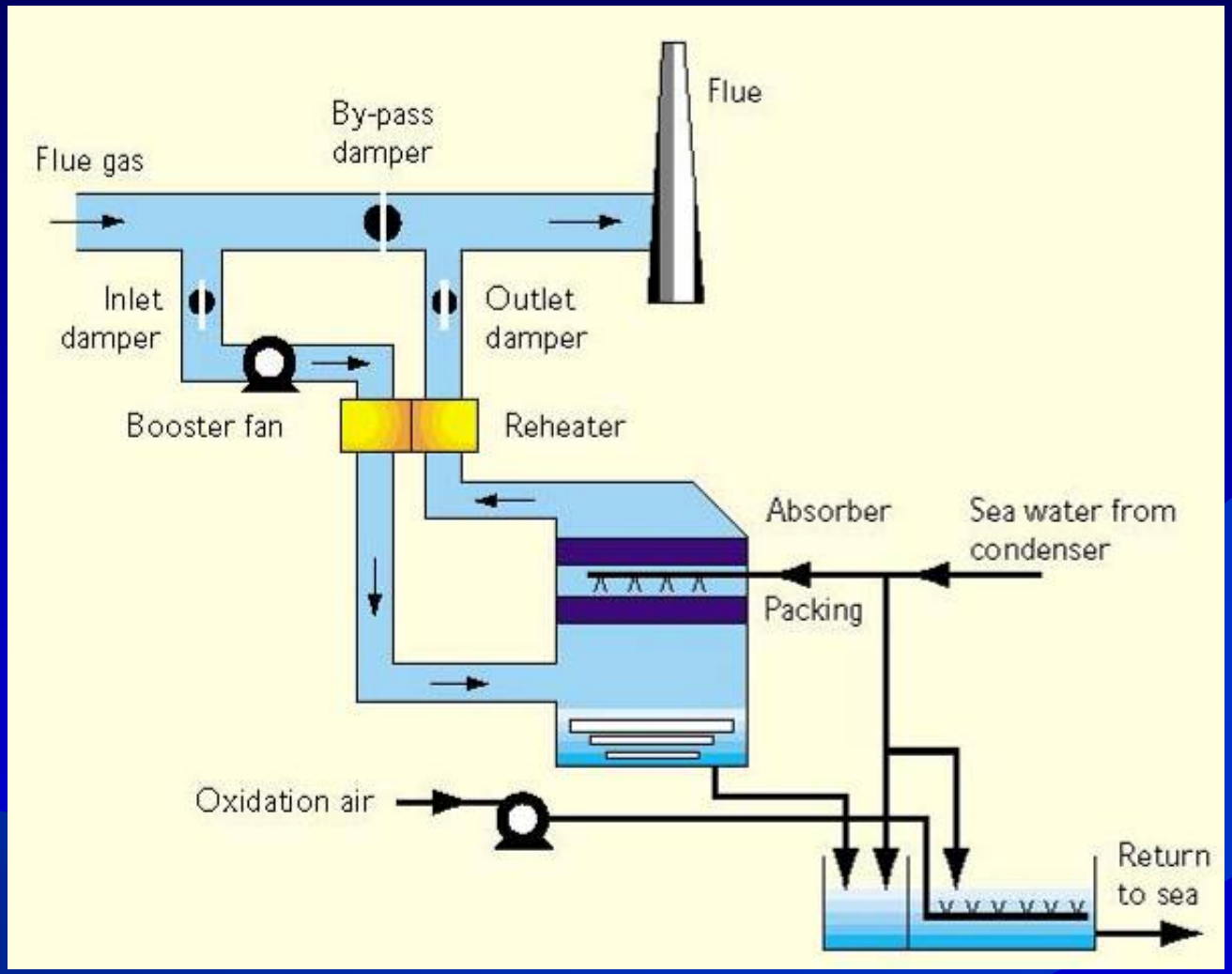
FGD Technology: Sea Water Washing



FGD Technology: Sea Water Washing

- Use untreated sea water to neutralize the SO_2 and scrub the flue gas;
- After scrubbing, water is treated with air to reduce its chemical oxygen demand and acidity, and then discharged back to the ocean.
- Advantages: no solid sorbent required as a reagent; plant design is relatively simple.
- >90% SO_2 removal for fuel sulfur content is below 1.5%.
- Disadvantage: limited to use at coastal sites.
- 3.5% share in Chinese FGD.

