Policy Forum 97-13: Energy and Acid Rain Projections for Northeast Asia

The NAPSNet Policy Forum provides expert analysis of contemporary peace and security issues in Northeast Asia. As always, we invite your responses to this report and hope you will take the opportunity to participate in discussion of the analysis.

Recommended Citation

David G. Streets, "Policy Forum 97-13: Energy and Acid Rain Projections for Northeast Asia", NAPSNet Policy Forum, June 17, 1997, https://nautilus.org/napsnet/napsnet-policy-forum/energy-and-acid-rain-projections-for-northeast-asia/

Energy and Acid Rain Projections for Northeast Asia

June, 1997

The ESENA Policy Forum Online is intended to provide expert analysis of contemporary energy, security and environmental issues in Northeast Asia, and an opportunity to participate in discussion of the analysis. A set of questionsbased on the following work is appended below. The Nautilus Institute invites your responses, based either on these questions or on any other thoughts you have after reading the work. We will post selected responses on our Web site. Please send your responses to us at: esena@nautilus.org.

"Energy and Acid Rain Projections for Northeast Asia"

By David G. Streets

* DRAFT * PLEASE DO NOT CITE OR QUOTE WITHOUT PERMISSION * DRAFT *

This report was developed with support from:
The U.S.-Japan Foundation
The Center for Global Partnership.

David Streets is a Senior Scientist in the Decision and Information Sciences Division at Argonne National Laboratory. Dr. Streets was one of the prime movers of the Annual Conferences on Acid Rain and Emissions in Asia that eventually led to the Regional Air Pollution INformation and Simulation-Asia (RAINS-ASIA) project.

The RAINS-Asia model is an analytical tool to help decision-makers analyze future trends in emissions, estimate regional impacts of resulting acid deposition levels, and to evaluate costs and effectiveness of alternative mitigation options.

In this paper, Dr. Streets uses the RAINS-Asia model to discuss energy and socioeconomic projections for the region and their implications for emissions of the acidifying species, sulfur dioxide and nitrogen oxides. He examines the relationships between population growth, economic development, urbanization, energy use, and emissions. Dr. Streets also suggests potential joint US-Japanese policy initiatives to curb acidifying emissions in the region.

SummaryNortheast Asia is one of the most dynamic and diverse regions of the world. It contains one of the richest and most highly developed countries of the world, Japan, as well as some of the poorest and most backward areas of North Korea and rural China. It contains areas of extremely rapid growth in population, economic development, and industrial productivity, such as Seoul and Shanghai. Millions are living in affluence; millions are near starvation. As the poorer regions strive to catch up to the more developed ones, the environment is often ignored or given only cursory attention. But in a region like Northeast Asia, where the rich live and work alongside the poor, all share the burden of environmental degradation. Increasingly the need for regional cooperation in solving environmental problems is becoming apparent. And none more so than with air pollution and acid rain, where the problems do not respect geopolitical borders.

Northeast Asia has experienced phenomenal economic growth since the end of the second World War. Japan and South Korea sustained average annual economic growth rates of 8-10% for several decades, and China has recently joined the ranks of the booming Asian economies. It is interesting to note in passing, however, that economic strength is by no means uniform across the region, with average per capita GDP values of $19,400 in Japan, $5,900 in South Korea, and only $270 in China. Economic growth is expected to continue at a fast pace in the future, but slowing down from a continental

annual average of 6.5% (1990-2000) to 3.7% (2010-2020).

Population growth and economic growth in Northeast Asia will lead to increased energy demands to provide the goods and services needed by the more affluent societies. Sectoral shifts away from heavy industry to the transportation and services sectors and continued improvements in energy efficiency will help to decouple energy growth from economic growth; but, nevertheless, increased energy consumption in Northeast Asia in the future is unavoidable, and much of it will be provided by fossil fuels.

Northeast Asia (comprising Northeast China, Japan, South Korea, and North Korea in this study) presently consumes about 12% of the world's energy. This paper estimates that energy consumption in Northeast Asia will grow from 43 exajoules (EJ) in 1990 to as much as 111 EJ in 2020 (or 82 EJ if strict energy conservation measures are introduced). Most of the growth will occur in and around the industrial cities of Northeast China: Beijing, Shanghai, Tianjin, Shenyang, etc., and in the Seoul/Inchon area of South Korea. Coal will satisfy about half of the region's energy needs, and oil about 35%. China has extensive reserves of coal that will continue to dominate its energy supply picture for the foreseeable future, despite expected advances in the provision of nuclear energy, oil and natural gas, and renewable energy--especially hydroelectric power.

