EXECUTIVE SUMMARY

BACKGROUND

During the next 30 years, the direction that Asian countries take to meet their energy needs will have a profound impact on global climate change, energy security, local environmental and human health, and the world economy.

A recent report by the Intergovernmental Panel on Climate Change (IPCC) makes it clear – with more than 90 percent confidence – that human activities since 1750 have led to significant global warming, which will be responsible for severe environmental impacts for hundreds and even thousands of years (IPCC, 2007a).[1] In addition, recent reports suggest that the overall risks and costs associated with the impacts of climate change would be significantly more than the costs of reducing greenhouse gas (GHG) emissions (Stern, 2006; IPCC, 2007b).[2]

This report analyzes the role that clean energy can play in Asia's development, with a focus on Asia's six largest developing economies: China, India, Indonesia, the Philippines, Thailand, and Vietnam. The report adopts a regional lens in assessing the potential for clean energy options in Asia. It was prepared as a collaborative effort with numerous partners and stakeholders in these countries. The objective of the report is to review forecasts of energy supply and demand trends, synthesize information on projections in the growth of GHG emissions, and identify interventions with the potential to slow the rate of increase in emissions when implemented on a regional level. Furthermore, it highlights the importance of addressing energy security for the Asian region – an issue of increasing concern, as the limited availability of energy resources within the region will require countries to rely more and more on energy imports. This increasing reliance on energy imports is important, since sustained high oil prices could lower annual GDP growth rates in Asia's developing economies by 0.5 to 1.7 percentage points (ADB, 2004).

This report presents an objective analysis of technical solutions to Asia's clean energy challenges. It is not intended to address the complex issues raised in official international climate change negotiations. The clean energy options discussed in this report have been developed in a transparent and consultative manner, and they represent a set of priority solutions to common barriers faced by the six focus countries.

Funded by the United States Agency for International Development (USAID), this report is the initial task of USAID's ECO-Asia Clean Development and Climate Program.[3] It is intended to serve as a resource for both the public and private sector: policy-makers, business leaders, researchers, and advocates working in Asia to promote clean energy investments that address global climate change and

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1. The report concludes that "The understanding of anthropogenic warming and cooling influences on climate has improved since the Third Assessment Report, leading to *very high confidence* [at least a 9 out of 10 chance of being correct] that the globally averaged net effect of human activities since 1750 has been one of warming.
2. The Stern Review estimated that the overall costs and risks associated with climate change could reduce global GDP by 5 to 20 percent per year. An estimate of resource costs suggest that the annual cost of cutting global GHGs to about three quarters of current levels by 2050, consistent with a 550 ppm CO_2 equivalent stabilization level, will be in the range of -1.0 to + 3.5 percent of GDP, with an average estimate of 1 percent. The cost of mitigation ranged from a 3 percent reduction to a 0.6 percent increase in 2030 in the IPCC's Fourth Assessment Report.
3. Environmental Cooperation-Asia (ECO-Asia) comprises a portfolio of programs managed by USAID's Regional Development Mission for Asia (RDM/A) in Bangkok. For simplicity, in the context of this report, the term "ECO-Asia" will be used to refer to the ECO-Asia Clean Development and Climate Program.

development. It catalogues existing activities, identifies regional networks, and highlights priority options with the aim of promoting regional cooperation and coordination of clean energy activities. As it is hoped others in the region will do, the ECO-Asia Program will select a few of these options to implement over the next three years to help catalyze regional efforts. Although the ECO-Asia program will draw significantly from the findings in this report, the report is not necessarily a reflection of specific activities or plans for the program itself.

METHODS

In October 2006, a team of experts was assembled to support research activities in the six focus countries. During November and December 2006, the members of this team:

- interviewed government agencies and stakeholders in Asia and the United States;
- organized "listening tours" and meetings with key energy stakeholders (202 individuals from the public, private, and non-profit sectors) in the six focus countries to identify solutions;
- prepared in-depth country reports on the energy needs of the six countries (Annexes 1-6);
- prepared more than 300 profiles of clean energy institutions, policies, programs, and development assistance projects in the six focus countries (Attachment 2); and
- conducted a desktop study, drawing upon internet databases and published reports.

