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Energy and the Environment in Asia Pacific: Regional Cooperation and Market Governance

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AbstractEnergy demand in Asia-Pacific is projected to mushroom over the next decade and, indeed, over the whole of the next century. If the future looks like the past, the explosion in energy use will greatly compromise human health; severely, perhaps irreversibly, degrade regional and global eco-systems; and potentially inflame regional and even global tensions.

In another scenario, deliberate energy sector choices--about sources of energy supply, technology, infrastructure investment, pricing and trade policies and, most importantly, long-term objectives--lead to a more ecologically benign and secure future. Given that energy resources in Asia are increasingly supplied via global and regional markets, the key to energy sector outcomes lies in how

markets are governed.

This paper examines the role of regional cooperation in nudging markets towards more environmentally sound and secure energy development in Asia. Part I profiles the trend towards markets in the energy sector and then describes the energy-security-environment nexus and the policy dilemmas it creates. Part II analyzes energy-environmental market failures and develops a broad policy framework for regional energy cooperation.

Part III maps initiatives on energy cooperation in the region 5 overarching organization, viz, the Asia-Pacific Economic Cooperation forum (APEC), as well as the sub-regions of Northeast and Southeast Asia. After considering obstacles to regional cooperation, the paper concludes that, because of investment lead-times, the next 10-15 years present a crucial window of opportunity to lay the foundation for more environmentally sustainable energy use in Asia. In the short term, the most important step is to coalesce around a common regional vision and long term policy objectives. Expanding the role of scientists and environmental advocates in developing such a vision will be crucial.

Introduction

Energy use in Asia-Pacific will grow dramatically over the next decade and indeed, for the next hundred years. As a whole, the Asia-Pacific region (South and East Asia) is expected to use 133 percent more commercial energy in 2010 than it did in 1995.1 In economically dynamic East Asia, commercial energy demand will double; in China alone, electricity-generating capacity is expected to nearly quadruple.2

If the future looks like the past, rising energy use based heavily on fossil fuels will create severe, possibly irreversible environmental and health problems, as well as heighten concerns about energy supply security. To be sustainable, energy development in Asia over the long term must lead away from dependence on fossil fuels. However, some of the leading alternatives to fossil fuels, especially nuclear and hydro, pose their own environmental and security problems.

The explosive hunger for energy is prompting structural changes in Asian economies, primarily a move toward greater reliance on domestic, regional and global energy and financial markets to meet energy demand. The transition towards marketization will present governments with new policy imperatives and options. Given the increasing level of globalization, the most powerful policy instruments--those which shape market incentives--will be those undertaken collectively.

This paper examines the role of regional cooperation in nudging markets toward an energy path which enhances both environmental and supply security. Part I profiles the trend towards marketization and describes the energy-securit--environment nexus and the policy dilemmas it creates. Part II analyzes energy-environmental market failures and develops a broad policy framework for regional energy cooperation.

Part III broadly maps regional energy issues and initiatives in the region's overarching organization, viz, the Asia-Pacific Economic Cooperation forum (APEC), as well as the sub-regions of Northeast and Southeast Asia. After considering obstacles to regional cooperation, the paper concludes that, because of investment lead-times, the next 10-15 years present a crucial window of opportunity to lay the foundation for environmentally sustainable energy use in Asia. In the short term, the most important steep is to coalesce around a common regional vision and long term policy objectives. Expanding the role of scientists and environmental advocates in developing such a vision will be crucial.

I. One Hundred Years of Smoke and Smog? The Energy Picture in Asia

Energy demand in Asia is driven primarily by rapid economic growth, with concomitant increases in energy use by industry, transport and household sectors, including in newly electrified rural areas. Demographic factors are also important, both in terms of absolute population growth--by 2010, over 4 billion people will be living in Asia--and high rates of urbanization. By 2025, over half of the Asian populace will be living in cities, up from only 35 percent in l995.3

Energy demand projections are derived from projected growth rates for GDP which, in turn, are based on the economic

boom of the last decade. In 1996, the International Energy Agency projected, for example, that GDP in China would grow by 9 percent per year between 1995-2005 and 7 percent per year between 2005-2010. For the rest of (developing) East Asia, the corresponding projections were 6.6 percent and 5.9 percent.4

These projections were made before the recent financial crisis in Southeast Asia, which will undoubtably dampen economic growth, energy demand, and investment in the power sector.

In Laos, for example, plans for Nam Theun 2, a large-scale hydro project on the Mekong River which was to export electricity to Thailand, will almost certainly be scrapped following Thailand's decision to float the baht and the subsequent collapse of the Thai financial sector.5 Nonetheless, the long term economic "fundamentals" point towards sustained industrialization and increased energy use, including within the region's two giants, China and India. Moreover, environmental problems associated with growing energy use are already evident even with past and current levels of demand (see below). Indeed, the slowdown in growth may exacerbate environmental problems, as governments cut environmental budgets.6

1. Moving Towards Markets

One of the central elements in the energy picture is the financing of energy infrastructure. By one estimate, annual investments required to meet Asia's power demand over the next decade are projected to be some $600 billion--over 62 percent of the world's projected power sector investments.7 By another estimate, in Northeast Asia alone (China, Japan, Taiwan, North and South Korea), the investment requirements of the power sector are projected to average $72 billion per year for the next 15 years--a total of $1.8 trillion.8 By any estimate, the capital requirement is huge and has raised concerns, in Northeast Asia and beyond, about where the capital will come from.

In nearly all of the developing countries of Asia--including China, India, South Korea, and Taiwan--the power sector is dominated by the central government and depends on it for capital allocations. Moreover, domestic capital markets are still largely undeveloped and unable to tap domestic sources for large scale investment. In the past, Asian governments looked to multilateral financing agencies such as the World Bank and the Asian Development Bank for help in financing investment in the power sector. However, Asian governments have increasingly recognized that, given the scale of the required capital and the current political climate, multilateral banks can at best play a brokering role. This recognition has triggered substantial changes in methods of financing to allow the private sector--both domestic and foreign--to invest in power generation. The increasing role of Independent Power Producers (IPPs) means that the power sector, while still in large part a government monopoly, is moving towards being market-based.9 In China, for example, foreign investment accounted for 18 percent of power sector investment in 1995, up from only 6.4 percent in 1985.10

The trend towards greater reliance on global markets to meet surging demand is also evident in the changing structure of energy supplies. The primary fuels used for energy in Asia are coal and oil, which in 1995 accounted for 46 and 38 percent respectively of total primary commercial energy consumption (Figure 1). While there are large reserves of coal in China, India, and Southeast Asia (and Australia), the growing demand for oil has created a new and growing dependence on oil imports.

