

Clean Air for Asia:

Update and Overview of China-India-Japan-United States Cooperation To Reduce Air Pollution in China and India

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In Memoriam

Dr. Donald L. Guertin

1930-2006

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Director, Program on Energy and Environment, 1992-2005

Founding President, 1992-1994

Executive Director, 1996-2005

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As director of the Atlantic Council's Program on Energy and Environment, Dr. Guertin directed and/or was rapporteur of projects on U.S.-Japanese energy cooperation to help achieve sustainable development in Asia, the future of nuclear power, energy for sustainable development, global climate change, Russian and Ukrainian energy policies and U.S. energy policy. He led a long-standing U.S.-Japan Energy Policy Dialogue. He helped found the World Energy Efficiency Association. He played a seminal role in initiating and guiding the project on Clean Air for Asia, for which this is the final report.

This policy paper is dedicated to his memory.

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Foreword

A main theme of *Clean Air for Asia* is that the need to reduce air pollution is increasingly connected to global concerns over energy production and sustainable development. Consequently, the scope of the discourse and study reflected in this paper is significantly broader than a narrow interpretation of the title might imply. If China and India are to continue their economic development, effective policies governing energy use and environmental stewardship will be essential—a fact this study has endeavored to address. The challenge of providing clean air for Asia, then, is a major element of the broader challenge faced by the region and, for that matter, by the entire world.

Since the publication of the first policy paper on this subject in 2003, two additional seminars have been held. In New Delhi in 2004 and Beijing in 2005, prominent groups of scientists, engineers, academics, businessmen, and government officials gathered to comment on the project's previous work and suggest further recommendations. The conclusions of the members of the working group are their own. Each member of the group acted in his or her individual capacity and the report does not necessarily represent the views of their organizations or of the Atlantic Council. This updated report represents the general consensus of the group's work and members of the group have approved it as such, without necessarily endorsing every sentence of the report.

I would like especially to thank the four co-chairs, General Richard Lawson, a vice-chairman of the Council; Shinji Fukukawa, a senior adviser to the Global Industrial and Social Progress Research Institute (GISPRI) and the Dentsu Institute (Japan); N. Srinivasan, director general of the Confederation of Indian Industry (CII); and Prof. Yang Jike, director of the South-North Institute for Sustainable Development (Beijing), for their leadership of the project. Thanks are also due to John Lyman, director of the Council's Program on Energy and the Environment, for his work as project director and principal rapporteur, as well as to his co-rapporteurs V. Raghuraman, senior advisor for energy to the CII; Jiang Kejun, director of the Energy, Environment and Climate Change Research Center (China); and Kotaro Kimura, executive director of GISPRI, for their work in condensing the rich discussions engendered by the project's meetings into the body of this paper. I also thank the many participants in the seminars for their excellent papers and recommendations. Special thanks are also due to Eliane Lomax, the associate director of the Council's Program on Energy and the Environment, for her tireless efforts to ensure the project's success. Dr. Donald Guertin, the initiator of this project and its director until late 2004, passed away in January 2006, and I wish to honor here his outstanding leadership and selfless contribution on behalf of the program.

The Council greatly appreciates the support of the sponsors who made the project possible. These include the Department of Energy, the National Energy Technology Laboratory, Simmons & Company International, the Energy Environment and Security Group Limited, the Confederation of Indian Industry, the Committee for Energy Policy Promotion (Japan), and the Energy Research Institute of the National Development and Reform Commission of China.

Jan M. Lodal
President
The Atlantic Council of the United States

Executive Summary

In recognition of the impact China's and India's quest for sustainable development will have on the world's energy markets and the global environmental outlook, the Atlantic Council of the United States undertook a major project in 2000 to conduct a dialogue among prominent experts in China, India, Japan and the United States. This dialogue was to address some of the more significant problems facing China and India due to the existing and increasing level of air pollution that will accompany rapidly growing energy consumption.

In 2000, both countries were concerned about security of supply, as well as the impact of price levels and price volatility on balance of payments and economic growth. Per capita consumption of energy in China was only one-sixth of that in the OECD countries, and one-twelfth of the OECD level in India.

In the course of the multi-year project, particular emphasis was given to developments in the electric power and urban transportation sectors. In both China and India, per capita consumption of energy for electricity and for transportation remains extremely low by developed world standards, and the energy requirements of these sectors were seen as accounting for over 75 percent of the total increase in projected energy usage, with electricity alone accounting for over 50 percent.

Following preliminary consultations in Beijing, Tokyo and New Delhi in December 2000, a first quadripartite seminar was held in New Delhi in April 2002 and a second in Beijing in February 2003. These seminars provided a forum for the exchange of ideas and the development of close relations that laid the foundations for the July 2003 policy paper and its recommendations.¹ Participants were well informed on existing policies and activities and focused on identifying specific recommendations to accelerate the existing efforts to improve the environmental quality linked to energy consumption.

During the first series of two seminars, discussions resulted in thirty-nine specific recommendations in the following seven major areas:

- Strengthening government institutions
- Long-term strategy
- Electric power reform
- Strengthening educational institutions
- Technical cooperation
- Improving enterprise capability
- Rural development

A second series of dialogues focused on reviewing progress on the initial recommendations was initiated with a November 2004 meeting in New Delhi and followed by a November 2005 meeting in Beijing. By 2004, oil imports into China has risen to 2.9 million barrels a day, and India's imports had

1. The Atlantic Council of the United States, *Clean Air for Asia: China-India-Japan-United States Cooperation to Reduce Air Pollution in China and India*, Policy Paper, July 2003, 23-24.

grown to 1.5 million barrels a day. The International Energy Agency (IEA) was predicting that over the next 25-30 years China and India would account for almost one quarter of the world's projected increase in energy consumption.² Furthermore, by the end of 2004 the world had experienced significant price increases for oil, coal and a number of other commodities such as steel.

