Technological Alternatives to Reduce Acid Gas and Related Emissions from Energy-Sector Activities in Northeast Asia Abstract and Exec. Summary

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Technological Alternatives to Reduce Acid Gas and Related Emissions from Energy-Sector Activities in Northeast Asia

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Abstract

Acid rain, caused primarily by emissions of nitrogen and sulfur oxides (NO_x and SO_x), is already having an environmental and economic impact in the countries of Northeast Asia. The problem is regional in scope, as emissions cross national boundaries and can have impacts in other nations. Projected growth in energy consumption in the region, particularly in the now-developing

economies, creates the potential for vastly increased emissions in coming decades. This paper reviews a selection of options for reducing NO_x and SO_x emissions in five categories: post-combustion pollution control, burner modification, fuel pre-treatment, fuel-switching, and energy efficiency improvement. The relative cost per unit of emissions reduction of measures from each category are compared. A number of different options for regional cooperation to address SO_x and NO_x emissions reduction are suggested, as are particular opportunities for collaboration between the United States and Japan to assist countries of the region in reducing emissions.

Executive Summary
Of the many environmental concerns currently facing the nations of Northeast Asia, the problem of "acid rain" or "acid precipitation" presents perhaps the most potent combination of immediate and ongoing impact and regional scope. Acid rain in Asia has already been implicated in the declining health of some of the region's forests, in the premature weathering of metals and other man-made materials, and in the degradation of irreplaceable cultural monuments. Acid precipitation is primarily the result of the reaction of oxides of sulfur and nitrogen (SO_x and NO_x) the "acid gases"- with water or water vapor, yielding sulfuric and nitric acids. Acid gases can act as local air pollutants, or, depending on weather conditions and how they are emitted, can be transported for hundreds of kilometer or more. Acid gases are produced primarily when fuels are combusted, although smelting of the ores of some metals is also a significant source of sulfur oxides.

The recent and projected growth in economic output and fuels use in Northeast Asia creates both a challenge and an opportunity. The challenge is that unless changes are made in the way that fuels are used, acid rain and other environmental problems threaten to seriously erode (literally and figuratively) the gains of development. The projected increase in fuels use does, however, provide an opportunity for the countries of the region, in cooperation, to promote a development path for the developing nations of Northeast Asia that takes advantage of a suite of available measures, measures that not only reduce acid gas emissions, but can concurrently provide other environmental and economic benefits.

The types of measures available to reduce the quantities of acid gases emitted from the energy sector include:

- **"Post-combustion"** or **"end-of-pipe"** measures designed to remove SO_x or NO_x by reaction of the acid gas with a chemical and/or a catalyst. These technologies, including the "flue gas desulphurization" devices or "scrubbers" now common on coal-fired plants in industrialized countries, are best suited to utility and large industrial applications, although the catalytic converter is an example of an end-of-pipe technology used in the transport sector.
- **Burner modification** measures change the way that a fuel is burned so as to avoid acid gas emissions. For sulfur oxide emissions control, this generally means either injecting a chemical (usually lime or limestone) into the area where the fuel is burned. NO_x is more typically controlled by manipulating the physical configuration of the burner, including the zones where fuel and air are added in the boiler or furnace. Burner modifications can be used on a variety of equipment, including industrial, commercial/institutional, and some residential-scale applications. Burner modifications are most cost-effective on new equipment, but are often also cost effective for existing units.
- **Fuel pre-treatment** measures that can be used to reduce acid gas emissions include washing of coal (already widely practiced in China), changing refinery processes to produce heavy fuel oil and diesel oil with lower sulfur contents, or simply changing supply patterns to use lower-sulfur imported or domestic fuels in the first place.
- **Fuel-switching** measures that replace the use of higher-sulfur coal or oil with low-sulfur natural

gas or biomass fuels, or with electricity generated via hydroelectric, wind, solar photovoltaic, nuclear, or other fossil-free means.

- **Energy-efficiency** measures that deliver the same *energy service*-a liter of water heated, a passenger kilometer of travel, or a tonne of cement produced, for example-with less fuel input than standard-efficiency equipment.

Of these categories of measures, fuel-switching and energy-efficiency measures hold the most promise for reducing acid gases at costs that are either relatively low or negative (meaning that the measures pay for themselves with fuel, capital, and operating savings alone) on a net basis. End-o--pipe and burner modification measures are will continue to be important to retrofit the existing equipment in the region and to the extent that growth in coal-fired power will continue to occur. Burner modifications (such as "low-NO_x" burners) in new combustion equipment typically add little to the cost of producing the equipment, and should be uniformly applied (as is increasingly the practice in industrialized countries). Coal cleaning will continue to be important to reduce the sulfur and ash content of lower-quality coals, to improve the combustion properties of coal, and to reduce coal transport costs. The reduction of sulfur contents of refined products is not a present widely applicable in China, which now uses mainly low-sulfur crude oil in its refineries, but probably will be in the future as China is forced to purchase more and more higher-sulfur crude oil from the Middle East.

How can regional cooperation help to implement some of these measures? Possibilities include:

- **Provide Information and General Training to Government Officials** to increase their understanding of the issues and support for key programs.
- **Provide Specific Information and Training to Local Actors** so that domestic or imported technologies can be used most effectively.
- **Encourage the Implementation and Enforcement of Energy and Environmental Standards** to further encourage environmentally-sustainable development.
- **Establish Programs of Grants and Concessional Loans** to catalyze the introduction of appropriate technologies.
- **Modify Existing Incentives for Energy Efficiency and Pollution Prevention** to remove social and economic roadblocks to improved practices.
- **Promote Joint Ventures and Licensing Agreements** to start the manufacturing of appropriate acid gas-reduction technologies in the developing countries of the region.

Some potential starting points for United States-Japan and regional collaboration in reducing acid gas emissions in Northeast Asia might include:

- **Create a clearinghouse for summary and detailed information on acid gas reduction measures** where planners, officials, plant managers, entrepreneurs, and others can access to up-to-date information on the types of technologies and measures are available for acid gas reduction, and how they can be obtained.
- **Create a trade liaison to promote the transfer of appropriate technologies.**
- **Promote and sponsor study tours and in-country training activities** for personnel from the developing countries of the region.
- **Promote and assist in applications that demonstrate promising technologies**, including providing equipment, expertise, and financial assistance.

- **Help to fund and organize regulatory infrastructure in China and North Korea**, including providing know-how and equipment for testing laboratories, monitoring facilities, and research installations.

Read the complete version of "Technological Alternatives to Reduce Acid Gas and Related Emissions from Energy-Sector Activities in Northeast Asia"

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