The information was then compiled and analyzed to identify priority clean energy technologies and sectors, identify a set of policy and market initiatives, and assess opportunities for cooperation and action through existing regional partners and networks.

KEY FINDINGS

An analysis of projected energy supply resources needed to meet expected energy demand over the next 25 years indicates that a business-as-usual scenario will lead to an unprecedented increase in GHG emissions and increase the threat posed by climate change. While it is a daunting challenge to address the complex issues associated with climate change, it is clear that regional cooperation to address problems shared by developing Asian countries can help lower climate change mitigation costs by promoting increased trade and investment in clean energy technologies and practices.[4]

CLIMBING CARBON EMISSIONS AND AIR POLLUTION

If the region's robust economic growth continues as expected, the energy consumption of developing Asian countries will more than double during the next 25 years, while carbon dioxide (CO_2) emissions will increase more than three-fold as energy supplies, dominated by coal, become more carbon-intensive (APERC, 2006; IEA 2006). Some of the most marked trends include the following:

- Currently, developing Asia accounts for about 23 percent of global CO_2 emissions (6 million out of 26 million metric tons (Mt)), and its share of global emissions is projected to increase to nearly 50 percent (20 Mt out of 40 Mt) of global CO_2 emissions by 2030 (IEA, 2006).
- Coal use in developing Asia is projected to increase nearly four-fold during the period 2006-2030. Together, China and India are slated to consume 57 percent of the world's annual coal supply in 2030, up from 40 percent in 2004.

4. The IPCC, in its Fourth Assessment Report, highlights the importance of working cooperatively at the international level, and the need for "greater cooperative efforts to reduce emissions" (IPCC, 2007b, p. 32).

- Local air pollution related to energy use (power plants, factories, and vehicles) is linked to as many as 530,000 premature deaths in developing Asia every year. Twenty of the 30 most polluted cities in the world are in China.
- If current trends continue, by 2035 there will be around 250 million more cars and SUVs operating in China and India.[5] The increased demand for transportation will lead to a 2.6-fold increase in oil demand in developing Asia during this period, and a corresponding three-fold increase in CO_2 emissions.
- Climate-friendly renewable energy resources in a business-as-usual scenario will continue to supply a small (<10 percent) proportion of the primary energy mix in developing Asia, despite some recent acceleration in growth.

ENERGY SECURITY RISKS

Energy security is also a growing concern for Asian countries as they become more dependent on imported fossil fuels, especially oil. Asia now imports more than 44 percent of the oil it consumes, up from 7 percent during the 1970s and 1980s, and 32 percent in the 1990s. Southeast Asian nations are particularly vulnerable. Between 2002 and 2025, their import dependency is projected to increase from 10 percent to nearly 70 percent. Further, the sources of these imports will be less diverse. Currently, more than 50 percent of Asia's imported oil comes from the Middle East, and this share is expected to rise to 80 percent by 2030.

Asia's reserves of natural gas, a cleaner burning fossil fuel, are limited, and by 2030 between 40 to 75 percent of national requirements will need to be imported. This will place a limit on the amount of energy demand that can be satisfied by natural gas, while also exposing many Asian economies to potential volatility in regional and international gas prices, as well as risks of supply disruption.

Overall, increasing dependence on imported oil and gas will leave Asian economies extremely vulnerable to supply disruptions and price volatility unless there are sustained efforts to diversify energy sources by increasing the market penetration of energy efficient technologies and practices and domestic renewable energy resources.