Progress to date

The second series of seminars indicated major progress on a number of fronts as well as heightened concerns and a growing recognition of the increasing complexity of the issues:

- In both China and India, the responsibility for developing *integrated energy and environmental policies* has been elevated, and major new comprehensive policy documents have been completed.
- In both countries, considerable attention has been given to the development of *longer-term strategies that recognize the limitations of indigenous energy supplies*.
- Emphasis is being placed on the *need for energy conservation and efficiency* measures, and China has recently initiated fiscal policies to support these strategies.
- Efforts to *diversify hydrocarbon supply sources* through expanded contracts with producing countries and equity investments have been noted frequently, as have China's efforts to establish oil stockpiles.
- The benefits of *market-based pricing* to reduce economic distortions have been recognized, although policy implementation has proved difficult with recent world market price increases.
- A more holistic *integrated approach to energy planning* has been developed, supported by sophisticated modeling by the Chinese.
- The importance of *technological change and innovation* along with international technical cooperation is being emphasized.
- *Power sector reforms* have been initiated:
 - In China, significant reform and restructuring has taken place:
 - Generation has been separated from transmission and distribution.
 - A State Electricity Regulatory Commission has been established in Beijing.
 - Regional power market pilot projects have been undertaken.
 - New tariff reform has been approved.³
 - In India, there has also been significant action:
 - A Comprehensive Electricity Act was passed in 2003 that created a centralized Power Grid system and established State Regulatory Commissions.
 - A new National Tariff Policy was scheduled to be set in December 2005.
 - A draft New Integrated Energy Policy was released in December 2005.

2. International Energy Agency, *World Energy Outlook 2004*, World Oil Demand Table 3.1, 82.

3. Throughout the text, the term "tariff" refers to domestic pricing, consistent with usage in India and China.

- In both countries, substantial efforts are being made to *address rural poverty and energy requirements*:
 - In China, 99 percent of all households were reported to have been connected to the grid during 2004. Although the availability and reliability of this power was initially poor, it is being systematically improved over time with the growth in generating capacity.
 - In India, the government has set an ambitious goal of providing electricity by 2007 to the 125,000 villages without power in 2004.⁴
- Based on current assessments of technology need, both countries have *numerous cooperative efforts* in progress with U.S., European and Japanese companies and governmental agencies. Also, both countries view increased international cooperation on R&D and increased technology transfers as top priorities.

New Recommendations

While progress has been impressive, changing conditions and the difficulty of implementing some of the earlier recommendations has led to a revised list of policy recommendations based on current conditions:

- There remains an ongoing need to *improve regulatory performance* by ensuring that environmental regulatory agencies at the national, state, and/or provincial levels are independent agencies staffed and budgeted to enforce regulations in a predictable manner.
- *Energy security* has become even more challenging and needs to be seen as an issue requiring international cooperation.
- The difficulty of providing *adequate energy at affordable prices* means that technology R&D transfer and international cooperation should be accelerated.
- *Transportation energy* issues will benefit from:
 - International cooperation on developing and commercializing advanced technologies.
 - Greater utilization of mass transit electric rail.
 - Extensive utilization of alternative fuels.

Conclusions

Without a major shift in policies and/or technological developments, China and India will continue to experience high growth rates for energy consumption as they pursue rapid economic growth to support continuing urbanization and improvements in rural living standards. Their growing reliance on energy imports, particularly for oil and natural gas, will present major challenges to international energy markets and supporting industries. Energy security has become a global concern that will require increased understanding and cooperation.

Technology change is seen as a major lever to meet energy requirements in a sustainable manner, given the difficulty of rapidly changing energy efficiency levels and the need for economic growth. Again, a substantial increase in international cooperation among countries will be required to facilitate the development, commercialization and transfer of energy related technologies.

4. The Atlantic Council of the United States, *Clean Air for Asia*, Bulletin, May 2005, 7.

Since 2000, China and India have both made substantial progress in developing coherent energy strategies and development plans. While the policies and regulations to implement these strategies and plans are ongoing, it is a particularly opportune time to expand the dialogue with China and India on energy security issues and to increase cooperation on the development and commercialization of energy technologies to improve efficiencies and provide alternative sources of energy.

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Clean Air for Asia

Update and Overview of China-India-Japan-United States Cooperation to Reduce Air Pollution in China and India

Introduction

It is well understood that China and India will have a major impact on global economic and political trends in the twenty-first century. In their quest for sustainable development, both are trying to maintain economic growth rates of about 8 percent per year in order to alleviate poverty, continue raising income levels, and improve their citizens' overall quality of life. By dint of the size of their combined populations - over one third of the world's total - and the scale of their need for energy, the policies and technologies they decide to adopt will have a critical impact on both their own and the global environment.

In November 2005, the Atlantic Council held its fourth dialogue with experts from China, India, Japan, and the United States to review the prospects for economic growth, energy use and the environment in order to make policy recommendations based on an understanding of developments to date. The four dialogues were initiated by meetings in 2000 that identified some of the major energy issues concerning policy makers and industry leaders in China and India.

Given the broad range of potential topics, the dialogues focused on the electric power sector and urban transport, and on how cooperation on technology among the four countries might contribute to better energy development strategies. Special attention was given to the possibility of cooperation on technologies that could improve air quality. When the project was first conceived, there had only been very limited dialogue between China and India on energy matters.

China's and India's impact on world energy markets and trade was much less in 2000 than today, as both countries depended heavily on indigenous energy supplies, mainly coal, for most of their energy needs. In both countries indigenous oil production had tended to stabilize. In 2001, China imported 1.7 million barrels a day of oil (one-third of its oil demand), having become a net importer for the first time in 1993. India imported 1.4 million barrels a day (two-thirds of its oil demand). Oil supplied 23 percent of total energy demand in China and 33 percent in India. Fuels other than coal or oil met only six to seven percent of total commercial energy requirements.¹

1. International Energy Agency, *World Energy Outlook 2002*. Non-commercial fuels consist of agricultural wastes, dung, firewood, and trash.

By 2004, China's net oil imports had risen to 2.9 million barrels a day and India's to 1.5 million barrels a day.² China's petroleum import dependency had risen to forty-five percent and India's to sixty-five percent. The 2.0 million barrel a day growth in China and India's oil consumption between 2000 and 2004 represented over one third of the world's growth in total oil demand.³ By the end of 2004 the world had experienced significant price increases for oil, coal and for a number of other commodities such as steel. The trend continued through 2005.

These developments as well as a growing concern among some analysts of the long term availability and accessibility of conventional oil supplies has led both China and India to focus even greater attention on energy policies. Simultaneously, there have been increasing pressures to reduce environmental pollution and to address global climate change issues. These pressures have arisen from both internal and external forces that have led to a growing awareness of the complexity of the issues as well as the wide range of possible solutions. Numerous firms and individuals have approached both countries with projects and technical assistance to address specific issues.