China, for example, traditionally a major oil exporter, has become since 1993 a net importer at the rate of 600,000 barrels per day and is projected to increase its oil imports five-fold by 2010.11 Indonesia, long the largest oil exporter in Southeast Asia, will likely become a net oil importer between 2000 and 2005.12 The shortfall between India's domestic crude oil production and oil consumption is nearly 900,000 barrels per day.13 Overall, imports accounted for 59 percent of Asia Pacific oil supplies in 1995 and oil import dependence, primarily on the Middle East, and will increase to 77 percent by 2010.14

Apart from oil, energy supplies in East Asia are met largely via intra-regional markets, including Australia (Figure 2). There is a substantial intra-regional trade in coal and LNG, as well as oil. The primary exporters are Indonesia and Australia and the primary importers are Japan, South Korea and Taiwan. The demand for natural gas, which accounted for 9 percent of energy use in 1995, is met almost entirely within the region. Excluding China, about two-thirds of coal demand is met by imports and three quarters of imports are supplied within the region.15

The trend towards greater reliance on markets to fulfill energy needs in Asia is evident not only at the lofty heights of the power sector but also at the level of the rural and urban poor. Processes of modernization and urbanization are increasingly replacing non-commodified, traditional energy sources such as biomass, animal and human power with commodified, often fossil fuel-based forms of energy. The move up the "energy ladder" has implications for both

environment and equity.16

The trend towards greater reliance on markets in the energy sector parallels the general trend in Asia towards more open trade and investment policies. This macro-level liberalization, in turn, will affect the energy sector in two broad ways. First, it will affect the level of overall energy demand, both by accelerating GDP growth and by enhancing the efficiency of energy use not only in the power sector but more broadly in industry, as well as transport and household sectors. Through more open markets, Asians will have generally access to more efficient producer and consumer goods. Secondly, a greater reliance on markets will encourage the development of forms of governance more appropriate to markets. Innovation in governance at the macro level should help develop better approaches to governance in the energy sector as well.

2. The Energy-Security-Environment Nexus

The expected surge in energy demand in Asia--and the ways that the demand is met--will have enormous implications not only within but beyond the region. On the one hand, increasing energy use will bring welfare benefits to millions of Asians--as well as to economies throughout the world which will gain export markets. Job creation and rising standards of living are integral aspects of sustainable development.

On the other hand, the region's growing hunger for energy resources will create new forms of insecurity and could potentially inflame relations between major powers within and beyond the region. Moreover, given Asia-Pacific's current dependence on fossil fuels, its highly inefficient and technologically backward power sector, and its weak environmental management capacities, a future which resembles the past will rain massive ecological damage on Asia, primarily through acid deposition, and globally, through climate change.

Current energy demand in Asia-Pacific is met overwhelmingly by coal and oil. Natural gas accounts for 9 percent of primary commercial energy consumption, and nuclear and hydro account for 5 and 2 percent respectively (Figure 1). In India, domestic coal, which has a high ash content, accounts for over 55 percent of energy consumption.17 In China, which is the leading coal producer in the world, coal accounts for a whopping 77 percent of energy consumption (Figure 1.)18

Emissions from coal-fired power plants, especially in China and India, have resulted in widespread acid deposition both within and beyond national borders. Acid deposition occurs when emissions of pollutants, including sulfur and nitrogen, interact with water and oxygen in the atmosphere. Elemental sulfur emissions react with oxygen to produce sulfur dioxide, which reacts in the atmosphere with hydroxyl radicals and then with water to become sulfuric acid (S03). Transported by air currents, the pollutants mix and are finally deposited bath to the earth's surface. The chemical reactions and depositions may be fairly close to the source of emissions--or hundreds of miles downwind.

Acid deposition is an especially pressing problem in India and Northeast Asia. In India, sulfur dioxide levels in nearly all cities greatly exceed international standards.19 In Northeast Asia, according to the RAINS-Asia model, sulfur dioxide emissions totaled 14.7 million tons in 1990. Under a "business-as-usual" scenario, sulfur dioxide (S02) emissions will more than double by 2010 and nearly triple by 2020; emissions of nitrogen oxide (NOX) will more than triple between 1990 and 2020.20 Even under a "higher efficiency forecast" scenario, in which governments make targeted efforts to increase energy efficiency and institute reasonable fuel substitution measures, sulfur dioxide emissions would double in the next 30 years.21 Given that Europe and North America have taken strong measures to reduce acid rain, Asia will emerge as the dominant emitting continent.

The impacts of acid rain are not well understood since ecological degradation is usually the result of multiple variables. Generally, acid deposition is believed to modify the rate of nutrient leaching from soils and biomass; diminish or destroy fish populations; affect soil bacteria and fungi; increase uptake of heavy metals such as cadmium; and exacerbate pre-existing stresses such as pesticide contamination. The increase in emissions of nitrogen oxide, which will increase both acid deposition and ambient ozone levels, may be especially problematic. Initial studies have suggested that the increase in Nox emissions and fertilizer use in Northeast Asia may lead to ozone levels sufficiently high to threaten rice, wheat and corn production.22

The sensitivity of a particular ecosystem to the effects of acid deposition varies. Northeast Asia is especially vulnerable due to the combination of high deposition and sensitive soils and vegetation.23 Coal-related emissions also jeopardize human health by causing respiratory problems. By the end of the 1980's, the annual cost of direct acid-rain damage in the worst affected areas of China was estimated to be 16 billion yuan (US $2 billion).24

Acid rain is a problem not only within but also between countries in Asia. In Northeast Asia, sulfur emissions emanating from China deposit acid in Japan, North Korea, South Korea and the Sea of Japan. According to RAINS-Asia, China accounted for some 37 percent of Japan's sulfur deposition and 34 percent of North Korea's in 1990.25 Crossborder emissions have generated some friction, as well as propelled some cooperative efforts to monitor and mitigate acid rain.

In addition to acid rain, Asia's future heavy reliance on coal and oil to fuel energy will produce a large volume of greenhouse gas emissions, especially carbon. In 1992, China was second only to the United States in total carbon dioxide emissions; India was the world's sixth largest emitter.26 Cumulatively, the U.S. and the European Union are responsible for the lion's share of the stock of carbon dioxide emissions in the atmosphere. The U.S., for example, has generated 4 times more emissions than China and nearly 14 times more than India.27 In terms of the flow of emissions, however, China will soon emerge as the world's single largest emitter. As whole, Asia's emissions of carbon dioxide will surpass those of OECD countries by 2015.