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FGD Technology - Ammonia Scrubbing

- Works similar to limestone gypsum process except aqueous ammonia is used as scrubbing agent.
- SO_2 is removed from the flue gas by reaction with ammonia, and the final product is ammonium sulfate.
- Advantage: no wastewater discharge.
- Disadvantage: ammonia is expensive and potential risks from ammonia.

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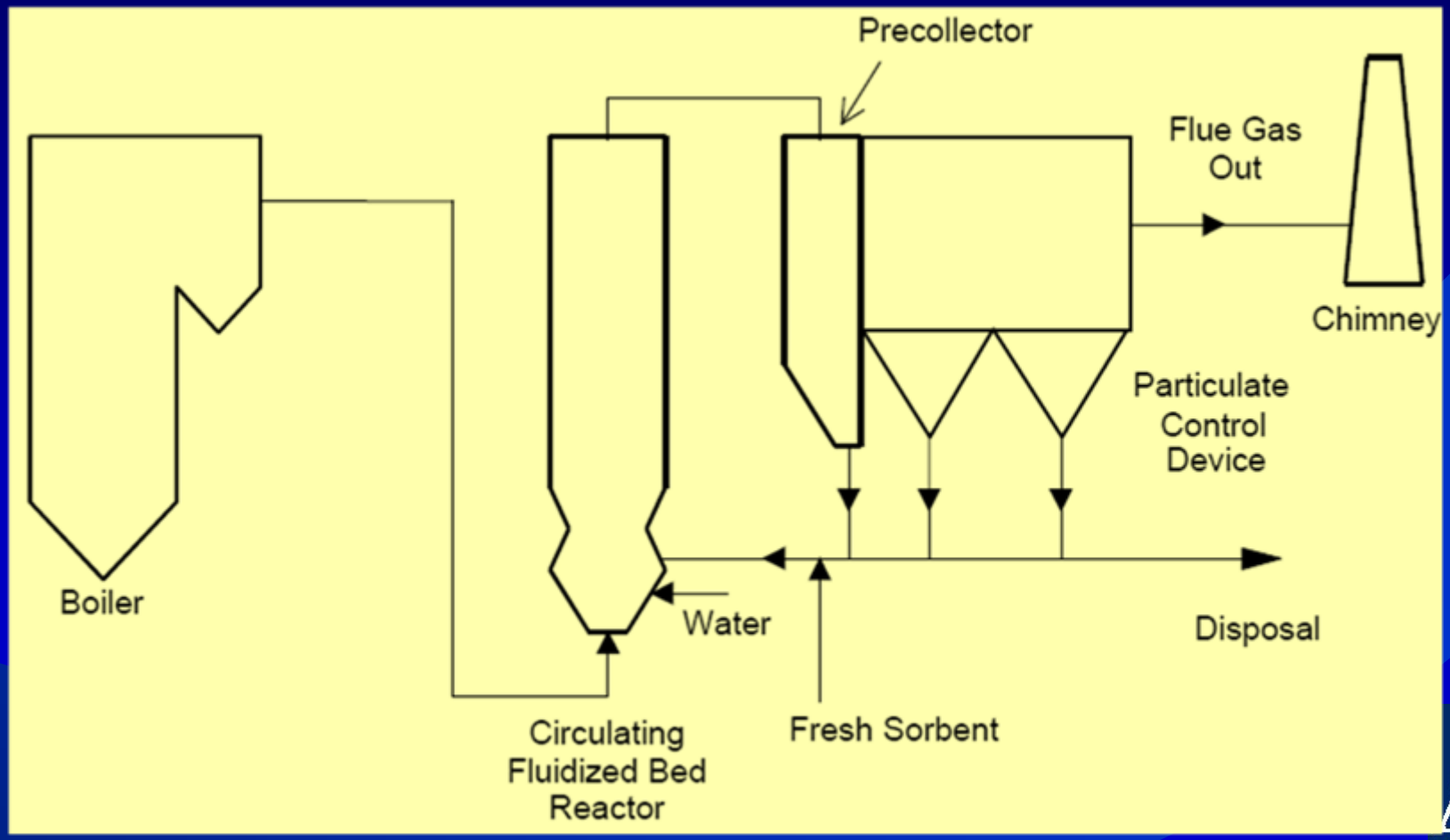
FGD Technologies - Wellman-Lord