As a result, both countries have become more sophisticated in analyzing their energy issues and in designing energy policies and strategies. This is seen in the specific steps that have been taken to address many of the recommendations discussed in the July 2003 policy paper.⁴ This paper reported on the initial meetings that took place in New Delhi in April 2002 and in Beijing in February 2003 that resulted in 39 policy recommendations in the following seven categories:

- I. Strengthening government institutions
- II. Long-term strategy
- III. Electric power reform
- IV. Strengthening educational institutions
- V. Technical cooperation
- VI. Improving enterprise capability
- VII. Rural development

These recommendations dealt with a number of fundamental concerns reflecting the basic nature of the then-current dialogue on energy matters in the two countries. By the start of the second series of meetings in 2004, the urgency of providing adequate and reliable energy supplies had become even clearer to policy leaders in both countries as had the increasing challenges facing the international energy markets and supporting industries.

In both countries there is widespread knowledge that the continuing high growth rates for energy consumption are leading to a growing reliance on energy imports, especially the oil and natural gas imports that represent a major portion of the world's growth in energy consumption. India is also starting to face a rapid growth in coal imports that could reach 500 million tons per year by 2030 versus 30-40 million tons today, depending on the intensity with which other fuel options are pursued.⁵

2. Energy Information Agency, U.S. Government, 2006 Official Statistics.

3. International Energy Agency, *World Energy Outlook 2005*.

4. Atlantic Council of the United States, *Clean Air for Asia: China-India-Japan-United States Cooperation to Reduce Air Pollution in China and India*, ix-xi, 24-31.

5. Planning Commission, Government of India, *Draft Report on the Expert Committee on Integrated Energy Policy*, December 2005, 47.

These more recent developments have caused both governments to become much more focused on energy security issues. This is evident from the aggressive expansion in overseas hydrocarbon equity investments as well as increased diplomatic and commercial relations with energy exporting countries. The growing linkages developing in both China and India between domestic and international markets means that their energy issues have to be seen as issues for the international community.

In this setting, the second series of dialogues, held in New Delhi in November 2004 and in Beijing in November 2005, focused on reviewing progress on the initial recommendations and on noting the shifts in emphasis on certain issues. One issue area, “Improving Enterprise Capability,” was not reviewed as it covered a number of subjects that are under constant discussion in other formats. Instead, a session was held to discuss steps to improve environmental performance, and another session focused on transportation issues.

Status of Progress on Issues

Issue I

Strengthen existing institutions and create new entities that would support development of energy and regulatory policies to ensure affordability, accessibility, and availability of energy supplies that result in less environmental damage and cleaner air.

In both China and India, significant progress has been made in developing integrated energy and environmental policies, with better coordination among the relevant ministries at the central level. In both countries the responsibility for this activity has been elevated.

China has established a National Energy Office under Premier Wen Jiabao to develop an integrated set of energy strategies and policies. Several related documents have been prepared. The recently approved Five-Year Plan (2006-2010) includes a National Five-Year Energy Development Plan. In addition, a China Medium- and Long-Term Energy Conservation Plan has been prepared, as has a National Medium- and Long-Term Science and Technology Development Plan.

Taken together, these plans address a large number of issues, such as the need for:

- Twenty percent energy intensity reduction target in 11th Five-year Plan period.
- Energy conservation to be supported by meaningful national and local efficiency regulations and programs.
- Reform of energy pricing systems to make them more market based.
- Greater use of fiscal policies to support energy policies.
- Economic recycling to reduce energy demand growth.
- Increased public awareness and involvement in energy and environmental issues.

India has given the responsibility for developing a long-term energy strategy to the Planning Commission, which has integrated energy strategy into India’s overall development strategy. A Draft New Integrated Energy Policy was released in December 2005.

The principles underlying the new policy are identified as follows:

“A competitive market without any entry barriers is theoretically the most efficient way to realize optimal fuel and technology choices for extraction, conversion, transportation, distribution and end use of energy. The tax structure and regulation across energy sub-sectors should be consistent and institutional arrangements should provide a level playing field to all players. Social objectives should be ideally met through direct transfers. Environmental externalities should be treated uniformly and internalized, as far as possible, under the polluter pays principle. An energy market with the foregoing features would minimize market distortions and maximize efficiency gains. An integrated energy policy is needed to ensure that energy availability does not become a constraint on India’s economic growth and competitiveness.”⁶

The Commission concluded that a cost-effective energy system requires:

“(i) Markets that promote competition. (ii) Pricing and resource allocation to take place under market forces under an effective and credible regulatory oversight, as far as possible. (iii) Subsidies to be transparent and targeted. (iv) Improved efficiencies across the energy chain. (v) Policies that reflect externalities of energy consumption. (vi) Policies that rely on incentives and which are implementable.”⁷

In both countries the structural changes needed to develop a more holistic approach to energy planning have basically been addressed. However, in both countries greater emphasis needs to be placed on building strong and credible regulatory institutions that are independent, transparent and viewed as fair. China’s director of the State Environmental Protection Administration, Zhou Shengxian, recently recognized the need for stricter enforcement of regulations,⁸ and in India, the new energy policy provides some guidance in this area.

Recommendation

While the need for transparency and even treatment under regulations has been recognized in both countries, budget limitations, weak enforcement, and a multiplicity of jurisdictions has led to slow progress on the 2003 recommendation to improve regulatory agencies and policies. Hence, it is still recommended that:

“Environmental regulatory agencies at the national and state or provincial level should be independent agencies that are staffed and budgeted to enforce regulations in a predictable manner. Regulations should be supported by cost/benefit analysis based on accurately collected data. Once promulgated, the impact of regulations should be accurately monitored and publicly reported.”⁹

6. Ibid., page ii of summary.

7. Ibid.

8. Shai Oster, Wall Street Journal, 13 March 2006.

9. The Atlantic Council of the United States, *Clean Air for Asia: China-India-Japan-United States Cooperation to Reduce Air Pollution in China and India*, 25.

Issue II

Develop long-term energy strategies that balance the need for security of supply with economic and environmental concerns.

Both China and India have devoted considerable attention to developing and initiating a number of strategies that address the recommendations in the 2003 policy paper. Since the initial dialogues, strategic decision-making has become even more complex owing to changing conditions. There are now major uncertainties impacting both countries, such as:

- Availability of supply
- Affordability of price levels
- Price competition among energy sources.