Besides contributing to greenhouse gases and local pollution, the use and transshipment of oil poses the risk of severe marine pollution arising from supertanker and offshore oil exploration and drilling platform spills. The rate of marine oil spills seems to be increasing and several large spills--the most recent in the Singapore Straits in October--have occurred this year.28 While a large increase in the use of fossil fuels, especially coal, will undermine environmental security, an increased thirst for oil presents another kind of security problem, viz, vulnerability to supply disruption and price volatility. The primary source for crude oil imports is the Middle East. In 1997, 76 percent of total Asia-Pacific crude imports came from the Middle East. Given the large refining capacity throughout Asia, including in Japan, China, South Korea, India and Singapore, oil requirements will be continue to be met through imports of crude oil. By 2005, the Mideast share is projected to rise to 90 percent.29

The growing dependence on Middle East oil may make Asian importers vulnerable to supply disruption and monopolistic pricing, as happened in the heyday of the OPEC cartel in the 1970's. The problem of oil dependence, writes one analyst, "is not that we are about to 'run out' of oil. The problem is that the world's conventional oil resources are concentrated in relatively few countries who are able to manipulate the economic scarcity of oil to their advantage."30 Most Asian nations do not have well-developed strategic reserve stockpiles. Moreover, Asia's growing dependence on Mideast oil may have broad geo-political repercussions, since it will generate a level of interdependence much higher than that prevailing between the Middle East and the West.31

Concerns about environmental impacts and supply/price security have prompted interest in other cleaner fuels, especially natural gas, nuclear power and hydro. While growing in absolute terms, the share of oil in electricity generation in Asia Pacific will slip from about 15 percent in 1993 to only about 5 per cent in 2010. The share of nuclear, on the other hand, is projected to increase from 12 to nearly 14 percent, hydro from 15.5 to nearly 17 per cent, and natural gas from about 12 to about 14 percent.32 While they would help to reduce air pollution, both nuclear power and hydro generate their own security and environmental problems. For nuclear power, the overriding problems are safety and the potential proliferation of nuclear weapons, especially given the region's undeveloped capacities for spent fuel management and the tack of a regional spent fuel management regime.33 In the absence of such a regime, the widespread adoption of nuclear power could trigger a nuclear arms race.

Japan, China, Taiwan, India, Pakistan, South Korea and North Korea all have nuclear power programs; Indonesia and Thailand may join the group soon. Moreover, proposals in Japan to move towards a "plutonium economy" based on closed-cycle plutonium reactors have generated both widespread environmental and security concerns in Asia.

Large-scale hydropower, on the other hand, often has large social and ecological costs. Social costs include displacement of communities, sometimes affecting millions of people, as well as loss of agricultural, fishing, tourism and other resources. Ecological impacts can broadly be categorized as impoundment effects--the consequences of flooding large areas of land required for storage reservoirs--and barrier effects. Impoundment effects include deforestation and other loss of vegetation. There is also a health risk, since reservoirs often provide habitats suited to disease vectors. Barrier effects are significant for biodiversity, especially migratory fish species. Moreover, large-scale hydro dams pose a risk of large-scale flooding should the dam crack or break.34

Given the nexus of source-related environment and security issues, the most attractive energy sources to fuel Asia's energy growth are natural gas--of which there are substantial reserves in the region--and renewables (mini-hydro, wind, solar, photovoltaics, tidal, biomass, geothermal). The widespread use of natural gas, however, will require a huge investment in infrastructure to transport and distribute--either via pipeline or transmission lines--gas (or gasfired electricity) from fields in the northern regions of China, Central Asia and the Russian Far East, and Southeast Asia

(Figure 2). Given the transboundary nature of the gas fields and especially the pipelines, it will also require a high level of regional cooperation.

The construction of a large-scale gas field and 4100-kn pipeline from lrkutsk in Siberia to Ulan Bataar, Beijing and Seoul, for example, will require an estimated investment of $11 billion.. Recently, Korea, China, Russia and Japan agreed to exchange letters of intent to develop the Siberian gas field. When completed, the gas field would provide 20 million tons of natural gas to China, Russia and Korea annually for 30 years at a much lower price than liquefied petroleum gas. However, there is a long lead time: under the best scenario, the pipeline would not be ready until 2006.35 Moreover, given the high level of intra-state cooperation and the enormous financial requirement, some analysts consider the pipeline scheme to be a pipe dream and recommend transmission lines instead.36

The role of renewables is still very small. However, four Asia-Pacific nations--India, Japan, China and Australia--are pursuing renewable resources for electricity generation on a large scale.37 Moreover, small-scale renewable energy technologies can offer proven and environmentally benign alternatives to grid-based power. In India, less than 40 percent of households are connected to the grid.38

Nonetheless, like a shift to natural gas, a major shift towards renewable energy sources is some ways off into the future. In the short to medium term; that is, the next 10-20 years, coal will continue to dominate the Asian region and the short term policy imperatives will revolve around ways to make the use of coal cleaner and more efficient and to substitute cleaner fuels for coal and oil as much as possible. The deeper dilemma entailed in finding environmentally sustainable, secure and politically sound alternatives to coal and oil energy can be solved only in the medium to long term.

II. Regional Governance of Energy Markets

The anticipated explosion in energy demand in Asia poses dilemmas for policy makers. At the first level, it will be a challenge simply to meet the demand at all--to mobilize the required to finance and channel it into well-managed and efficient power projects. The deeper challenge is to meet the demand in ways which at once promote environmental health and security, enhance supply security, and encourage (or at least do not undermine) prospects for peace. In other words, if it is not to create new sets of intractable problems, energy planning must be based on integrating security and environmental, as well as economic objectives. Given the past large societal investment in (dirty) coal and imported oil (and nuclear power, especially in Japan), and the long lead times required to develop and disseminate alternatives, this challenge can fully be met only over the long term--perhaps 50-100 years.

The crucial and central policy imperative is to define overarching, integrated objectives for the development path of the energy sector. In other words, the bedrock for energy policy and planning should be the embrace of a long term scenario. From environmental, security and geopolitical points of view the heart of such a scenario should be to end dependence on fossil fuels by shifting to renewable forms of energy.

Guided by a long term "Fossil Free Future scenario, an ensemble of policy initiatives can. be designed which fulfill short and medium term energy sector objectives while at the same time promoting a transition to renewables.39 Without a long term strategy, policies and resultant energy choices; will be skewed towards the status quo or towards crisis-management and crucial investments in transition fuels like natural gas may be foregone.

The embrace of a l00-year fossil free scenario does not obviate the need to meet the challenges of today. In the short term, environmental-security objectives should be: 1) to make the use of coal in the power sector and energy throughout the economy as clean and efficient as possible; 2) to substitute cleaner fuels for coal and oil wherever feasible; 3) to reduce dependence on MidEast oil; 4) to phase out nuclear power and, in the interim, make its use as safe as possible; and 5) to invest in the development of natural gas and renewables.

There is substantial room to improve energy efficiency. India uses 60 percent more energy per dollar of GDP than the world average.40 China uses 20 times as much primary energy to produce a dollar of economic product as does Japan. Only part of the difference stems from the different structure of the two economies. The rest stems from inefficient equipment and outmoded practices.41 The widespread embrace of best available technology--even if for only new plants--will require innovative financing instruments.

Achieving these short and long term objectives will require new roles for the state, including new approaches to governance of energy, electricity and financial markets. Given the shift towards market forces throughout the region, policy instruments and initiatives must be designed which appropriately and effectively enhance the role of market

forces themselves in achieving the desired objectives. The key question for this paper is what should or could be the role of regional, as against national or global approaches to energy planning and policy initiatives.