POTENTIAL SOLUTIONS AND KEY CHALLENGES

Notwithstanding these projections, it is clear that a range of viable solutions to mitigate greenhouse gas emissions exist for developing Asia. There are examples of progress in all of the countries examined, and in developing Asia as a whole. Asian leaders are increasingly aware of the need to scale-up investments in energy conservation and clean energy promotion, and they have announced a plethora of policies and regulations in this area. China and India are global leaders in the promotion of various forms of renewable energy, namely, small hydropower, solar water heating, and wind power. Asia has served as an "incubator" for a range of market transformation approaches and models, including public benefit funds, soft loans, project development facilities, and investment funds, and is a leader in the emerging global carbon market. Large investments are planned in a range of clean energy technologies, including clean coal, liquefied natural gas, renewable energy, and nuclear energy.

Despite these examples of progress, Asian countries continue to face a number of challenges. Often, broad national laws and policies are not translated into sector-specific benchmarks, targets, and incentive structures. Difficulties in monitoring and enforcing existing laws and regulations are common and persistent. The technical and institutional capacity to effectively implement clean energy initiatives varies

5. Up from a combined 19.1 million cars and SUVs in China and India in 2005 (ADB, 2006b).

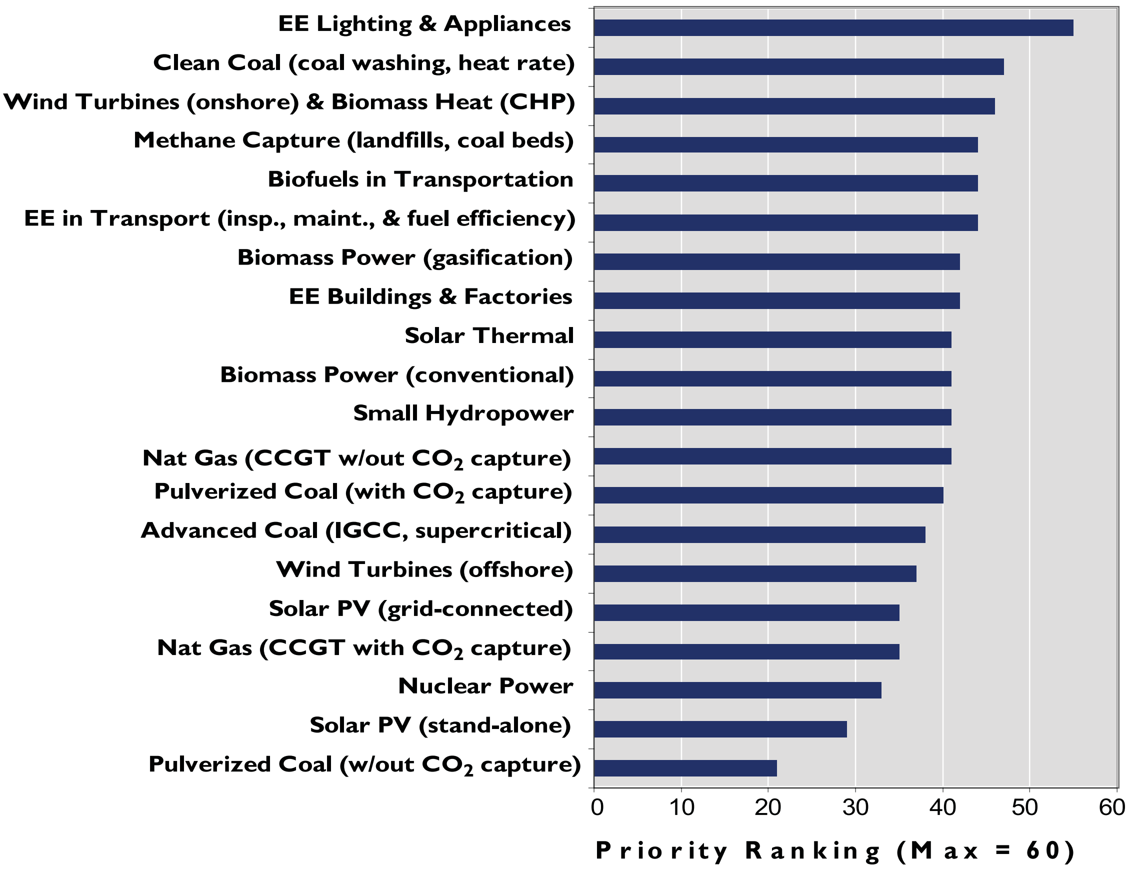
widely across the region, and investments in conventional fossil fuel-based energy options far outweigh investments in clean energy.