Both governments have acknowledged that new actions will be needed to meet growing energy requirements in an environmentally sustainable manner, even if indigenous resources such as coal, natural gas, hydro-electricity, and renewables are fully utilized.

Coal will remain the dominant source of energy in both countries for the next 3-5 decades even with a rapid growth in nuclear and renewables. While China is importing coal into southern ports to meet rapid demand growth for electric power in these areas and to avoid long rail hauls, most of its growth in coal supplies will come from indigenous sources. On the other hand, India expects to require a rapid increase in coal imports to meet power requirements.

Both countries expect to increase their use of nuclear power. For example, China has an aggressive plan to raise nuclear capacity to a total of 42 gigawatts (4-5 percent) of total generating capacity by 2020. In 2003 nuclear capacity of 8,750 megawatts represented only 1.3 percent of total electricity generating capacity. By mid-2005 nuclear capacity had risen to 15 GW.¹⁰ With limited indigenous uranium supplies, China has recently signed a long-term contract with Australia to meet its needs.¹¹

India has limited supplies of low-grade uranium. In its case, “a three-stage nuclear power program” is envisaged. This program consists of setting up Pressurized Heavy Water Reactors (PHWRs) in the first stage, Fast Breeder Reactors (FBRs) in the second stage and reactors based on the Uranium 233-Thorium 232 cycle in the third stage.”¹² This program is viewed as essential if India is to become truly energy independent beyond 2050. However, even with a 20-fold increase in nuclear capacity over the next 25 years, nuclear will only account for 5-6 percent of total energy.

Renewables will supplement but not supplant conventional power. Both countries have active programs to encourage the development of renewables, such as hydro, solar, wind and biomass. The development of hydropower is ultimately limited by site and water conditions, and is increasingly being restricted by public concerns over environmental impacts. Other renewables had been limited by economics that have recently been improving with technological developments and the current price increases for competitive fuels such as oil.

10. Energy Information Agency, U.S. Government, Country Report, August 2005.

11. Jane Perley, “Australia to sell uranium to China for energy,” *New York Times*, 3 April 2006.

12. Planning Commission, 37.

Much attention has been given to the recent efforts of both China's and India's numerous moves to diversify hydrocarbon energy supplies through long-term supply contracts and equity investments in response to their rapidly growing hydrocarbon imports. A number of these cases have involved the construction of new pipelines or LNG imports.

However, both countries seem to recognize that supply diversification is a short-term solution to the growing energy requirements to meet economic growth. Recently released strategy documents in both China and India indicate a clear recognition of the desirability of reducing the dependency on fuel imports by improving efficiencies and conservation. In March 2006, China enacted a number of fiscal measures designed to reduce energy consumption and has made energy conservation its top energy priority.

These developments at least partly reflect recent analysis of how the energy mix in their countries will change over the long-term. In China, complex sophisticated modeling is being used to understand energy options and international market pressures.

Simultaneously, both countries have recognized the need to develop market-based pricing mechanisms. However, implementation of policies to support such a transition has proven difficult with the recent increases in world energy prices and the concern over consumer reactions. As a result, policies related to fuel pricing and the use of price controls and subsidies are still evolving. The principles of market-based pricing need to be more broadly extended, especially where primary energy supplies are allowed to move with world markets and final energy outputs such as refined petroleum products and electricity are still controlled.

Recommendations

1. China and India should continue to bring market mechanisms into greater play. When politically and socially necessary, they should provide subsidies to consumers through direct governmental support rather than through pricing mechanisms that distort the financial performance of energy companies and reduce the viability of investments.
2. In both countries, policies should be developed that encourage the most effective and efficient use of fuels recognizing their cost and long-term availability. For example, natural gas and LNG should be prioritized for direct burning as a residential fuel for cooking and heating rather than as a source of electricity, as suggested in the July 2003 policy paper.¹³
3. Continue to develop and refine policies based on a long-term outlook as to how the energy mix and pricing structure is likely to change over time. This will necessarily entail an assessment of world supply availabilities, particularly for oil and natural gas where greater transparency of data is required.
4. Restructuring of the energy sector should continue to evolve so as to encourage private and international investment. This is particularly important for India.
5. Continue to improve energy security through supply diversification, recognizing that security of supply—not security of equity—is the objective.
6. Recognize that diversification alone is not sufficient. Energy security will ultimately depend upon

13. The Atlantic Council of the United States, *Clean Air for Asia: China-India-Japan-United States Cooperation to Reduce Air Pollution in China and India*, 26.

international cooperation and coordination as the world trade in energy resources expands and the potential for energy disruptions impacts more nations.

7. Both the United States and Japan should encourage positive nuclear energy development plans in China and India.
8. Both China and India should actively encourage and support technological changes and innovations to meet energy requirements.

Issue III

Establish the long-term financial viability of the electric power sector.

Both China and India have made major strides in establishing a financially viable electric power sector. In 2003 this was the single most important task that needed to be accomplished to promote efficient and effective improvements throughout the economy. The two countries took different approaches to implementing improvements.

China

By 2005, China had expanded the national power grid to reach almost all villages, although a shortage of generating capacity severely limited the initial availability of supply. Generating capacity has been rapidly expanded such that total capacity was to reach 500GW by the end of 2005, with additions of over 100GW still in the pipeline. Most of the additions to generating capacity will utilize coal, and consideration is being given to a new coal law that would focus on coal safety and environmental issues.

A new renewable energy law will expand such facilities by 3,570MW by 2010 and to 127GW by 2020 (70GW hydro, 30GW wind, 20GW biomass and 7GW other). This law will provide for compulsory purchase by the grid at protected tariffs, establish a public benefits fund, and provide preferential tax policies.¹⁴

At the same time significant reform and restructuring of the power sector has occurred:

- Generation has been separated from transmission and distribution.
- A State Electricity Regulatory Commission has been established in Beijing for the whole country.
- Regional power market pilot projects have been undertaken.
- New tariff reform has been approved.

Going forward, additional reforms are expected to further restructure the industry and to enable regional power markets and competitive bidding. Furthermore, new policies will combine mandatory rules with market-based mechanisms to:

- Internalize environmental costs
- Establish stringent emission standards

14. Jiang Kejun, Energy Research Institute, presentation at November 2005 Beijing meeting on *Clean Air for Asia*.

- Strengthen enforcement of regulations
- Improve competition.