1. Geography and Globalization

The most obvious and compelling rationale for regional energy cooperation arises when energy resources and/or energy~related environmental impacts are transboundary. In both Southeast and Northeast Asia, including Siberia and the Russian Far East, are found significant reserves of natural gas and oil, the development and distribution of which cross national borders.42 In South Asia, there is potential for crossborder hydro development, especially between Nepal and India. In addition to primary resource development, the integration of electricity grids on a regional (or sub-regional) basis can offer economic advantages.

Energy-related environmental pollution, especially acid deposition, also crosses national boundaries in Asia. Regional cooperation is required to adequately monitor emissions. Moreover, regional initiatives can reduce the costs of mitigating the effects of acid rain by pooling scientific and management resources and helping to build management capacities where they are weakest. Most important, significant differences in the costs of reducing emissions in different countries provide scope and incentive for adopting regional as against purely national strategies.

Geography-based incentives for regional cooperation exist regardless of the particular character of the economy. A new rationale emerges when economies are market-based and increasingly integrated. The growing openness of Asia's economies to trade and foreign investment--especially in the power sector itself--suggest that energy sector choices will be increasingly guided by domestic and global market forces. Without proper governance, however, markets have three major failings, all highly relevant to energy sustainability and security.

The first failing, now commonly understood, lies in the fact that market prices do not--and perhaps cannot fully--incorporate social costs. For fossil fuels, externalities include local air pollution, atmospheric pollution and the costs of climate change, marine pollution, and the costs of war in maintaining supply. The inclusion of these externalities in market prices, however partially and imperfectly, would change millions of energy production and consumption decisions every day.

The second problem with markets is that, to be efficient, market decisions must be based on perfect information. When it comes to ecological and health impacts of production and consumption, the state of the art is that information is imperfect or even inherently unknowable because of uncertainty. Moreover, information often takes the character of a public good. Because the benefits of investing in information cannot be fully captured privately, private entities such as consumers or firms tend to underinvest in gathering it. Without pubic investment in information and policy instruments to incorporate it in market decisions, markets are flying blind when it comes to gauging the environmental and health costs and benefits of energy choices.

The third failing of markets is that they do not incorporate the future and tend to guide production and consumption decisions according to a short-term rationality. However, many important and desirable economic outcomes, including technology development, are path dependent: decisions taken today shape the options for tomorrow. Markets value the future only in terms of foregone consumption (i.e. net present value), but not in terms of foregone benefits due to today's consumption. From a long term point of use, the optimal use of fossil fuels would be as a bridge towards non-fossil fuel sources. Without policy intervention, markets will not chart such a course and may even foreclose options.

These three failings--in pricing, information, and the future--reflect the fundamental weakness of markets, which is that they are riddled with prisoner's dilemma-type situations, i.e. what makes sense at the micro-level of the individual does not add up to social rationality at the macro level. It is up to good governance, incorporating both formal and informal rules, norms, and organizations ,to create an institutional framework which can channel the enormous power of markets towards social goals, including a more ecologically sustainable future. In Asia, a framework for energy governance is probably the single most important component of a path towards sustainable development.

Developing such a framework is primarily the role of government. The more effective the state is an institution, the better the chance for environmental governance of markets. An ardent supporter of markets, the World Bank, concluded as much in a recent report. "Far from supporting a minimalist approach to the state," preaches the Bank, "these examples [of economic growth in East Asia] have shown that development requires an effective state, one that plays a catalytic facilitating role, encouraging and complementing the activities of private businesses and individuals.. Without an effective state, sustainable development, both economic and social, is impossible."43

The unilateral policymaking capacities of national governments in governing energy, electricity and financial markets, however, are conditioned and constrained by global market forces. On the one hand, market openness means that local prices for goods, services and financial assets are determined, or at least influenced by, international prices. On the other hand, pressures to be competitive in export markets and to attract foreign investment dampen policy initiatives which would impose significant costs on producers or investors. Purely domestic policy initiatives--such as a national carbon tax to improve energy pricing--become "stuck in the mud" of competitiveness concerns. Rules of market behavior, including energy regulatory requirements and standards, are increasingly pushed by markets towards international convergence.44

Global markets, in short, like global ecosystems, require global governance. The Framework Convention on Climate Change, if successful, will set broad parameters for controlling greenhouse gases which will affect energy markets world wide. Global governance, however, is extremely complex. There are some 190 nations in the world, split along many divides, including the richer Western nations economic and the poorer nations of Asia, Africa and Latin America (and both themselves split by cultural difference and economic interest). Negotiations are costly and difficult. Regional approaches either to creating or implementing a governance framework may be easier. As one analyst argues, regional approaches to energy governance "encourage the break-up of the 'global cooperation' problem into smaller and more manageable pieces."45

Moreover, when markets--for primary energy supplies, electricity or power sector financing--are themselves primarily regional, there is a strong rationale for regional approaches to governance.

2. Regional Policy Framework

A framework for regional environmental governance of energy in Asia would focus first on developing a broad regional consensus for energy policy; and second, on generating the institutional and policy framework to implement it. In Europe, this two-part approach underlay the development of the European Energy Charter.

A regional institutional framework should incorporate at least five key policy targets: 1) rational pricing; 2) environmental guidelines for financial markets and innovative financing instruments for cleaner fuels and technologies; 3) the convergence of energy regulations and standards, including energy efficiency standards; 4) investment in scientific information, including mapping renewable resources; and 5) the creation of a strong interface between government, the scientific community, environmental advocates, and the public.

1) Pricing: Rational pricing strategies entail policy instruments--potentially including taxes, and tradeable permits--which aim to internalize environmental externalities in energy prices. Currently, however, energy prices--domestic prices in Asia and global prices--not only exclude externalities but include subsidies to fossil fuels. In other words, energy markets are based on prices which are irrational even excluding environmental considerations. In China, energy subsidies are estimated at xx percent above the world price, and in India, at xx percent above the world price.46 Ending subsidies to the coal sector, especially in China, and promoting freer trade in coal would help to substitute low sulfur coal imports, including from Australia, for high sulfur domestic coal.47

While embracing world fossil fuel prices would promote more rational energy choices, the deeper problem is that world prices are themselves skewed by direct and indirect financial and environmental subsidies. Both OECD and developing countries subsidize energy, including fossil fuels. According to one study, in the United States, "all energy forms are subsidized, estimated at $14-36 billion [per year] depending on the definition used."48 Producer subsidies to coal have been estimated at over $10 billion in 8 OECD countries.49

While there are broad domestic social and economic benefits to ending fossil fuel subsidies, adjustment costs make subsidy reform politically difficult. Collective action at the regional level to reduce subsidies would "level the playing field" and help governments overcome domestic political opposition. As a recent OECD study concluded, "Overcoming opposition to subsidy reform will be substantially easier if countries can be convinced to react together, rather than separately, in reducing subsidies/tax concessions to particular industries or sectors (emphasis in original)."50

The economic logic for the removal of subsidies to fossil fuels is unimpeachable. Subsidies for renewables, on the other hand, might be justified on the basis of social benefits (positive externalities). In India, a "medium" level of governmental support could increase the share of renewables in total power generation capacity to about 8 percent by 2015, while a "high" level of support could increase the renewables share to about 12 percent.51

2) Financial Markets: Perhaps more than any single factor, the character of the huge projected investment in the

power sector will affect the environmental future of Asia. If financial markets can be structured so as to be environmentally sensitive, they will be a powerful channel for improving ecological and public health. If they remain environmentally blind, financial markets will be channels for ecological degradation.