PRIORITIES TO MITIGATE CLIMATE CHANGE

In order to prioritize the clean energy technologies and sectors that offer the most promise to mitigate climate change regionally, a three-tiered process was used in this report. First, clean energy technologies and sectors were analyzed (Section 3) and a list of priority technologies and sectors ("options") were developed. Next, this list of priority options was matched against a set of policy and market initiatives proposed by stakeholders from the focus countries (summarized in Section 6). Finally, the research team analyzed how each of the proposed initiatives would address the barriers identified in this regional analysis (see Section 4).

Eight weighted criteria were considered when prioritizing technologies and sectors: (1) regional applicability; (2) potential to reduce total carbon emissions; (3) cost of energy generated or saved; (4) cost of carbon reductions; (5) other pollution impacts; (6) employment benefits; (7) timeframes for widespread availability of technology; and (8) potential for cost reductions in future. Figure 1 shows the results of the prioritization of clean energy options. The ranking provides an approximate prioritization of options that have strong regional applicability and have the greatest potential for low-cost carbon mitigation in a short-term time frame (three to five years).

FIGURE 1: PRIORITY RANKING OF ENERGY TECHNOLOGIES AND SECTORS



Note: CCGT = combined cycle gas turbines; CHP = combined heat and power; CO_2 = carbon dioxide; EE = energy efficiency; IGCC = integrated gasification combined cycle; and PV = photovoltaic

The following options emerge from the analysis as the top-priority areas. While the ranking and scoring in such a study can never be exact, it provides an approximate method of sorting options to identify those that can have the greatest impact, for the least cost, on a regional level.

- **energy efficient lighting and appliances**,[6] including compact fluorescent lamps, refrigerators, room air conditioners, and electric fans;
- **clean coal technologies**, including coal washing, heat rate improvements, and advanced coal combustion technology such as IGCC and supercritical;
- **renewable energy technologies**, specifically onshore wind, CHP, and biomass gasification;
- **methane capture** from coal mines and municipal landfills;
- **biofuels for transportation**, including ethanol and various types of biodiesel; and
- **energy efficiency in the transport sector**, including inspection and maintenance of in-use vehicles and improved fuel efficiency of new vehicles.

CONCRETE STEPS TOWARD CLIMATE CHANGE MITIGATION

The report assesses the potential impact of five of the six priority options[7] identified above on Asia's carbon emissions profile over the period 2002-2030. These options are considered to be the most politically viable and cost-effective, and capable of being implemented immediately with current, proven technologies.

Under a business-as-usual (BAU) scenario, developing Asia's CO_2 emissions are expected to increase from a current level of 6 billion metric tons (Bt) annually (23 percent of global emissions) to roughly 20 Bt annually (50 percent of global emissions) by 2030, a more than three-fold increase. The regional analysis considers the estimated CO_2 reduction potential for the following five priority options:

Option 1: Reduce energy use in buildings by 30 percent.
Option 2: Improve the average coal-fired power plant fleet efficiency from 33 percent to 48 percent.
Option 3: Expand renewables-based power generation by 10-fold.
Option 4: Reduce oil demand in the transport sector by 30 percent.
Option 5: Replace 25 percent of oil demand in the transport sector with biofuels.