To support these developments, the State Environmental Protection Administration (SEPA) is developing national cap and trade mechanisms to reduce emissions and minimize costs. Also, performance-based regulations impacting transmission and distribution facilities will create incentives to lower costs and improve performance. Customers will be encouraged to increase efficiencies, and generating utilities will use demand side management to reduce capacity additions by 100GW by 2020.

Recommendations for China

1. Emphasize the use of market-based tariffs.
2. Implement financial sector reforms to ensure that the most efficient generating plants and transmission lines are financed.
3. Further deregulate the industry to encourage private investment and joint ventures to improve the sector's efficiency.
4. Consider giving incentives to power generators to develop off-peak tariffs.
5. Assess the adequacy of plant maintenance and the use of appropriate coal to improve plant efficiencies.

India

Since the July 2003 policy paper, India has also taken a number of actions to improve the financial viability of its electric power sector and to increase the availability of power. A new Comprehensive Electricity Act was passed at the end of 2003. Major elements included the establishment of State Regulatory Commissions and the creation of a centralized power grid system. Although private investments are permitted in the grid system, none have yet occurred.

Prime Minister Singh recognized the need to expand the availability of power to foster economic growth throughout the country when he set a goal of providing electricity to all by 2012. However, India is also facing major challenges in implementing policy. In many states tariffs still do not reflect the cost of supply, as there is a reluctance to change past practices. Under these conditions, the weak financial position of the power sector continues to make it difficult to attract investments and to address the urgent need for new capacity. At the same time, inappropriately low tariffs encourage the inefficient utilization of power that exacerbates the problems caused by capacity shortages. A new National Tariff Policy was set at the end of 2005 to address this issue.

Targeted subsidies for subsistence consumers may be necessary to soften the transition to cost-based market pricing. Such subsidies should be provided from central/state government budgets to consumers directly through well-managed and transparent programs.

Historically, extremely low tariffs to the agricultural sector have had a major negative impact on the power industry's financial performance. The low tariffs have also led to the inefficient use of pumps for irrigation that has resulted in a more rapid depletion of ground water than required. Proper

tariffs would thus address both the financial viability of the utilities and the growing shortage of water supplies.

India's power industry is also being adversely affected by a shortage of new indigenous coal and gas supplies. In addition, cooling water supplies are being limited by competition from irrigation requirements. As noted earlier, India now expects to have to import substantial quantities of coal to meet growing generating requirements.

Nevertheless, there has been progress in a number of states where financial losses have been reduced under reform agendas. In these states investments are starting to respond to the improved tariff structures. Reliability of delivery has improved where demand-side management has shifted peak loads, and the grid has become more disciplined with the use of availability-based tariffs.

Recommendations for India

1. Encourage reluctant states to undertake tariff reform by showing the positive results in those states that have implemented reforms.
2. Increase competition among utilities by bringing in new private and international investors.
3. Encourage the faster application of new technology.

Issue IV

Improve air quality while reducing poverty through rural development and electrification.

In both countries, substantial efforts are being made to address rural poverty and energy requirements. Providing access to affordable electricity is viewed as the biggest and most important initiative to raise living standards in the rural areas where the majority of both populations live on less than \$2 a day.

In China, by 2005 a huge government investment had been made to extend the electric power grid to 99 percent of all households. In recognition of the extremely low rural income levels, rates were heavily subsidized. Even with this support, rural tariffs remained higher than urban tariffs. While the availability and reliability of this power was initially poor, it is being systematically improved over time with the growth in generating capacity.

In China, the decision to expand the grid was undertaken because most renewables were more expensive than grid power. However, in some of the most remote locations, where transmission costs would be prohibitive, the use of biogas technologies to produce gas and electricity, supported by micro financing at low interest rates, could be justified. Wind power is also being utilized, as its cost was only 20–30 percent higher than grid power in 2005. With the continuing rise in fossil fuel prices and the growing need to reduce pollution and carbon emissions from power plants, renewables are becoming more attractive, especially with government policy support.

China is actively encouraging the development of renewable power through compulsory purchases by the grid at protected prices and government financial support.

In India, the government has also recognized the urgency of raising rural living standards through the provision of energy. The government remains committed to a very ambitious target of trying to provide electricity by 2007 to the 125,000 villages that were without power. India's December 2005 Energy Plan also indicates a goal of providing electricity to all households by 2009-10, with subsidies of 90 percent of the connection cost to households below the poverty line. Clear pricing and subsidy policies to implement these objectives are still in formation.¹⁵

In the past two years several options for expanding rural power on a financially sound basis have been explored as reported in the May 2005 Atlantic Council bulletin *Clean Air for Asia*:

“One would use the concept of rural cooperatives. As recommended in the 2003 policy paper (*op.cit.*), a U.S. delegation came at India's invitation to explain the U.S. experience with rural cooperatives. The Indians are considering expanding the concept beyond electric power to include other rural services such as roads, water and agricultural distribution. Cooperative boards would be independent and self-financing, as are their U.S. counterparts.”¹⁶

“The second option is to expand the grid using a program introduced by a private enterprise to the west of New Delhi. The program entails the following critical components designed to change behavior and improve efficiencies while providing affordable and available power:

- Exercise supply side intervention by increasing access to electric power without the opportunity to steal so that reliable power can be provided at lower costs and tariffs can be collected based on the metering of all supplies.
- Use demand side intervention by applying commercial rates and providing energy efficient pumps such that consumer efficiencies result in 40 percent lower cost.
- Use social intervention by having a separate non-governmental agency:
 - Promote awareness of the program.
 - Build consensus linked to 95 percent collection rates and seven percent losses.
 - Sponsor village electrification committees to provide interface with consumers.
 - Provide a women's program for gender development and social enlightenment.
- Use administrative intervention by developing face-to-face contacts and consumer meetings on meter registration and billing policies.

Both of these options allow for the generation of revenues based on full-cost tariffs that eliminate the distortions in incentives inherent in many of the State Electricity Board's current tariff structures.”¹⁷

Under current market conditions, both countries should examine the interactions between renewable power and conventional electric power to look for hybrid solutions to optimize the availability and enhance the economics of renewable power

15. Planning Commission, 99.

16. Atlantic Council of the United States, *Clean Air for Asia*, bulletin, 7.

17. *Ibid.*, 7-8.