According to the RAINS-Asia "Best Available Technology" scenario, for example, sulfur emissions in Northeast Asia could be cut by nearly 70% between 1990 and 2020. The scenario assumes that all major point sources of emissions (existing and new, industrial and power) install state-of-the-art desulfurization systems and that all other users of fossil fuels switch to lower sulfur fuels. Even under a somewhat less ambitious "Advanced Control Technology" scenario, in which desulfurization technology is applied only to new power plants and there is a modest level of fuel switching, sulfur emissions could be cut or stabilized.52

The key is in mobilizing capital markets to deliver best available coal burning technologies and cleaner fuels. For capital markets, two approaches might be fruitful. First, governments could collectively set environmental guidelines for energy infrastructure and power sector development. Such guidelines, which could be implemented through a regional "Infrastructure Agreement", a proposal floated by the Philippines, could require social and environmental impact assessment and mitigation strategies. They could also require public hearings or other avenues of public input into the design and construction of resource development projects and power plants.

Broad rules to govern investment are emerging at the global level. The OECD is developing the Multilateral Agreement on Investment (MAI),which sets forth stringent policy parameters, primarily to ensure that foreign investors receive national treatment. However, to date, environmental (or other social) parameters are strictly voluntary in the MAI, causing widespread criticism from environmental groups.53 Governments in Asia could move the process forward by promoting their own environmental guidelines for investment.54 Creating innovative financial instruments is another way governments can utilize capital markets to promote environmental goals. The primary goal of such instruments is to find ways to capture the social and crossborder benefits of investment in cleaner technologies when markets (or governments) are reluctant to finance them. The more traditional way to finance such investment was through multilateral banks or through bilateral assistance. For example, Japanese ODA has helped to finance clean coal technologies in China. However, given the massive scale of needed investment, public financing alone will be inadequate. New, more subtle and targeted approaches are needed based on public-private sector partnership. One innovative proposal currently being explored by the Nautilus Institute is a financial guarantee mechanism for technology risk in China.55 The mechanism could be established via a joint initiative of Japan, China and the United States and financed multilaterally through the Asian Development Bank, the World Bank or an independent regional initiative.

3) Regulations and Standards: Reflecting different histories and socio-economic conditions, energy regulations and standards vary widely in the Asian region. Market integration, however, creates pressures for standards to converge. Southeast Asian nations, for example, have moved to integrate EIA requirements and ambient environmental standards as part of the process of establishing the ASEAN Free Trade Area (AFTA).56 The crucial policy issues are first, how to push convergence upwards toward a higher (rather than lower) level of environmental performance; and secondly, how to manage an upward-convergence process in a way which recognizes the region's diverse needs and concerns. Rather than harmonization of specific standards, diversity might entail the adoption of broad regional principles, guidelines and methodologies.

One category in which (upward) convergence would offer significant environmental benefits is energy efficiency standards. With common standards, markets for key energy~using "white goods" such as air conditioners and refrigerators would help disseminate the more efficient products. Higher standards would also stimulate innovation in higher-efficiency products and applications.

There are likely to be significant impacts, however, on competitiveness, with imports replacing locally-produced products. As a result, there will be opposition by some countries and policies will need to be designed to help overcome it. Moreover, countries have adopted a patchwork of different standards. Rather than adopt uniform standards, one approach might to create Mutual Recognition Agreements (MRAs) based on tests which establish equivalence in performance. Energy efficiency testing would be a first step towards convergence.

4) Information. Deepening and broadening the energy-environment information base in Asia is a crucial and immediate task for regional cooperation. One of the most pressing needs is to map the region's energy resources, especially renewable sources. There is also a need for more information about the sources, quantities and effects of emissions and for effective monitoring networks to be put in place.

A wise investment in information must extend beyond acquisition to learning to use it, especially for planning purposes. The embrace of planning tools, especially scenarios, would enhance medium and long-term planning capabilities. Getting nations region on the same track in terms of planning tools could have enormous benefits over term in terms of energy resource and product development, as well as the design better how the use of within the longer of policy instruments. An investment in training is part and parcel of an investment in building a regional sustainable energy information base.

5) Widening Scientific Input and Public Debate: The integration of environmental with economic and security objectives in energy planning requires a much broader level of expertise than an economic (or security) driven approach alone. In particular, it is crucial to bring the judgment and knowledge of the scientific community into the policy debate. Scientists have been central in forming and transforming the idea-structures which underlay international environmental regimes, including on acid rain in Europe and North America.57 Energy planning and policy decisions in Asia, however, continue to be dominated by energy policy experts with little training or knowledge of ecological sciences. A regional institutional framework must design explicit windows for scientific input into policy debate and design. Other key contributors to the debate include environmental advocates, as well as consumer, community and other citizen groups. Environmental groups are often a source of innovative policy ideas, as well as a transmission vehicle for information and communication flows between governments and communities.58 Moreover, a vibrant regional network outside of the official lines of government can explore politically sensitive issues and help to build popular support for a regional energy strategy. Without popular support, political will for a regional institutional energy framework~~including public investment in information and price adjustments~~may not materialize.

III. Regional Energy Initiatives

The Asia Pacific region spans a large swathe of the world and the world's population. Moreover, there is no "geographic" contiguous set of territories and oceans which "naturally" constitutes the Asian region. The parameters of "Asia Pacific" tend to be drawn--and drawn differently-- by researchers, depending on what they are trying to illuminate; or by regional organizations. For the United Nations, the "region" is bounded by ESCAP (the Economic and Social Commission on Asia and the Pacific), which spans over 40 countries from the Middle East to South Asia to East Asia. The broad geographic boundaries of ESCAP are reflected in its broad tasks and issue areas, which span from information exchange to capacity-building, from poverty alleviation to human rights.