- Wellman-Lord Process is regenerative, i.e., the active reagent used for removal of SO_2 from the flue gas is regenerated in a second process stage, and returned to the first stage (absorber tower) for re-use.
- High capital cost and operation cost.
- Not widely used.

Dry FGD Technology - CFB



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FGD Technology - CFB

- Flue gas passed through a dense mixture of lime, reaction products, and sometimes fly ash, and removes the SO_2, SO3, and HCl
- Final product is a dry powdered mixture of calcium compounds
- The process has been commercially used in 1980s and China started to use it in mid-1990s
- Simplicity, higher performance, lower space requirement, and lower cost
- Its share is 5.1% in China FGD and increasing

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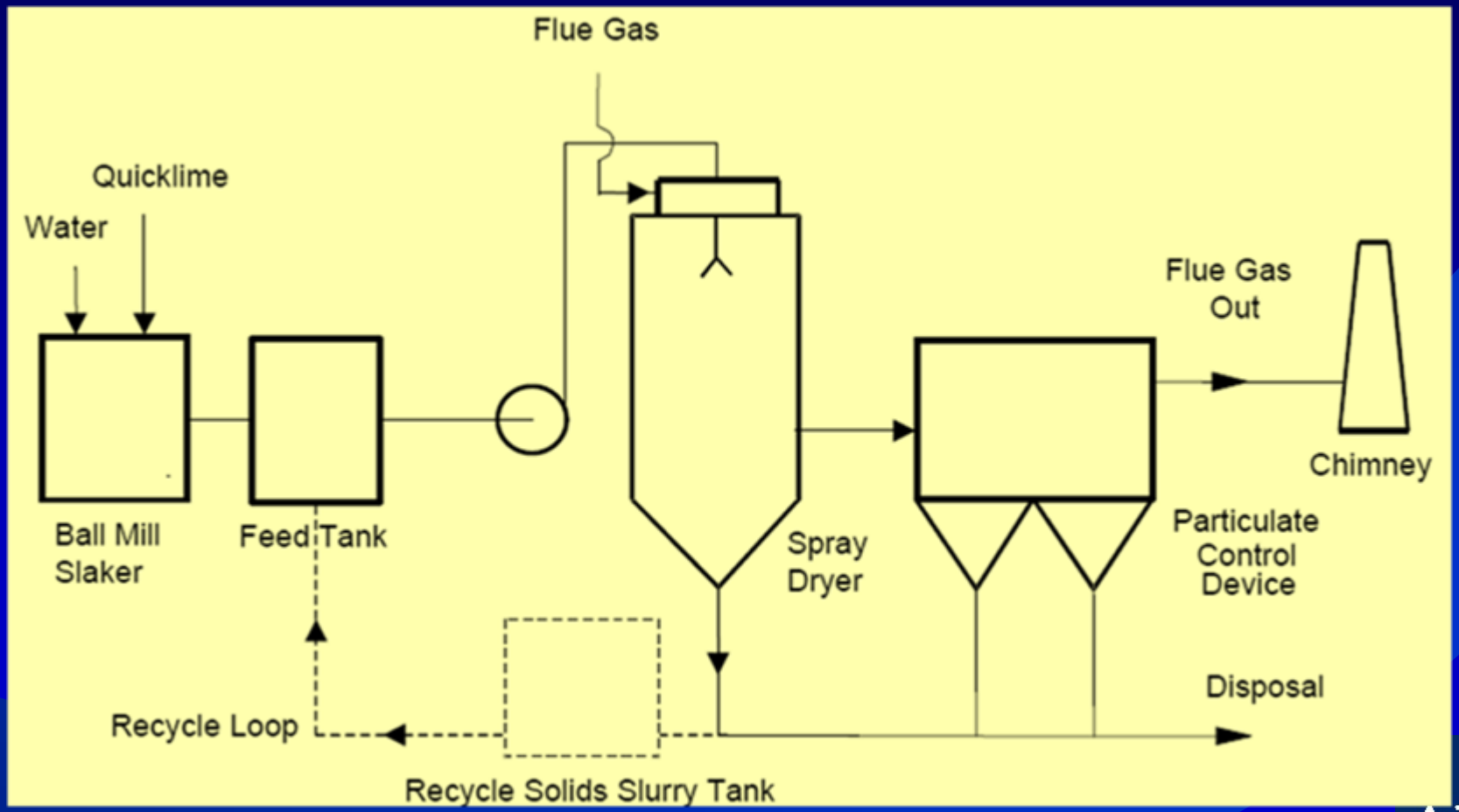
FGD Technology – Spray Dry