Recommendations

1. Renewable energy with distributed generation should become a mainstream activity.
2. Micro financing solutions need to be developed to leverage funding from overseas direct investment that will efficiently minimize the spread in interest rates.
3. Subsidies, if required, should be paid by the state.
4. Local community involvement is critical.
5. The process for encouraging renewable energy need to be institutionalized.

Issue V

Establish or strengthen educational institutions to provide training in the analysis of energy issues from a holistic viewpoint that integrates social, technical and economic impacts.

This issue was revisited at the November 2004 meeting in New Delhi.¹⁸ The desirability of maintaining multiple educational institutions at the doctorate level to train individuals to think holistically about energy and environmental issues was reaffirmed. However, it was stressed that individuals entering such institutions should have previously exhibited a disciplinary excellence at the master's level before attempting to develop the skills to work on multidisciplinary analysis and evaluation.

Funding for graduate centers of excellence could come from government, financial institutions and/or corporate sponsors. However, there was strong sentiment that the credibility of the institutions' technical analysis and policy recommendations would be diminished if the government ran such institutions.

There was also a recognition that younger students should be introduced to the multifaceted nature of problems in order to help raise the general public's awareness of the complexity of energy and environmental issues.

Recommendations

1. Continue to support the development of non-governmental graduate schools focused on curricula that encourage holistic thinking about energy and environmental issues through the provision of scholarships and interactions with third party educational institutions.
2. Develop primary and secondary school curricula to increase the population's awareness of the multidisciplinary nature of energy and environmental issues.

Issue VI

Improve environmental performance.

This is another issue that was mainly reexamined at the November 2004 meeting in New Delhi. Public pressure to reduce environmental pollution has accelerated in both countries. These political pressures should assist efforts to formulate and enforce environmental policies and regulations. However, these efforts need to be focused, as improving environmental performance requires long-term commitment

18. Ibid., 5.

of resources and people. In both countries the problems are massive and should be prioritized using cost-benefit analysis if there is to be major progress. There are simply not enough financial and human resources to solve all problems simultaneously.

In order to improve environmental performance, both China and India should be encouraged to adopt international standards wherever possible. In fact, they are already doing so for some automotive transportation fuels. It was noted that adopting an integrated approach to monitoring, inspecting and enforcing environmental performance on air, water and land would help reduce some of the dysfunctional results that can occur if only one aspect of a particular problem is addressed.

Both China and India face severe staffing restraints in trying to implement and enforce environmental policies. There needs to be a significant increase in training and budgets to reduce manpower limitations and to improve knowledge levels. These efforts should be supported by increasing international collaboration on technology, with effective protection and management of intellectual property rights.

As noted in the recommendations on regulations (Issue I), local and provincial environmental offices need to be independent and adequately provided with budgets, staffs and equipment if meaningful environmental progress is to occur. By itself, policy guidance from central authorities is not enough to ensure significant improvements.

The pace of environmental improvements can be accelerated by both countries' decision to utilize the Clean Development Mechanism in the Kyoto Protocol to encourage the use of more advanced technologies. But in the end, reasonable and achievable environmental goals will only be obtained with clear and transparent mandatory regulations that are monitored and enforced by independent organizations.

Recommendations

1. Reasonable and achievable environmental goals need to be made a public priority that is gradually tightened over time.
2. Where practical, China and India should adopt international standards.
3. Local and provincial environmental regulatory offices need to be independent and provided with adequate budgets, staffs and equipment.
4. International assistance focused on the transfer of technology should be accelerated with adequate protection of intellectual property rights.

Issue VII

International cooperation on R&D and technology transfer.

Significant progress has been made on increasing the level of international cooperation with China and India, with numerous efforts in progress in both countries with European, U.S., and Japanese companies and governmental agencies. Increased international cooperation on R&D and increased technology transfers are viewed as top priorities by both countries.

There remains a strong feeling that developed countries have an obligation to seek and make available technologies to solve environmental problems if they are serious about resolving such problems.

Many of the problems are increasingly being viewed as global issues, not simply national issues. This is especially true for some subjects such as CO₂ abatement and for major pollutants like sulfur and mercury that migrate across the globe. The Clean Development Mechanism of the Kyoto Protocol is supportive of some technology applications but is not sufficient by itself.

International cooperation was seen as being most beneficial when R&D results can be widely applied across countries, as in the areas of clean coal technology, new transportation fuels, and nuclear safety and storage. It is still felt that global cooperation in providing technical support will not be sufficient if only undertaken on a purely commercial basis. Also, if cooperation is to expand, technology transfers and collaborative R&D development must be mutually beneficial arrangements.

Both China and India are continuing to strengthen a number of effective R&D institutions that have the capability of developing complex technologies. It was suggested that, after each of the four countries participating in this project have determined their own priorities, they should seek to establish international cooperation at multiple levels depending upon the subject:

- Government to government
- Public direct cooperation
- Public/private partnerships
- International consortia.

Where basic research is needed, there should be a connection between business risk and financial return if the private sector is to be involved. This may mean that governments need to be involved, at least financially, in some of the necessary research.

It was also suggested that funding should be concentrated on marketable processes that meet human needs in order to ensure that the R&D is adding value. Further, the potential economic benefits of technology developments should be continually monitored and practical developmental paths should be identified.

In many instances, new technologies should be specifically designed for the locations where they are required. In these instances, international companies should work in collaboration with local companies to design and build facilities that are country and/or location specific.

Recommendations

1. The United States and Japan should expand governmental support for international collaborative R&D with China and India.
2. The United States, Japan, and other developed countries, should provide greater support for new and existing technologies to treat major pollution issues.
3. China and India should work together with the United States, Japan and other coal consuming countries to further develop clean coal technologies.

4. India should consider participating more actively in the International Coal Conference, an annual event involving 16 countries.
5. If China has become interested in technological solutions that could provide integrated solutions to sulfur and CO₂ emissions, it needs to identify its requirements.
6. China, India, Japan and the United States should continue to expand the number of cooperative activities at multiple levels.
6. Several international collaborative programs such as Asia-Pacific Partnership on Clean Development and Climate (APP) are currently in progress. Partners should promote further concrete collaboration with these programs.

Issue VIII **Transportation issues.**

Since the initial meetings in 2002 and 2003, considerable attention has been given to the increasing contribution of transportation fuels to urban pollution. The growth in demand for transport fuel has also been the major factor leading to the rapid increase in each country's oil import requirements.