From the UN point of view, there are several "sub-regions" in Asia, which, largely through ESCAP and UNDP nurturance, have developed programs for environmental cooperation. These include programs in Northeast Asia and in South Asia via the South Asia Association for Regional Cooperation (SAARC). These broad-based programs are helpful in building technical and management capacities. However, the goals of environmental market governance are likely to best be achieved by lodging them in the institutional context of regional economic organizations, especially those focused on trade and investment. Such institutions are already self-consciously developing rules of market behavior. Although they are focused primarily on macroeconomic policy, energy-environment policies can parallel and gain momentum from the regional policy creation effort. "An ecologically sustainable regional energy strategy, " concludes one analysts, "would require an institutional framework comparable in scale and scope to agreements on commerce and trade."59

The leading economic organization in the region is the Asia-Pacific Economic Cooperation forum (APEC), which links 18 countries around the Pacific Rim spanning from East Asia and Australia to North America, Mexico and Chile. Within APEC, some 70 percent of trade and 65 percent of investment is intra-regional. APEC economies have embraced a vision of "free and open trade and investment" by 2010 for developed and 2020 for developing countries.60

Other regional organizations which are on a path of market integration include the Association of Southeast Asian Nations (ASEAN), which is pursuing the creation of an ASEAN Free Trade Area (AFTA); and SAARC, which agreed in 1993 to form a South Asia Preferential Trading Arrangement.61 Another sub-regional organization moving toward economic cooperation is the Greater Mekong Subregional Programme, which is supported primarily by the Asian Development Bank and is focused largely on infrastructure development, including energy. In Northeast Asia, regional institutions are still nascent. However, a variety of initiatives are underway to promote economic and environmental cooperation.62

The key issues are thus, first, which institutions--global, regional and sub-regional--can best undertake which aspects of collective action; and second, how initiatives and policies at one level should be "nested" within a larger regional and global framework so that emerging rules and norms do not contradict each other.

In general terms, policies which aim to directly to govern pricing, trade or investment policies should be developed within the institution which most closely bounds markets. In terms of the framework presented in Section II, this would mean that a long-term energy "vision," as well as energy subsidies and an environmental framework for investment should be taken up by APEC (as well as SAARC). Any APEC policies on pricing and investment would need to be consistent with the World Trade Organization.

Convergence of regulations and standards could usefully be pursued within both APEC and sub-regionally. Investment in information and training should be taken up both sub-regionally and within APEC, as should the design of opportunities for scientists, environmental advocates and others to be part of the policy process. The development and transport/transmission of crossborder energy resources would, of course, need to include the cooperation all the countries involved, either as producers, consumers, or financiers. Likewise, the monitoring, mitigation and reduction of crossborder externalities like acid deposition would need to involve all emitting and recipient countries.

Regional energy cooperation in Asia is still in its infancy. The rest of this section outlines and evaluates initiatives currently underway.

1. APEC

Based on a consensus model of decision making, APEC is a forum for building norms and encouraging unilateral initiatives by national governments toward common goals. Since 1993, APEC's goals have been dominated by trade and investment liberalization. In the energy sector, APEC's primary goal to date has been to promote freer trade in energy products and power sector investment.

Institutionally, APEC addresses energy issues via two vehicles: a Regional Energy Cooperation Working Group (EWG), chaired by Australia and Japan; and meetings of Energy Ministers. At the most recent Energy Ministerial in August of this year, the Australian Chair of the EWG listed APEC's key challenges as: 1) improving market transparency and removing barriers to trade in energy products and services; 2) mobilizing sufficient capital for power infrastructure demand; 3) adjusting energy policies to reflect market dynamics and reduce business costs and investment risks; and 4) "mitigat[ing] any adverse environmental impacts."63 Environmental cooperation, he suggested, was a "prime example where regional cooperation can be beneficial," and proposed initiatives such as adopting environmental impact mitigation criteria as a standard component for planning and energy project evaluation, and multilateral joint ventures for reducing greenhouse gas emissions. In conclusion, he suggested an "accelerated program of work" on energy-environmental issues.

Acceleration is very much what the program needs. Despite the adoption of 14 Energy Principles in 1996 (Table 1), environmental issues have taken a back seat in the Working Group to the active promotion of coal--albeit cleaner coal--and generally a supply-driven approach to energy.64 Although a host of workshops, seminars and expert groups have pondered the relationship of environmental and economic costs and benefits, the Working Group has been slow to recognize the need for a regional energy strategy.

One of the problems is that, like the rest of APEC, the Energy Working Group and the Energy Ministerials are dominated by diplomats and civil servants. There was some progress in 1996 in expanding the involvement of the business community, especially in the United States. However, scientists and environmental groups have no regular interface with either the EWG or the Ministerials. "From the perspective of the government officials involved," suggests one APEC watcher, "some of these groups appear more likely to cause headaches than provide realistic advice and support. If business tends to be critical, they are mild critics compared to what is likely to come from academics, politicians, the NGOs and the media. Yet a healthy APEC, truly engaged in community~building, will need to involve them.65

A new initiative spawned by (but independent from) the Energy Working Group is the Asia Pacific Energy Research Centre. Based in Tokyo, the Centre will produce an annual "energy outlook" as well as studies on specific priority research themes, currently being finalized. As of August, three of its six proposed themes focused on environmental issues, including energy pricing practices, energy efficiency indicators for industry, and the costs and benefits of large scale natural gas resources.66 If the Center emerges as a dynamic and independent builder of information resources--and a vibrant vehicle for a broader public policy debate--it could make a significant contribution towards a regional energy strategy. However, if it is captured by supplier interests or bureaucrats, it will do little to build regional momentum.

Another source of momentum may come from the Climate Change Convention. If the Conference of Parties to the

Convention meeting in Kyoto in December succeeds, APEC may be called upon to implement the global agreements.

2. Northeast Asia

The scale of the acid deposition problem suggests that there are strong incentives for regional energy cooperation in Northeast Asia. However, the political divides are deep: as recently as 1991, the region was split by the Cold War, North and South Korea remain technically in a state of war, and historical animosities arising from Japan's occupation of Korea and China have not been eradicated. As a result, economic ties within Northeast Asia are not as developed as geographical proximity would suggest.

Most important in terms of solving collective action problems, regional institutions in Northeast Asia are undeveloped. When Europe and North America encountered acid deposition problems, they were much richer institutionally than Northeast Asia is today. In Europe, the European Union provided a forum, while the U.S. and Canada have a rich set of communication channels. Even research forums are still lacking or in their infancy in Northeast Asia.

Nonetheless, regional initiatives for environmental cooperation have emerged since 1991 and energy-related issues are the top priority. A UNDP-funded effort to establish a Northeast Asian Regional Environment Program selected energy-related air pollution as the first of three priority areas and has developed pilot demonstration clean coal projects. There are also bilateral initiatives, primarily between Japan and China, involving the monitoring of acid deposition and, through Japanese ODA, financing of clean coal technology.