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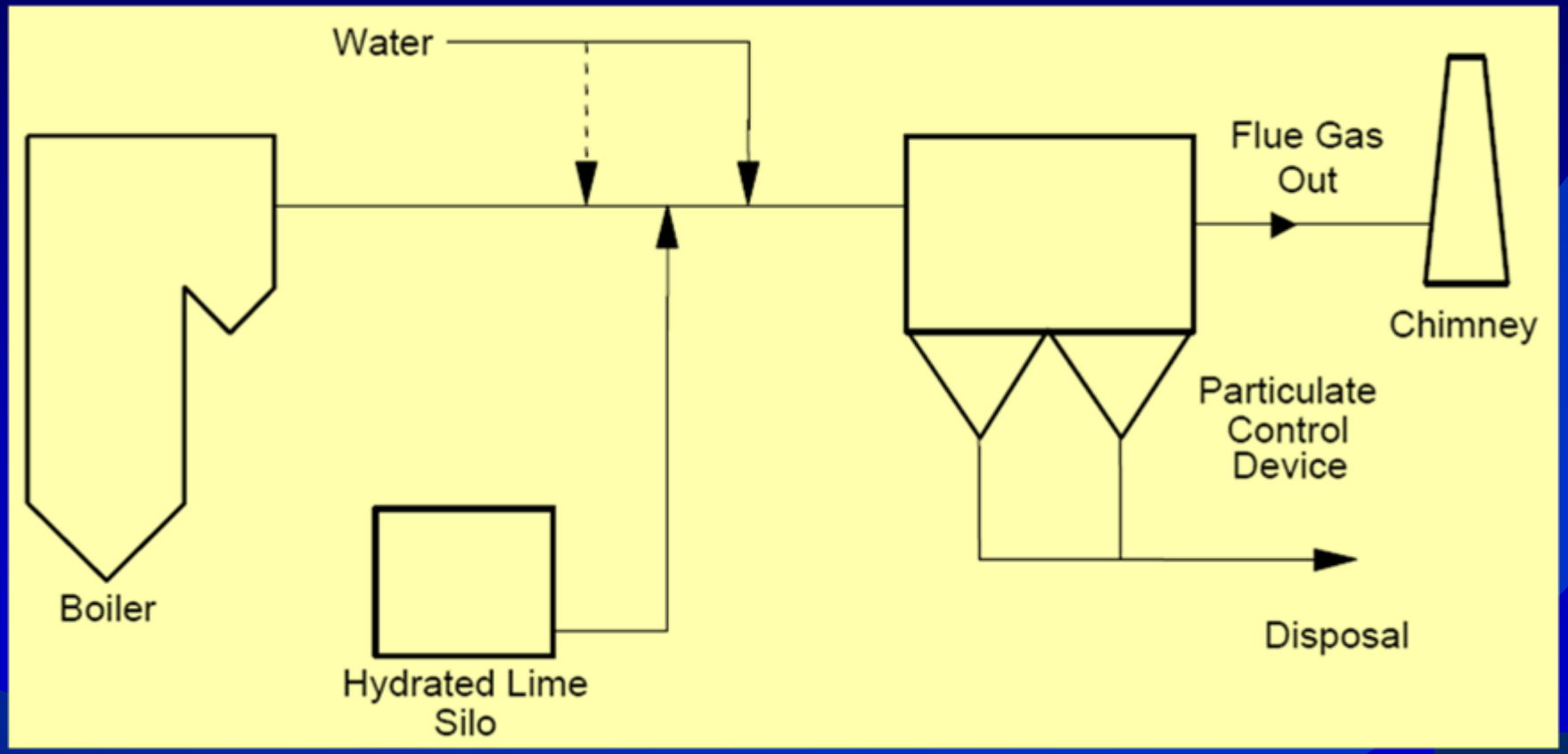
FGD Technology – Spray Dry