Both China and India are approaching transportation issues in a similar manner by systematically examining:

- Fuel and engine technology
 - Fuel quality
 - Improved engine technology
 - Alternative fuels
 - Alternative engine designs
- Transportation modes
- Traffic management
- Inspection and maintenance
- Monitoring of air quality
- Development of policies for cleaner transport systems
- Implementation of regulation for emission standards.

To date, these activities appear to have involved little international cooperation, although a number of multinational companies are engaged in each country, with investments particularly large in China.

Both China and India have examined regulations and policies in other countries, and have implemented European fuel standards in some more populated cities. China has also recently adopted CAFE standards that are more rigorous than those approved in the United States.

With the recent rise in crude oil prices to around US\$70 a barrel and a growing likelihood of further tightening in conventional oil supplies, the issues facing China and India will have increasing relevance for developed countries, including the United States and Japan. Hence, an opportunity exists to expand international R&D cooperation on transportation issues.

Some of the major challenges are those already identified as impacting the ability to implement and enforce other environmental polices, namely:

- The need to determine the probable effectiveness of different policies.
- The need to incorporate cost/benefit analysis when selecting policies and setting regulations.
- The need to have reliable benchmarks on air quality.
- The need to enforce regulatory policies.
- The need to provide high quality oil products for implementing emission regulations.

The need for adequate supplies of cleaner burning and lower CO₂ emitting transportation fuels at reasonable costs will represent a major challenge in the years ahead.

Recommendations

1. Both China and India should analyze the probable effectiveness of different policies.
2. Cost/benefit analysis should be used when selecting policies and setting regulations.
3. China, India, Japan and the United States should consider expanding collaborative efforts on transportation issues.
4. China and India should consider the greater utilization of mass transit electric rail systems such as subways and light rail in major urban areas.
5. The United States and Japan should consider supporting an international consortium of car/bus/truck manufacturers to develop more efficient, cost effective, and less polluting vehicles designed for the Chinese and Indian markets. (This was also recommended in the July 2003 policy paper, and might result in technologies that would prove useful in the United States and Japan.)¹⁹

Concluding Comments

Since this project was initiated in 2000, both China and India have made tremendous strides in understanding their energy situation and the need for many fundamental structural reforms. Following the first series of dialogues in 2002 and 2003, progress has been evident, as a more integrated, holistic approach has been taken to developing energy policies and regulations.

However, dramatic changes in energy markets in 2004 and 2005 have significantly increased the complexity of ensuring access to the quantities of affordable energy supplies required by both countries to sustain growth. Hence, international cooperation on a wide range of issues has become considerably more urgently needed since the publication of the July 2003 policy paper. Moreover, this cooperation is seen as benefiting all participants.

The challenge of meeting energy requirements with less environmental degradation has led to an increased emphasis on conservation and efficiency in an effort to reduce supply requirements. At

19. The Atlantic Council of the United States, *Clean Air for Asia: China-India-Japan-United States Cooperation to Reduce Air Pollution in China and India*, 29.

the same time, it is evident that new technologies will be needed to provide cleaner fuels and to lessen dependence on uncertain and potentially unstable sources of supply.

These new realities mean that increased international cooperation on technology developments, conservation and efficiency improvements, and energy security is essential if the world is to avoid major shortages of clean, reliable energy sources that are affordable, available and accessible to the billions of people seeking to improve their living standards.

Appendix 1

Comments by Working Group Members

Shinji Fukukawa, executive advisor, Dentsu Institute and Global Industrial and Social Progress Research Institute (Japan)

While our study has been focused on the challenges and prospects of India and China, I expect that their energy and environment policies would be coordinated with the related strategy of East Asian countries within the framework of APEC.

Kazuo Shimoda, senior advisor, Committee for Energy Policy Promotion (Japan)

1. As broadly acknowledged nowadays, the most substantial and reliable energy for securing supplies and sustaining the global environment is nuclear power. If swelling of world oil consumption and abiding of its high price were inevitable in the considerable term of the future, the role of nuclear energy would be furthermore contributable for matching the balance of world energy.

Actually, the United States, some countries in the EU, and also Japan are eagerly making efforts to construct new national energy strategies under the recent conditions of energy and environment, emphasizing the importance of the role of nuclear power.

Both China and India also have very aggressive plans for developing nuclear power as shown on page five of the report. I think the United States and Japan should encourage and cooperate with the implementation of these plans with appropriate and thorough safety measures.

2. [In reference to Issue II, Recommendation 2 (page 6)] It is generally accepted that natural gas has the lowest impact among all fossil fuels to the environment and contributes to diversify the imported energy sources for a country like Japan. In fact, two thirds of the liquified natural gas imported to Japan is consumed as a fuel for electric generation.

Appendix 2

List of Papers Presented at the Seminars

New Delhi Seminar, November 2004

- ❖ Indian economic energy environment outlook, *Leena Srinastava*, executive director, TERI
- ❖ Indian electric power outlook, *H L Bajaj*, chairman, CEA
- ❖ Competition in evolving power market in India, *C P Jain*, chairman, NTPC
- ❖ Strengthening existing institutions and creation of new entities to support the development of energy and regulatory policies to ensure affordability, accessibility and availability of energy with environmental responsibility, *V S Ailawadi*, former chairman, HERC
- ❖ Development of long-term strategies to ensure long term energy security with economic and environmental responsibility, *Subir Raba*, chairman & MD, ONGC
- ❖ Long term viability of the electric power sector, *R V Shabi*, secretary, Ministry of Power, Government of India
- ❖ Strengthening educational institutions to analyse energy issues integrating social, economic and technological impacts, *Kirit Parikh*, member, Planning Commission, Government of India
- ❖ A review of international cooperation on R&D and technology transfer to promote cleaner air, *R R Sonde*, executive director, NTPC
- ❖ Improving environmental performance, TERI
- ❖ Improving air quality while reducing poverty through rural development and electrification, *Asbok Khosla*, president, Development Alternatives