In Europe, acid rain was tackled in part via a regional convention to reduce emissions. China, however, is not open to a regional agreement at this time, although it is interested in other forms of regional cooperation.67 The primary initiatives being explored involve monitoring--the creation of a regional acid deposition monitoring network--and financing. One proposal is to establish a joint fund to the incremental cost of abatement technology on those facilities where the greatest benefit would be achieved.68

Another approach is for the U.S. and Japan, as the dominant suppliers of energy technology and finance, to collaborate in establishing innovative regional financing mechanisms for clean coal and fuel substitution. Aimed primarily at China, such mechanisms could also be utilized to promote energy efficiency and reduce incentives for nuclear power in North Korea.69

3. ASEAN

Regional energy cooperation is nothing new to ASEAN's agenda. In July of this year, ASEAN Energy Ministers met for the fifteenth time and, inter alia approved Workplans on Energy Efficiency and Conservation and New and Renewable Sources of Energy. They also declared 1998 as ASEAN Energy Efficiency and Conservation Year.70 Among the regional projects underway are the Trans-ASEAN Gas Pipeline and the ASEAN Power Grid Interconnection Projects, both under the auspices of the Heads of the ASEAN Power Utilities/Authorities.

For ASEAN like the rest of Asia, key energy issues involve reducing supply dependence on the Middle East, developing new sources of energy, especially gas, and improving the access of poor and rural communities to energy resources. Indicating the high priority of energy issues, there is a focal point on energy within the ASEAN secretariat. In addition to cooperating in the exploration and development of new energy sources, the primary focus of ASEAN is on information exchange and capacity building. Funded by the EC, ASEAN has established the ASEAN-EC Energy Management Training and Research Centre. And in 1997, Malaysia hosted the first ASEAN Energy Business Forum, which drew some 230 public and private sector participants.

For the foreseeable future, however, ASEAN environmental cooperation will be dominated by the need to manage the forest fires burning out of control in Indonesia. Moreover, the overarching issue at ASEAN generally will be responding to the financial meltdown and the anticipated declines in energy demand as well as infrastructure financing capabilities.

CONCLUSION

Regional cooperation can be an important vehicle to promote more sustainable and secure production and use of energy in Asia. The growing reliance on markets--for energy resources, electricity and power sector financing--suggest that market governance is a crucial component of a regional energy strategy. The first step, however, is to develop a regional consensus about the goals and objectives of energy policy--in the long as well as short term. Such a

consensus should be built on the integration of environmental and security with economic objectives in an energy strategy.

The development of a regional--or even sub-regional--consens~5 will not be easy. The region is wracked by political animosities, perhaps most strongly in South Asia, and a lack of common language. Significant gaps in economic development and political power, along with historical memories of (Japanese) occupation and fears of (Chinese) expansionism create undercurrents of mistrust. In many countries in Asia, there is still little opportunity for critics and innovators--either inside or outside government--to have their say.

Nonetheless, perceptions of common good, as well as economic and financial incentives to cooperate, are becoming stronger. A new kind of social group is emerging: people born after World War II who have traveled in Asia, been educated in the West, speak English, and have a highly developed sense of social and environmental concerns. These people are beginning to wield influence in professional and governmental circles and may form the core for a new style of leadership and regionalism in Asia on environmental issues and beyond. Developing regional institutional mechanisms which enhance their voices in regional dialogue, both official and unofficial is the most pressing need.

TABLE 1APEC (Non-Binding) ENERGY PRINCIPLES

1. Emphasize the need to ensure energy issues are addressed in a mariner which gives fill consideration to harmonization of economic development, security and environmental factors.

2. Pursue policies for enhancing the efficient production, distribution and consumption of energy. 3. Pursue open energy markets for achieving rational energy consumption, energy security and environmental objectives, recommending action in the appropriate forum of APEC to remove impediments to the achievement of these ends.

4. Recognize that measures to facilitate the rational consumption of energy might involve a mix of market based and regulatory policies, with the relative components of the mix being a matter for the judgment of individual economies.

5. Consider reducing energy subsidies progressively and promote implementation of pricing practices which reflect the economic cost of supplying and using energy across the fill energy cycle, having regard to environmental costs.

6. The regular exchange of experience on the various policies being used by member economies to achieve a more rational energy consumption.

7. Ensure that a least cost approach to the provision of energy services is considered.

8. Promote the adoption of policies to facilitate the transfer of efficient and environmentally sound energy technologies on a commercial and non~discriminatory basis.

9. Encourage the establishment of arrangements t3/4r the development of human resource skills relevant to the application and operation of improved technology.

10. Enhance energy information and management programs to assist more rational energy decision making.

11. Encourage energy research, development and demonstration to pave the way for cost effective application of new, more efficient and environmentally sound energy technologies.

12. Promote capital flows through the progressive removal of impediments to the finding of the transfer and adoption of more energy efficient and environmentally sound technologies and

infrastructure.

13. Promote cost effective measures which improve the efficiency with which energy is used but reduce greenhouse gases as part of a suggested regional response to greenhouse gas reductions.

14. Cooperate to the extent consistent with each economy's development needs, in the joint implementation of projects to reduce greenhouse gas emissions consistent with the Climate Change Convention.

Notes

1 Fesharaki, Fereidun et al (1995), p.2. Asia-Pacific here is defined to include all of Asia, except the former Soviet Union and the Middle East. Commercial energy is oil, gas, and coal, and electricity supplied by power utilities

2 International Energy Agency (1996). World Energy Outlook OECD: Paris. Quoted in GrolIman (1996), Table 2; Blake Dawson Waldron (1995), Appendix E, Table 2. China's electricity-generating capacity is projected to increase from 167 Owe to 600 Owe.

3 World Resources Institute (1996), Data Table A. 1.

4 Op cit (footnote 2).

5 Bangkok Post, June 2,1997.

6 Environmental Conservation Budget Cut in Half," Connectivity Monitor, No.13, Asia Pacific Regional Environment Network, Nautilus 1nstitute, October 24, 1997~, (based on a report in The Star (Malaysia), October 21 1997)

7 Bakthavatsalam, V. (1997)

8 Razawi, Hossein (l997)~ p. 1

9 Ibid., passim.

10 Razawi, Hossein (1997) Table 2.2

11 Calder, Kent E (1997), p 24

12 Ibid.

13 Energy at a G1ance. Http://www.eia.doc.gov/emeu/cabs/india/eglance.gis

14 Fesharaki Fereidun et al (1997), Figure 2

15 Grollman, Nicholas (1996) p 14

16 See UNDP (1997), pp. 8-10

17 U.S. Energy Information Administration. Cited in U.S. Department of Energy (1997).

18 Streets, David G. (1997), p.10.

19 U.S. Energy Information Administration (1997).

20 Ibid, Table 6.

21 Ibid, p.12.

22

23 Bhatti, N. And Streets, David (1992).

24 Sinton, Jonathan E. (1997), p.2.

25 Carmichael Gregory and Arndt Richard (1995), Table 5.3

26 World Resources Institute (1996), Table 14.1. On a per capita basis, carbon dioxide emissions from the U.S. were more than 7 times those from China.