- Concentrated lime slurry is injected into the flue gas, to react with and remove acidic compounds.
- Final product is a dry powdered mixture of calcium compounds
- Its efficiency is about 90%
- One of the most well-developed technologies
- It is suitable for low and moderate sulphur fuel
- It has 3.5% in Chinese FGD market

FGD Technology – Duct Spray Dry



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FGD Technology – Duct Spray Dry

- Same process as conventional spray-drying, except that the spray-dryer vessel is omitted, and lime slurry is sprayed directly into the duct.
- Suitable for low and moderate sulphur fuel.
- Its share is <1% in Chinese FGD market.

Other FGD Technologies

- Dry Processes: Furnace sorbent injection;
  - Its efficiency is about 90%.
  - It is suitable for low and moderate sulphur fuel.
  - Its share is <1% in Chinese FGD market.
- Dry Processes: Sodium bicarbonate injection
  - Direct injection of dry sodium bicarbonate into the flue gas duct
  - Its share is <1% in Chinese FGD market.

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FGD Applications in Mongolia

- Sulphur content in coal reserves in Mongolia is not too high
- Coal-fired power plants are very old
- No FGD device in operation in Mongolia
- More on this in a later session.

Policy Issues on SO_2 Emission Standards

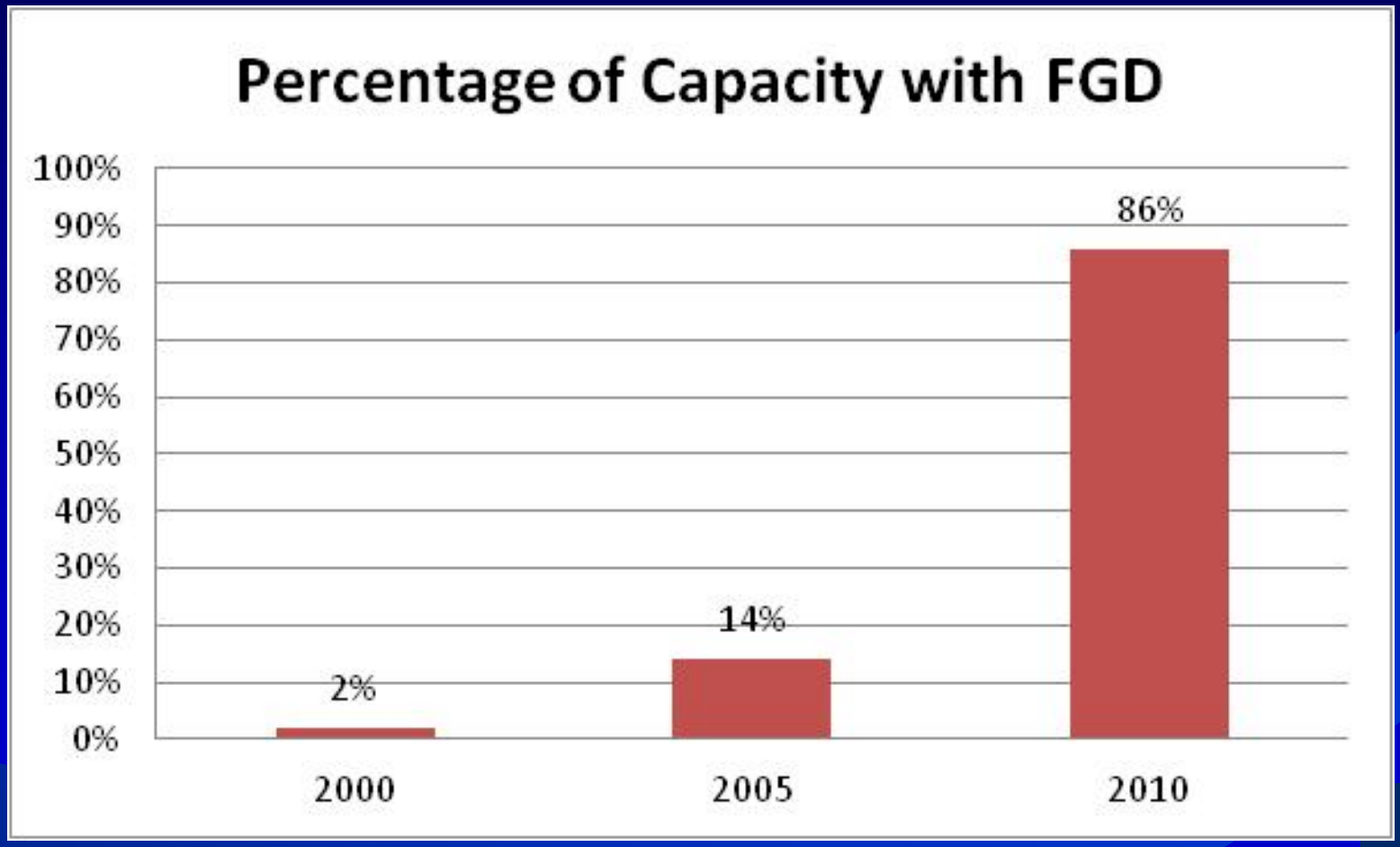
SO_2 Emission Standard in Mongolia

- The current emission standards for coal-fired boilers in power plants in Mongolia were established in 2008 (MNS5915:2008).
- Mongolia's current emission standards are based on emission measurements from existing boilers without strong rationale to justify these standards;
- SO_2 emission limits are from 615 - 1931 mg/m^3
- New standards have been developed to be adopted by the Mongolian authorities.
- The proposed new SO_2 limits: 400 mg/m^3 for urban areas and 600 mg/m^3 for remote areas.