Combustion of coal leads to releases of sulfur dioxide (SO_2) and nitrogen oxides (NO_x)--as well as carbon dioxide, which is not a focus of this paper. Both SO_2 and NO_x cause health and ecological damage if ambient concentrations are high enough, and both are implicated in the formation of acid rain. Nitrogen oxides also lead to the formation of ozone, which has received little attention in Asia thus far. Presently, only Japan has strict pollution control requirements to limit emissions of these two species--in fact, Japan has been a world leader in the development of pollution control regulations and equipment. South Korea has limited existing regulations, and China has only recently begun to contemplate regulatory action.

If current (1990) emission control requirements in the region remain unchanged in the future, it is estimated that there will be a 175% increase in SO_2 emissions and a 250% increase in NO_x emissions between 1990 and 2020. There is no doubt that this would seriously exacerbate the acid rain problem in the region, with growing amounts of pollution transported from Northeast China across to the Korean peninsular and to Japan.

Already, air pollution arising from high ambient levels of SO_2 and NO_x is a serious problem in the industrialized regions of China, e.g., the Sichuan Basin, and in the cities that are reliant on coal-based economies--such as Shanghai, Beijing, and Seoul. In addition, acid rain is already a regional problem in Northeast China, South Korea, and Southwest Japan. Monitored pH levels are decreasing all the time, due to the acidity associated with SO_2 and NO_x emissions. Damage to lakes and forests has already been

seen in those parts of China where the pollution is the worst. Such large emissions increases as are projected here would considerably intensify the severity and extent of current problems.

Pollution control measures are available to limit SO_2 emissions, but they are costly. It is estimated that the most stringent control scenario examined in this study--in which controls would be installed on all major existing and new coal-burning facilities and all smaller users would have to use lower-sulfur fuels--would cost as much as $35 billion annually by 2020 and reduce SO_2 emissions by 69% relative to today's levels. Less restrictive control scenarios have been examined that cost only $10-14 billion annually, but they permit emissions to increase by 40-75% relative to today. It is clear that any strategy that will materially limit halt the expected growth in emissions in Northeast Asia is going to be extremely expensive.

Average emission control costs vary considerably across the region, because of the different levels of control currently in place. Thus, average costs in Japan for further reductions relative to today's standards are about $3,600/t, compared with $450-1200/t in Northeast China, because Japan has already implemented the cheapest measures. This points out the need for regional cooperation in determining appropriate control measures. Though NO_x emission reduction methods are known (and implemented in Japan), they are sufficiently expensive and novel that they are unlikely to receive much attention in the rest of Northeast Asia any time soon.

In summary, transboundary air pollution has the potential to contribute to destabilization of political relationships among the countries of Northeast Asia. With the control costs being so high, and the distribution of incremental control opportunities so skewed, it seems essential that appropriate control measures be discussed in a regional forum.

Read the full version of "Energy and Acid Rain Projections for Northeast Asia"

The Nautilus Institute Invites Your ResponsesYour are invited to participate in this "virtual forum" by considering the questions below, or collecting any other thoughts you have after reading the paper, and then emailing your comments to: esena@nautilus.org . The Nautilus Institute will review responses and post selections to this web site.

1. This paper relies on the RAINS-Asia model to create a picture of acid deposition in Northeast Asia. Whereas the model may be the most comprehensive one available, it neglects numerous important factors that effect acid rain including local views of the problems, impacts on cultural heritage, and citizen involvement in monitoring activities. How significant are the non-scientific factors in mitigating acid deposition in the region?

2. This paper suggests that the issue of transboundary acid rain has potential to contribute to the destabilization of political relations in the region. Do you agree or disagree with this view and what should be done to prevent deterioration in relations among the countries of Northeast Asia?
3. The Russian Far East is not included in this analysis. How important is this region to the acid rain situation in Northeast Asia?

Nautilus Institute
608 San Miguel Ave., Berkeley, CA 94707-1535 | Phone: (510) 423-0372 | Email: nautilus@nautilus.org