Implementation of these options would reduce developing Asia's CO_2 emissions by 3.5 billion metric tons (Bt) relative to the BAU scenario by 2030 – from 20 Bt to 16.5 Bt annually. Among the different options, Options 2 and 3 (coal plant efficiency and renewable power generation) account for 26 percent and 28 percent of the reductions, respectively; while Options 1 and 4 (building efficiency and transport efficiency) account for 19 and 21 percent, respectively. Option 5 (biofuels) has the least impact and accounts for 5 percent.

This modeling exercise puts the challenge of clean energy development and energy security needs into context. There is no "silver bullet" that can address Asia's GHG mitigation, development, and energy security needs. What is needed is a portfolio of options, beginning with easily implemented, "no net-cost" activities that are widely acceptable. These "first-tier" activities serve as a bridge and can provide the momentum for Asia to aggressively pursue a suite of second-tier activities such as methane capture, carbon sequestration, and potentially nuclear power, which are essential to achieving the remaining reductions.

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6. The IPCC, in its Fourth Assessment Report, concludes that energy-efficiency options could considerably reduce CO_2 emissions with net economic benefit, and that they have large co-benefits (IPCC, 2007b, p. 18).
7. Methane capture was not considered in this analysis because of the difficulty in quantifying potential reductions across the region.

SPECIFIC OPPORTUNITIES FOR REGIONAL COOPERATION

During the country consultations, the research team developed a list of policy and market-based initiatives that promote clean energy based on proposals by stakeholders in the six focus countries. Recognizing that each country has its own particular set of barriers and opportunities, the proposed initiatives address a range of key near-term and medium-term barriers and needs that are *common* across the region. While specific interventions at the country-level are still indispensable to implementing clean energy, the main finding from the country consultations and needs assessment is that coordinated regional action and technical assistance is necessary to overcome the common barriers that individual countries are experiencing. Cooperation at a regional level needs to be more systematic and focused on working together to develop common solutions to common problems. The regional analysis highlights the potential benefits of the following priority initiatives at a *regional level*:

- establishment of a regional forum on clean energy legislation and implementing guidelines;
- promotion of regional harmonization and common protocols for energy efficiency standards and labeling of appliances and equipment;
- sharing of information and experience from the implementation of policy mechanisms for renewable energy promotion (e.g. feed-in laws, tax and credit schemes, renewable portfolio standards);
- development of financial models and deal structuring to scale-up investment in more efficient coal power supply options;
- working with regional networks of experts to close the gap between sources and uptake of finance for clean energy projects;
- development of regional technical standards for both sustainability and fuel characteristics of biofuels, in order to facilitate regional trade and enhanced energy security within Asia; and
- facilitation of public-private partnerships to promote voluntary clean energy investments.

Finally, this analysis also indicates the need for a regional "integrator" or a "catalytic agent" that can help facilitate collaboration among the various regional and national actors[8] working on clean energy. This regional agent could leverage resources and focus on viable opportunities that are best addressed through coordinated efforts.

FROM IDEAS TO ACTION

Asia's current business-as-usual trajectory poses significant challenges in terms of its global GHG footprint, local air pollution impacts, economic potential, and energy security. In response, Asian policymakers and business leaders are gearing up to implement an ambitious clean energy expansion program by drawing on national resources and by leveraging aid and investment from more developed countries. Many of the pieces needed to solve Asia's energy-related climate and environmental problems are already in place. To ensure success, a clear strategy is needed to lay the foundation for significant scaling-up of clean energy development over the coming decades. This strategy will involve integrating favorable policies and incentives with quick dissemination of the results of demonstration projects and adoption of global best practices, while catalyzing public and private-sector partnerships within Asia (as well as overseas). By capitalizing on this opportunity, Asia will ensure that it realizes its need for economic development, while safeguarding the environment for future generations.

8. Some of the current regional initiatives include the ADB's Energy Efficiency Initiative and Carbon Markets Initiative, the clean energy fora and working groups under Asia Pacific Energy Cooperation (APEC), the Association of Southeast Asian Nations (ASEAN), and task forces under the Asia-Pacific Partnership for Clean Development and Climate (APP).