27 Ibid. Table l4.2

28 Zarsky, Lyuba (1995), p 85; Connectivity Monitor, "Oi1 Tankers Collide in Singapore Straits," No.13, October 24 1997

29 Fesharaki, Fereidun et al (1997), Figure 3

30 Greene, David L. (1997), p 18

31 Calder, Kent E (1997), p 25

32 Fesharaki, Fereidun et a1 (1995), Table 1

33 Fei, Edward T. (1996)

34 Hirsch, Philip (1997)

35 Korea Herald, Korea to Develop Siberian Gas Field, Pipeline with Three Countries, October 22, 1997.

36

37 Fesharaki, Fereidun et al (1995), p 5

38 Bakthavatsalam, V. Financing India's Renewable Energy Boom, http://www.crest.org/renewables/ireda/bakthavatsalamtalk.html

39 For an excellent exposition of this argument, see Grollman (1997).

40 U.S. Department of Energy (1997).

41 Stinton, Jonathan (1997), p.8.

42 See Paik, Keun-Wook (1995).

43 (World Bank), 1997, foreward.

44 For a filler exposition of the argument, see Zarsky, Lyuba (1997).

45 Grollman, Nicholas (1997). P

46 Michaelis (1996), p.184.

47 Anderson (1996)

48 The Significance of Subsidies in Practice, p 2

49 Earth Council (1997), p.2

50 Runge and Jones (1996)

51 Bakthavatsalam, V (1997), p 1

52 Streets, David G (1997), pp. 12-13 and Figure 3

53 TEPAC letter

54 A Non~Binding Investment Code adopted by APEC included a provision which eschewed the practice of lowering environmental standards in order to attract investment See

55 Razawi, Hossein (1997)

56 AFTA reference

57 Wilkening, Kenneth (1997) p 1 and passim.

58 APEC SOM (1997)

59 Grollman, Nicholas (1996), p.5.

60 Yamazawa, Ippei (1994), pp.201-211 and Table 16.4.

61 Kalpage, Stanley, "SAARC Moves Slowly Forward," The Sunday Times, December 29, 1996. There has been little progress on SAPTA.

62 See UNDP (1997). Also, see the policy papers on line of the Nautilus Institute's Northeast Asia Peace and Security Network, http://www.nautilus.org/Napsnet.

63 Higgins, Russell (1997), p.1.

64 Grollman, Nicholas (1997).

65 Morrison (1997), p.8.

66 APERC (1997), p.1. The other proposed themes are a feasibility study of a regional power interconnection network in the APEC region; deregulation and privatisation of the electricity sector in APEC economies; and the value of oil stocks for the security of oil supplies.

67 Stinton,. Jonathan (1997)

68 Street, David (1997) p 8.

69 Energy, Security and Environment in Northeast Asia (ESENA) (1997). Http://www.nautilus.org/esena.

70 ASEAN (1997), p 4

References

Anderson, Kym

APEC SOM (Senior Officials Meeting) (1997).

APERC (Asia Pacific Energy Research Center) (1997).

ASEAN (1997).

Bakthavatsalam V. (1997). Financing India's Renewable Energy Boom. Indian Renewable Energy Development Agency, http://www.crest/org/renewables/ireda/bakthavatsalamtalk.html

Blake Dawson Waldron (1996). Regional Cooperation for Power Infrastructure, A Report to the APEC Energy Working Group, Canberra.

Bhatti N. And D. Streets (1992). Acid Rain in Asia, Environmental Management, Vol. 16, No. 4.

Calder, Kent E. (1997). Fueling the Rising Sun, Asia's Energy Needs and Global Security, Harvard International Review, Summer, pp. 24-31.

Carmichael, Gregory R. and Arndt, Richard (1997). Deposition of Acidifying Species in Northwest Asia. Energy, Security and Environment in Northeast Asia Project (ESENA), Nautilus Institute for Security and Sustainable Development, March.

Carmichael Gregory and Arndt, Richard (1995). Long Range Transport and Depoistion of Sulfur in Asia, Chapter 5 in RAINS-Asia: An Assessment Model for Acid Rain in Asia, World Bank, March.

Earth Council (1997).

Fei, Edward

Fesharaki Fereidun, Sara Banaszak, and Wu Kang (1997). Energy Supply and Demand in Northeast Asia. Paper to the Seventh Meeting of the Northeast Asia Economic Forum, Ulan Bataar, Mongolia, 17-21 August.

Fesharaki, Fereidun, Allen C. Clark and Duangjai Intaraprovich (1995). Energy Outlook to 2010: Asia-Pacific Demand, Supply, and Climate Change Implications, Asia Pacific Issues, No. 19, April, East-West Center.

Greene, David L. (1997). Economic Scarcity, Forget Geology, Beware Monopoly, Harvard International Review, Summer, pp. 16-19.

Grollman, Nicholas (1997). The Energy Subregion as a Basis for Greenhouse Policy, Energy Policy, in press.

Grollman, Nicholas (1996). Energy Dynamics and Sustainable Development in the East Asia-Pacific Region, Issues Paper No.7, Melbourne: Australian APEC Study Centre, December.

Higgins, Russell, Chairman of the APEC Energy Working Group (1996). "Energy Challenges for the

Asia Pacific Region," address to PECC Meeting, Sydney, Australia, 26-27 August.

Hirsch, Philip (1997).

Michaelis (1996). OECD

Morrison, Charles (1997).

Paik, Keun Wook (1995). Gas and Oil in Northeast Asia, Policies Projects and Prospects, London: Royal Institute of International Affairs.

Razavi, Hossein (1997). Innovative Approaches to Financing Environmentally Sustainable Energy Development in Northeast Asia, Energy, Security and Environment in Northeast Asia (ESENA), Nautilus Institute, January.

Runge, Ford C. And Jones (1996).

Sinton, Jonathan E. (1997). China's View of Acid Rain in Northeast Asia and Regional Cooperation Strategies for Mitigation. Energy, Security, and Environment in Northeast Project (ESENA), Nautilus Institute.

Streets, David G. (1997). Energy and Acid Rain Projections for Northeast Asia, Energy, Security and Environment Project (ESENA), Nautilus Institute, Draft.

TEPAC (Trade and Environment Policy Advisory Committee) (1997).

UNDP (1997). Energy After Rio, Prospects and Challenges, New York: United Nations Publications.

U.S. Department of Energy (1997). India: Economics, Demographics, and Environment, http://www.eia.doe.gov/emeu/cabs/indiaindiach1.htm#ENGECON.

Wilkening, Ken (1997).

World Bank (1997). World Development Report, 1997, The State in a Changing World, New York: Oxford University Press.

World Resources Institute (1996). World Resources 1996-97, The Urban Environment, New York: Oxford University Press.

Yamazawa, Ippei

Zarsky, Lyuba (1997), Stuck in the Mud? Nation-States, Globalisation and the Environment, in OECD, Globalisation and the Environment, OECD: Paris.

Zarsky, Lyuba (1995). Environmental Cooperation and Sustainable Development in Northeast Asia, in Economic and Regional Cooperation in Northeast Asia, Chicago: University of Chicago, September, pp. 75-94.

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