Policy Issues on SO_2 Control - PRC

- FGD R&D started in 1970s and 1980s
- First FGD unit was put into service in 1991
- More advanced FGD technologies were introduced into China in the 1990s.
- By the end of 2000, the operating power generation units with FGD reached 5 GW

SO_2 Control Progress in PRC



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Policy Issues – Standard in PRC

- Emission standard for power industry in PRC was first introduced in 1991 (GB13223)
- The standard was revised in 1996 and 2003
- New standard has been released and will become effective in January 2012.

SO_2 Emission Control – New Standards

- SO_2 emission limit for new plants will be reduced from current 400 mg/m^3 to 100 mg/m^3;
- All coal-fired power plants must install FGD to meet the new SO_2 emission limits.
- Existing coal-fired units equipped with FGD also need to upgrade FGD to meet the SO_2 emission limit;
- Estimated cost for meeting new SO_2 limits will be 65 billion RMB.

SO_2 Emission Control Policy During 12th FYP Period

- The overall annual SO_2 emissions will be controlled to around 8 million tons from power sector;
- New non-fossil fuel power generation capacity will reach 220 GW;
- Shutdown small, inefficient and polluting power plants;
- Promote unit capacity of 600 MW and more to improve efficiency; and
- Promote CHP for district heating systems.

Summary

- SO_2 emissions are increasing every year due to increased electric power generation from coal-fired power plants;
- SO_2 emissions can be effectively controlled using mature technologies;
- Countries in Northeast Asia have established policies to address SO_2 emission from coal-fired power plants;
- SO_2 emission standards are getting tighter; and
- SO_2 emission per unit electricity generated is decreasing.

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Thank You

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