Beijing Seminar, November 2005

- ❖ Development of long-term strategies to ensure long-term energy security with economic and environmental responsibility, *Gao Shixani*, Energy Research Institute, China
- ❖ Development of long-term strategies to ensure long-term energy security with economic and environmental responsibility, *V. Raghuraman*, Confederation of Indian Industry
- ❖ China's electric power outlook: scenarios for Chinese energy demand and supply to 2020, *Jiang Kejun*, Energy Research Institute
- ❖ China's urban transportation outlook, *Jiang Kejun*, Energy Research Institute
- ❖ Global economic energy/environment outlook, *Susan Holte*, EIA, United States Department of Energy
- ❖ China's economic energy/environment outlook, *Zou Ji*, Renmin University
- ❖ Economic energy/environment outlook, *V. Raghuraman*, CII
- ❖ Electric power and rural electrification outlook, *K. Krishan*, Malavalli Power
- ❖ Transportation outlook, *Vivek Adyanthaya*, Mahindra & Mahindra Ltd
- ❖ Review of the structure of China's power sector, *Zhou Dadi*, Energy Research Institute
- ❖ Coal regulation in China, *Zhou Dadi*, Energy Research Institute
- ❖ Policy issues for sustainable development in China, *Wang Wanxing*, Energy Foundation
- ❖ Establish and ensure the long-term financial viability of the electric power sector, *V. Raghuraman*, CII
- ❖ Improving air quality while reducing poverty through rural development and electrification, *K. Krishan*, Malavalli Power, India

- ❖ A review of international cooperation on R&D and technology transfer to promote cleaner air, *K. Krishan*, Malavalli Power, India, *Zou Ji*, Renmin University, China
- ❖ Impact of R&D and technology in reducing transportation pollution, *DQ Yang*, Powerzinc Electric, China, *Vivek Adyanthaya*, Mahindra & Mahindra Ltd, India
- ❖ Impact of pricing and mass transit on reducing transportation pollution; Impact of environmental policy and regulation on reducing transportation pollution, *Vivek Adyanthaya*, Mahindra & Mahindra Ltd, India

CEA = Central Electricity Authority (India)

CII = Confederation of Indian Industry

HERC = Haryana Electricity Regulatory Commission (India)

ONGC = Oil and Natural Gas Commission (India)

NTPC = National Thermal Power Corporation (India)

TERI = The Energy and Resources Institute (India)

Appendix 3

Additional Participants in the Seminars

In addition to working group members listed at the head of this volume, the following persons participated in the New Delhi seminar (November 2004) and/or the Beijing seminar (November 2005).

Mr. Vikvek Adyanthaya, Mahindra & Mahindra Ltd; Co-Chairman, SIAM Emission Committee (India)
Mr. V S Ailawadi, Adviser, Tata Teleservices. Former Chairman, HERC (India)
Mr. H L Bajaj, Chairman, CEA (India)
Dr. Bao Xiaobin, Program Officer, South-North Institute for Sustainable Development (China)
Ms. Shruti Bhatia, Energy Division, CII (India)
Mr. Dilip Chenoy, Director General, SIAM (India)
Mr. Timothy J. Collier, President, Westinghouse Korea (United States)
Mr. K. K. Gandhi, Executive Director, SIAM (India)
Mr. Gao Shixian, Director, Center for Energy Economics and Development Strategy, Energy Research Institute, National Development and Reform Commission of China (China)
Mr. Gautam Ghosh, Deputy General Manager, Noida Power Ltd (India)
Mr. Sajal Ghosh, Energy Division, CII (India)
Ms. Gloria Guo, Manager, International Marketing and Business Development, Chevron Global Gas (United States)
Dr. U. S. Hazra, General Manager, ONGC (India)
Mr. Yoshiaki Ichihara, Adviser, Tokyo Electric Power Co. (Japan)
Mr. Takao Kasumi, Deputy Manager, Committee for Energy Policy Promotion (Japan)
Mr. K. Krishan, Chairman, Malavalli Power Plant Pvt Ltd (India)
Mr. Suman Kumar, Energy Division, CII (India)
Mr. U. V. Ladsaongikar, Asst. General Manager, Tata Power Company (India)
Dr. Mao Yushi, Professor, Tianze Research Institute (China)
Mr. P. Neogi, Chief Executive, Noida Power Ltd (India)
Dr. Pan Jiahua, Research Center for Sustainable Development, Chinese Academy of Social Sciences (China)
Dr. Kirit Parikh, Member, Planning Commission, Government of India (India)
Mr. Nelson Rekos, National Energy Technology Laboratory (United States)
Mr. S. Padmanaban, Senior Energy and Environment Advisor, USAID
Mr. Pawan Sharma, NTPC (India)
Mr. A V Naik, Mascon, CII (India)
Mr. Hirotoshi Nishida, Manager, CEPP (Japan)
Mr. Neeraj Sinha, NTPC (India)
Mr. Harendra Singh, Chief Chemist, ONGC (India)
Dr. B. Sengupta, Secretary, CPCB (India)
Dr. R R Sonde, Executive Director, NTPC (India)
Dr. Leena Srivastava, Executive Director, TERI (India)
Mr. Neeraj Sinha, NTPC (India)
Mr. Pawan Sharma, NTPC (India)
Mr. Thomas Teo, Electric Power, Greater China Region, Caterpillar Inc. (United States)
Mr. Hiroshi Urano, Chief Executive Economist, Tokyo Gas Co., Ltd. (Japan)
Dr. Wang Wanxing, Energy Foundation (Beijing office) (China)

-
- Ms. Heidi Wong, Manager, Policy, Government and Public Affairs, Chevron International Exploration and Production (United States)
- Mr. Xue Xinmin, ERI, National Development and Reform Commission (China)
- Mr. Yu Shengmin, ERI, National Development and Reform Commission (China)
- Dr. Zhou Dadi, Director General, Energy Research Institute, National Development and Reform Commission of China
- Dr. Zou Ji, Professor and Head, Department of Environmental Economics and Management; Deputy Dean, School of Environment and Natural Resources, Renmin University of China

BHEL = Bharat Heavy Electricals Ltd (India)
CEA = Central Electricity Authority (India)
CEPP = Committee for Energy Policy Promotion (Japan)
CII = Confederation of Indian Industry
CPCB = Central Pollution Control Board (India)
ERI = Energy Research Institute (China)
HERC = Haryana Electricity Regulatory Commission (India)
IREDA = Indian Renewable Energy Development Agency Ltd
NTPC = National Thermal Power Corporation (India)
ONGC = Oil and Natural Gas Commission (India)
SIAM = Society of Indian Automobile Manufacturers
SNISD = South-North Institute for Sustainable Development (China)
TERI = The Energy and Resources Institute (India)
USAID = U.S. Agency for International Development

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